ABSTRACT

THE ECONOMICS OF UGANDA'S HEALTH SERVICE SYSTEM: IMPLICATIONS FOR HEALTH AND ECONOMIC PLANNING

By

David Wallace Dunlop

The major purpose of this study is to analyze the economic implications of the health service system of Uganda. An analytical framework is constructed in order to (a) isolate the economic implications of resource allocation decisions made in the several components of the health service system and (b) analyze the macro-economic impact of the health service system. The thesis focuses on the output of the health service system of Uganda, the differences in the alternative curative health service production processes and the economic implications of the choices available to health and economic planners involved in the development of health services throughout the country.

The analysis begins with information as to the economic context in which health services are provided in Uganda. The manpower, financial and institutional characteristics of the health service system are described. Analysis is made of the changing pattern of demand for curative health services, away from the predominance of infectious and parasitic diseases toward a demand which increasingly includes health problems related to malnutrition and maternal and child health.

The focus of the study shifts from the empirical setting of Uganda's health service system to a major theoretical issue in medical economics.

Prevalent conceptualizations of the output of a curative health service system are examined and found lacking. An alternative conceptualization of output is developed, with particular attention to the non-homogeneous and qualitative nature of the output. A methodology is proposed for the development of an empirical measure of health service system output.

A linear programming framework is then developed, incorporating the output conceptualization, in order to examine the relationships between resources utilized in the production of health services and the number of successfully treated persons. The framework developed, also accounts for the multi-product nature of Uganda's health facilities. In addition, a methodology is developed for examining the long-run effect of socio-economic and health variables on (a) the resources available for the production of health services, (b) the number of persons, with given age, sex and disease characteristics, demanding health services, and (c) the probability of successful treatment.

An empirical comparative analysis utilizing the linear programming framework is made of three subsectors of Uganda's health service system: (1) government hospitals, (2) mission hospitals, and (3) government rural health facilities with inpatient services. Using an objective function derived from the government's stated health objectives, the analysis reveals that despite a common assumption that doctors, nurses and beds are in short supply, considerable excess capacity exists in those factors in both hospital sectors and, to some extent, in rural units as well. The most binding supply constraints appear in such specialized diagnostic resources as lab and radiographic technicians.

At the macro level, the analysis focuses on the impact of the health service system on (a) the rate of population growth, (b) the rate of change in the age structure, (c) the balance of payments, (d) employment and its distribution, and (e) the extent to which the resources used in the delivery of health services were equitably distributed. Findings related to the demographic variables were weak but generally consistent within the theory of demographic transition.

Concluding remarks highlight the health and economic policy implications of the study, particularly with respect to Uganda's health manpower training strategy. Future research activities having health policy relevance in Uganda and similar countries are suggested.

THE ECONOMICS OF UGANDA'S HEALTH SERVICE SYSTEM: IMPLICATIONS FOR HEALTH AND ECONOMIC PLANNING

By

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EXPLANATION OF MEASURES AND SYMBOLS

The following equivalents may be helpful.

1 Ugandan shilling = U. S. $0.14 or 7.14 U. shs. = U.S. $1.00

The following symbols are used in the Tables.

NA = Data not available

__ = Magnitude zero, or less than one-half the unit employed.

PROLOGUE

"It is to the common man that this analysis has relevance.... It is in his care both medically and otherwise, that the command to care for one's neighbor, the humanistic ideal to make the most of mankind, and the biological common sense not to let the infinite potential of our species lie wasted, all unite in one final and compelling imperative--do all you can--ACT."

Maurice King, Medical Care in Developing Countries London: Oxford University Press, 1966, Epilogue.

CHAPTER ONE

During the 1960's, many sub-Saharan African countries allocated a substantial portion of budget expenditures to health services, amounting to as much as ten percent of the total in some cases. In a number of the countries, expenditures on health comprised one of the five largest items in the national budget. The allocation of resources to health in several developing African countries has thus been considerable. In this thesis, analysis is made of the health service system of Uganda, with particular reference to (a) the microeconomic tradeoffs within the health service delivery system and (b) the contribution, at the macro level, of the health service system to the country.

Within this context, the study focuses on the development of an analytical framework based on an improved conceptualization of the output and production process of the health service system. A second major focus is to be found in the empirical application of the conceptual and theoretical ideas developed.

The first and second chapters of the theses provide general background concerning Uganda, its health problems and its health service delivery system. A conceptual framework for the analysis is developed and presented in Chapters Three and Four. Empirical application of the conceptual and theoretical ideas presented is undertaken in Chapter Five. In Chapter Six, the discussion shifts from micro-level analysis of the health service system per se, to an analysis fo the important macro-inte actions between the health service system and other sectors of the economy. The final chapter summarizes the findings and proposes further related research activities which are seen as contributing to a more complete understanding of a complex social phenomonon.

The Importance of Health in Government Priorities: Sub-Saharan Africa

As mentioned above, many sub-Saharan African countries allocated between five to ten percent of total budget expenditures during the 1960's to health (Table 1.1). In the majority of cases, expenditure on health was one of the five largest items in the government budget, even in instances where the expenditures in health were only five percent.

When the countries are classified according to population size, an interesting pattern emerges. In the larger countries, the proportion of total government expenditures allocated to health tended to be significantly lower ($p < 0.001$) than in the medium and smaller countries.[1] There are at least two plausible explanations for this difference. First, the larger countries tend to have larger military and internal security obligations than do smaller countries which tends to reallocate resources away from social services such as health services. Second, economics of scale undoubtedly exist in a health service delivery system. This fact tends to manifest itself through the development of less expensive facilities (and the use of paraprofessionals) throughout the country after the development of a large hospital complex in the capital city.[2]

There is a large inter-country variability in the proportion of projected development expenditures on health (Table 1.2). In some countries, less than three percent of projected plan expenditures have been allocated to health. In other countries, such as Sierra Leone, Uganda, and Ghana, a relatively high proportion of the total projected budget has been allocated to health. Although it is difficult to know the extent to

Table 1.1 Population Estimates and Proportion of Government Expenditure Allocated to Health in Selected African Countries

(all data pertain to the mid-1960's)

Country	Estimated Population in Millions	% Health Expenditures is of Total Govt. Exp.	
(countries: population > five million)			
Algeria	11.0	4.6	
Cameroon	5.2	7.7	
Ethiopia	22.7	6.3	
Ghana	7.5	4.7	
Kenya	9.4	4.8	
Madagascar	6.1	8.8	
Nigeria	57.5	5.4	
South Africa	18.2	3.7	
Sudan	13.1	5.4	(1)
Tanzania	11.7	6.3	
Uganda	7.8	6.3	
United Arab Republic	28.7	4.1	
(countries: population between one and five million)			
Burundi	3.2	8.0	
Central African Rep.	1.3	7.8	
Chad	3.3	9.1	
Dahomey	2.3	12.7	
Liberia	1.0	9.4	
Malawi	3.9	5.8	
Mali	4.6	11.9	
Mauritania	1.0	6.7	
Rwanda	3.2	8.0	
Senegal	3.5	8.0	
S. Rhodesia	4.1	5.4	
Togo	1.7	9.0	
Tunisia	4.2	10.4	
Upper Volta	4.8	10.4	
Zambia	3.6	4.7	(2)
(countries: population < one million)			
Botswana	0.5	3.5	
Comoro Islands	0.2	11.1	
Congo (Brazzaville)	0.9	7.4	
Gabon	0.5	5.4	
Gambia	0.3	8.1	
Lesotho	0.9	9.6	
Mauritius	0.8	9.9	
Seychelles	0.1	12.5	
Swaziland	0.4	9.4	

Sources: _Demographic Yearbook_ (New York: United Nations, selected years); _Ethiopian Statistical Abstract, 1967/68_ (Addis Ababa: Government Printer, 1968); _Demographic Yearbook_ (New York: United Nations, selected years).

(1) Intergovernment transfers are excluded.

(2) Central government expenditures only.

Table 1.2 Projected Capital Expenditures on Health in Selected African Countries During the Development Plan Period Indicated

Country	Development Plan Period	Projected health (1) Expenditures as a % of Total Planned Expenditures
Cameroon	1961-1965	6.6
	1966-1971	2.5
Chad	1966-1970	3.5
Congo (Brazzaville)	1964-1968	2.4
Ethiopia	1968-1973	1.4
Gabon	1966-1970	0.8
Ghana	1963-1970	7.0
	1970-1971	6.0
Kenya	1966-1970	1.6
	1970-1974	0.3
Nigeria	1962-1968	2.5
	1970-1974	5.3 (2)
Senegal	1965-1969	2.0
Sierra Leone	1963-1972	20.3
Somali Republic	1963-1967	3.0
Sudan	1961/62-1970/71	3.0
Tanzania	1964-1969	2.0
Uganda	1966-1971	12.0
	1971/72-1975/76	5.7

Sources: Development Plans of individual countries.

(1) Health is defined narrowly here and excludes expenditures on (a) water supplies, (b) housing, (c) social services, (d) various agricultural improvements, and (e) funds allocated separately for population control activities.

(2) Includes total public capital investment by federal and state governments.

which projected expenditures actually occur, it can be said that the projected commitments to health are relatively high in a number of sub-Saharan African countries, given that there are other competing claims t(resources.[3]

The Case of Uganda

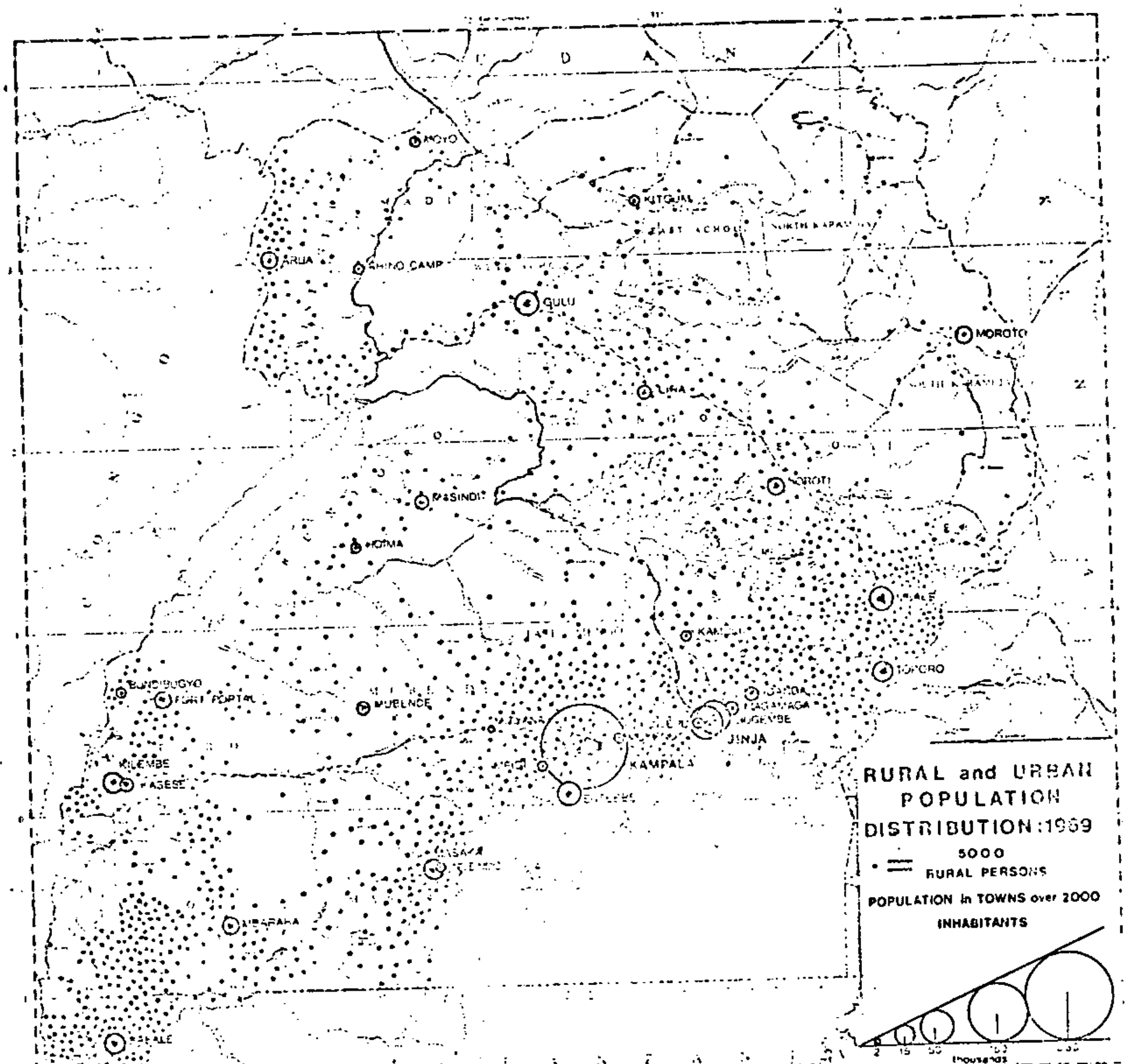
Economic Background

Like most sub-saharan African countries Uganda's economy is based on agriculture. The production of coffee and cotton are the main cash crops and provide a substantial share of foreign exchange earnings. In addition, a major portion of the economically active population are engaged in food cash production. There are more than 1.3 million estimated small farmers in the country out of a total population in 1969 of 9.5 million. The spatial distribution of Uganda's population is shown on the accompanying figure (1.1).

Since attaining independence in 1962, the government of Uganda has taken an active leadership role in the economic development process. Although recent political disruptions have left the country's short run economic picture in disarray, the government has systematically planned for the socio-economic development of the country. This planning effort as spelled out in three development plans since independence -- the first from 1962-66, the second from 1966-1971, and the third from 1971/72 - 1975/76 -- has laid the foundation for governmental encouragement of industrial development, mining, transportation, communications, electric power, education, and health.

The rate of growth of GDP at factor cost has fluctuated over the years, depending upon the output of the world prices for cotton and coffee.

Figure 1.1 Ugandan Population Distribution: 1969



Source: The Republic of Uganda, Uganda's Plan III, Third Five-Year Development Plan 1971/72 - 1975/76, (Entebbe: The Government Printer, 1972)

From 1954 to 1965, the monetary economy grew at an average annual rate of 4.2% and from 1966 to 1970, the first four years of the second development plan, it grew at 4.8% per year.[4] The rate of economic growth for the economy as a whole-including both the monetary and subsistance sectors during the last four years of the 1960's averaged 4.4% as compared to the projected target rate of growth for the economy during those years of 6.3% per year. During the period of the Third Plan, it is projected that the monetary economy will grow at an annual rate of 5.6% from 1969 to 1976, with non-monetary activities (subsistence food production) growing at an estimated rate of 3.6%, giving an overall growth rate of 5.0%.[5]

As referred to earlier, Uganda's economy is heavily dominated by agriculture. Throughout the 1960's the agricultural sector comprised between 50% and 55% of total GDP (including both the monetary and subsistence sector), and the third development plan projects a similar figure through 1976.[6] Agriculture is important to Uganda's development from at least three other perspectives. First, it has consistently accounted for about 85% of the exports outside of the East African Common Market area. Second, it has provided employment and income for approximately 90% of the population. In addition, large farms have provided about 20% of all wage jobs in the monetary sector, making it the second largest sector for wage employment, after services. Finally, the agricultural sector is closely tied to industrial development in the country. Agricultural processing industries such as coffee curing, cotton ginning, textile production, and the processing of cooking oils, sugar, and tea are all ranked in the top seven industries in the country, as measured by their contribution to gross output.[7] Thus, it is not surprising to find that the overall rate of growth of the industrial sector depends on increasing agricultural output.

Attempts have been made to diversify agricultural production away from the primary crops of coffee and cotton, toward tea, tobacco, and sugar production. During the Second Plan period, tea production expanded rapidly, primarily due to the successful introduction of small holder tea programs in the Western highland areas. During the Third Plan period, the tea program, as well as new projects in tobacco and sugar, are expected to result in rapid output increases.[8] In addition, substantial efforts are to be made to increase food and livestock production.

With its strong commitment to rural development during the third five-year plan, not only in terms of increasing total output, but also in terms of improving the distribution of social amenities and the standard living in rural areas, it appears that the government's expectations of economic and social prospects for development is increasingly based on the realities facing the country.

Ugandan Development Policy Related to Health

The role of health in Uganda's development has been given high priority in recent years. This is reflected in the country's two recent planning strategies, <u>Work for Progress</u> (1966-71 and <u>Plan III</u> (1971-76). During the second development period (1966-1971) the development strategy "aimed to change the structure of the economy so as to lessen its dependence on the existing export crops."[9] The campaign to develop the economy had "three spearheads": (1) agricultural development; (2) industrialization; and (3) expansion and improvement of education and health services.[10]

The government's concern for the third "spearhead" - the improvement of education and health services - was manifested during the 1966-71 plan by a combined expenditure of 380.6 million shillings, which comprised approximately 18% of all development expenditures during the period, with health receiving slightly more than half of the total, (191.3 million shs.) See Table 1.3.[11]

During the third five year planning period 1971/72 - 1975/75 government's concern for health has continued; although its priority, in terms of the proportion of the total development expenditures, has declined from about 9.1% to 5.7%. The absolute expenditure is estimated to remain constant (183.5 million shillings), however if inflation is taken into consideration, this figure represents only 80% of the second plan's expenditure on health services. This decline in total expenditures can be explained by the construction of twenty-two 100 bed hospitals during the second development plan, while the third plan emphasises improvment of rural health facilities such as health centers and training more health workers. In addition, a substantial increase is projected for two preventive health programs: water supplies (to a level of 159.8 million shs.) and population control (a nominal 1.0 million shs. allocated from government funds).

The development of rural areas clearly has high priority during Plan III. By its statements in the Plan, the government recognizes that (a) its resource endowment requires the development of rural areas and (b) rural living conditions, including health services, must be improved in order to increase agricultural production and to minimize the rate of rural-urban migration.

Uganda's Health Status

The health at Uganda's population has improved markedly over the last seventy years. In the early years of its protectorate status, the

Table 1.3 Uganda's Development Expenditures During the Second and Third Plans 1966-1971 and 1971/72 - 1975/76.

	Actual Expenditures Second Plan (1966-71)		Estimated Expenditures Third Plan 1971/72-1975/76	
	mill. shs.	% of total	mill. shs.	% of total
Defense	243.5	11.5	500.0 (1)	15.6
Public works, incl. housing	355.3	16.8	491.9	15.4
Agriuclture incl. Animal industry	321.3	15.2	493.6	15.4
Health	191.3	9.1	183.5	5.7
Water Supplies	84.7	4.0	159.8	5.0
Health, including water supplies	276.0	13.1	343.3	10.7
Education	189.3	9.0	235.3	7.4
Contributions to Government Corporations	339.3	16.1	624.2	19.5
All other Development Expenditures	384.8	18.2	572.9	17.9
Total	2109.5	100.0	3200.0	100.0

Source: Republic of Uganda, Uganda's Plan III, Third Five Year Development Plan, 1971/72-1975/76, Government Printer, Entebbe, 1972, Tables VIII-2, VIII-4, and VIII-5.

(1) estimated minimum figure. No precise figures are provided in the plan but this figure may be arrived at by reviewing the text of the plan between pp. 116-120.

country had a devastating epidemic of sleeping sickness, which contributed heavily to an absolute decline in population. Since then, however, sleeping sickness, as well as other infective and parasitic diseases such as smallpox, yaws, and meningitis have been largely controlled. The extent of this control was revealed in part in preliminary analyses of the 1969 census, which indicated a decline of 20% in infant mortality from about 150 per thousand to 120 per thousand over the previous ten year period. At the same time overall life expectancy at birth is now well above 40 years, and is as high as 46 years in some areas.[12]

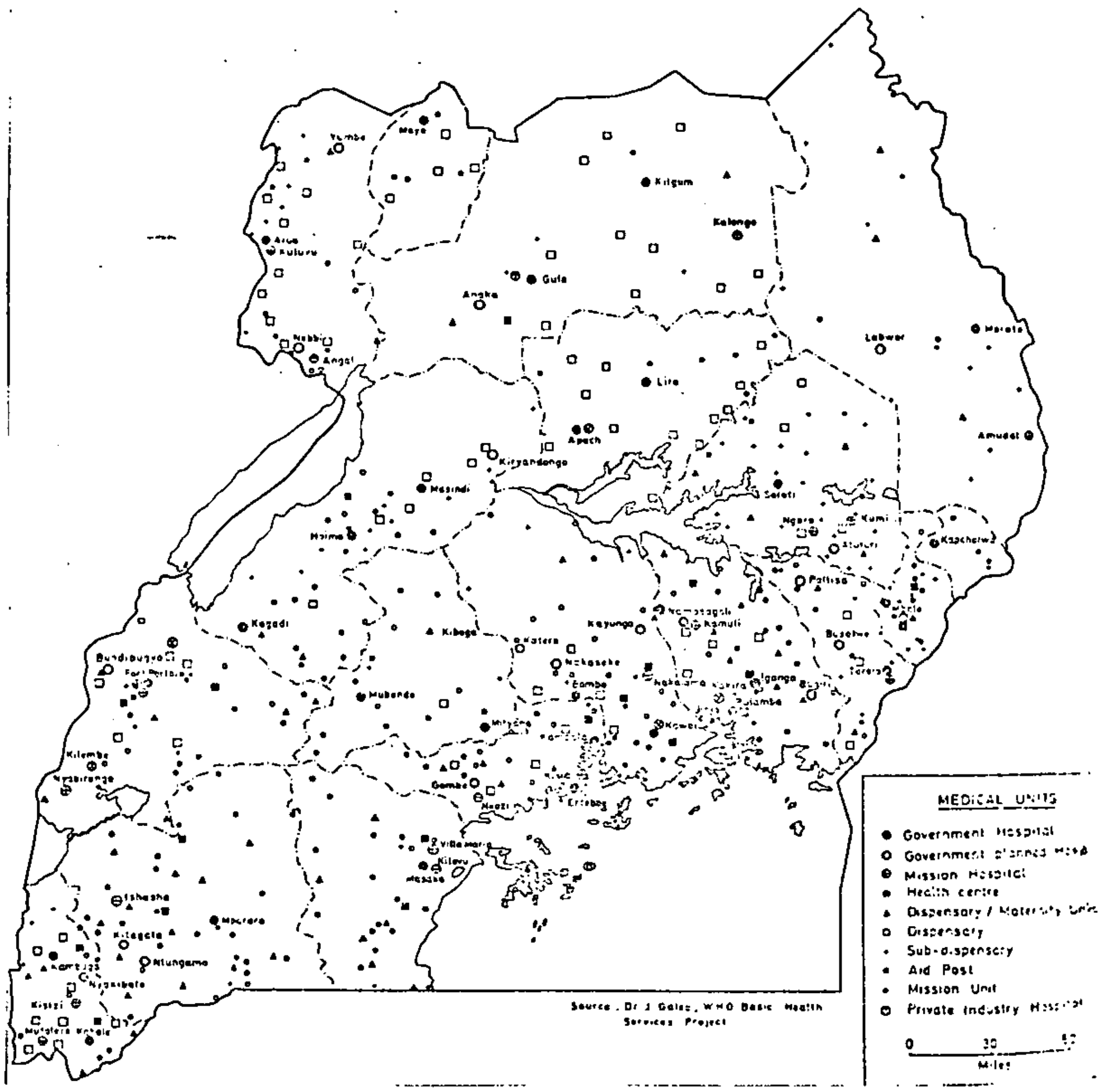
Infectious and parasitic diseases, such as malaria, tuberculosis, measles, gonorrhoea, and helminthic (worm) disease, are the major health problems today; such diseases comprise at least 25% of sickness episodes experienced by Ugandans. In addition, a number of respiratory illnesses are common, as are alimentary diseases (e.g., dental problems, gastroenteritis, etc.), diseases of the skin (e.g. tropical ulcers), complications of pregnancy, and miscellaneous infections, injuries and accidents. Subclinical malnutrition is also related to the contraction of infectious diseases, such as measles and upper respiratory infections. The major health concerns of the more developed countries of the world, such as heart disease, related circulatory problems, and cancer, do not pose a serious threat to the welfare of the majority of Ugandans.

Although some diseases are prevalent throughout the country, there are important regional differences in the composition of disease distribution.[13] For example, in areas of the country above 5,000 feet in elevation (e.g., the southwestern part of the country) the incidence of malaria is quite low, as the survival of the mosquito vector is substantially more difficult at higher elevations. Cultural patterns also affect the distribution of disease; gonorrhoea, for example, comprises approximately 5% of all diseases treated at rural health facilities in the eastern region, whereas the figure in other regions is not above 3%, and in some areas is less than 0.5%. Economic differences between various areas of the country affect the distribution of disease, too; for example differences in diet, housing conditions, sanitation and waste disposal affect the incidence of malnutrition, tuberculosis, and helminthic (worm) diseases. In sum, the differences in disease distribution play an important role in any analysis of the health service system, as well as in planning for the future development of the health system.

The Health Service System in Uganda

The curative health service system in Uganda is characterized by a number of different types of health facilities, as well as several administrative structures through which services are delivered (Figure 1.2). The government provides curative services, without charge, in hospitals, health centers, dispensaries, sub-dispensaries, maternity centers and aid posts. The Catholic and Protestant Church Medical Bureaus also provide curative health services through hospitals, sub-dispensaries, and maternity centers for a small fee. Curative health facilities are also operated by large commercial firms for employees and their families. The type of facility maintained by the firm is determined primarily by legal requirement: firms employing more than 1,000 persons must have a hospital, whereas smaller firms may either operate a dispensary or contract with a private physician for service as required. The Army and Prisons also offer curative health services to their specialized populations through dispensaries and, in the case

Figure 1.2 Distribution of Health Facilities in Uganda



Source: S. A. Hall and B. W. Langlands, eds., <u>Uganda Atlas of</u> Disease Distribution, Occasional Paper No. 12 (Kampala: Department of Preventive Medicine and Department of Geography, Makerere University College, 1968) of the Army, a hospital. Finally, there are a number of private practitioners in the larger cities and towns who provide a range of curative services to those willing to pay.

Government health facilities are integrated in such a way that an individual may be referred to a facility providing more intensive care or treatment than that offered by the facility originally attended. It is theoretically possible for an individual who initially attends a weekly outpatient clinic in a rural aid post to eventually receive treatment at Mulago Hospital in Kampala, the country's national referral, teaching, and research hospital. In addition, private physicians, mission facilities and other population-specific facilities may refer individuals to government facilities for certain specialized services. The most common referral relationship, however, exists between rural government health facilities and government district hospitals.

Preventive health services in Uganda are usually provided by local governments - district administrations, municipalities and townships. Environmental health services such as sanitation, waste disposal, vector control, and clean water supplies are administered by special health manpower, headed by the health inspector. Other preventive services, such as ante-natal clinics, young child clinics, and immunizations, are usually delivered through weekly clinics held at local health facilities. The central government also supports an immunization team, which travels throughout the country and conducts daily immunization clinics, and in one district, the preventive services of static facilities are supplimented by a mobile health team, which brings immunization, young child, ante-natal, and health education services to 30 different locations in the area one day each month.

Uganda's Financial Commitment to Health Services

Uganda has maintained a fairly large development commitment to health services for some time (Figure 1.3). From the mid-1930's to the present, the central government has consistent allocation a minimum of 6.5% of the total recurrent and capital budget to health services during years of minor capital improvements.[14] In addition to this central government commitment, local government expenditure on health has increased substantially in recent years. Since 1947, the percentage of total District Administration expenditures allocated to health has risen from approximately 3.5% to nearly 20% (Figure 1.4). The first upward shift (1956/57) was related directly to the implementation of the so-called Frazer Report, one of whose main recommendations was the improvement of rural health services.[15] The second major shift occurred near the time of Independence, October 9, 1962; the major cost increase at that time was due to shifts in power and political relationships between the central and various local governments.[16] Finally, the launching of the second five-year plan in 1966/67 gave emphasis to the expansion of health services. This expansion occurred not only in hospital facilities, but also in rural health facilities, such as health centers and dispensaries. The combined expenditures of local governments on health services increased from 22 million shs. in 1965 to 35 million shs. in 1970, in spite of a large decline in expenditures recorded in Buganda district. As a share of total local government expenditures, health services increased during this period from 8% in 1966 to approximately 20% in 1970. Given the present policy of developing at least one sub-dispensary grade health facility in every subcounty in the country as soon as possible, it would appear that spending

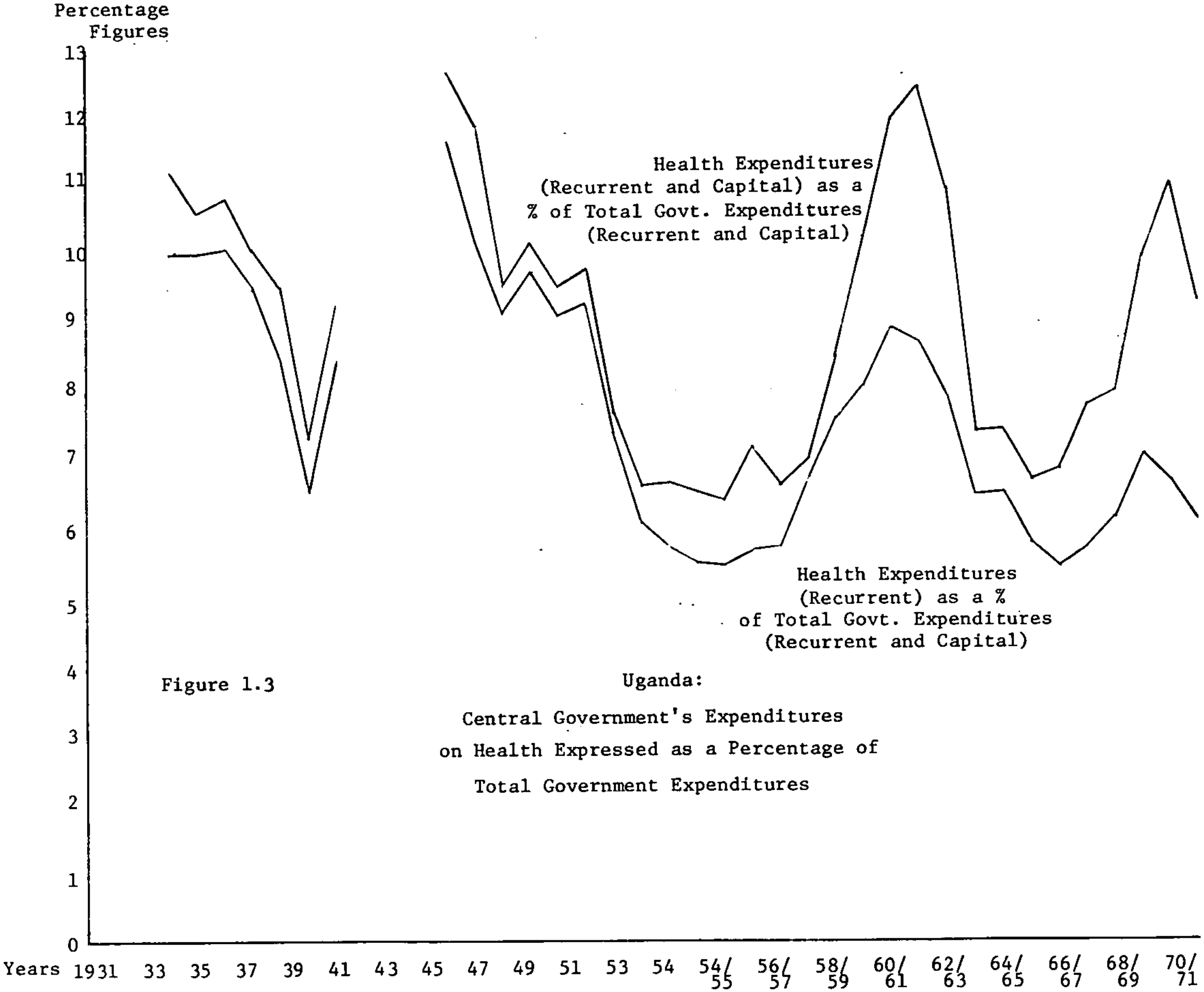


Figure 1.3

Uganda:

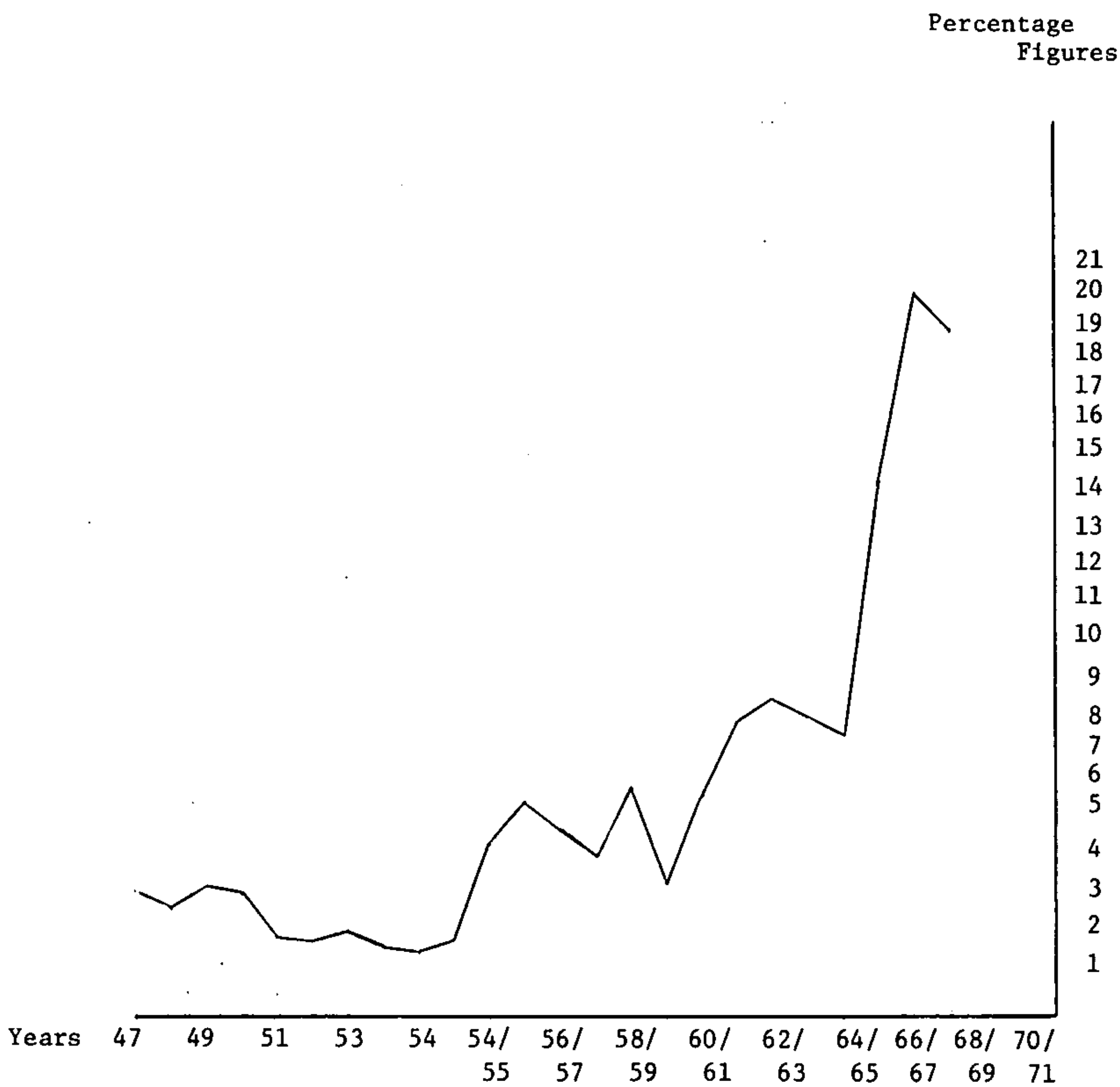
Central Government's Expenditures on Health Expressed as a Percentage of Total Government Expenditures

Figure 1. 4 Uganda:

District Administration Government's

Expenditures on Health (R & C)

Expressed as a Percentage of Total District Government Expenditures (R & C)



Note: R & C = Recurrent and Capital Budget Expenditures on rural health services will expand rapidly in the foreseeable future, not only for capital expenditures, but also for increased recurrent requirements which result from high levels of capital spending in health.[17]

Finally, it is important to point out that approximately 75% to 80% of expenditures on health services in Uganda have been directed toward curative as opposed to preventive services. Given that such a large proportion of present resource commitment is allocated to curative services, it is important to analyze in some detail this sector of the health service system in Uganda.

Summary

This chapter has presented a brief overview of the rationale for an economic analysis of the health service system in a less developed country such as Uganda. The importance of research on the economic aspects of the health service delivery system in sub-Saharan African countries was emphasized. Basic socio-economic background to the case study of Uganda was presented. Its economic status and development policy as related to health were discussed. In addition, the status of the country's health, its health service system, and the governmental financial commitment to health were reviewed for their importance to the subsequent analysis.

Footnotes

1. The results of the analysis are as follows:

	Mean %
Large countries, more than five million population (n=12)	5.68
Medium countries, population between one and five million (n-15)	8.49
Small countries, population less than one million (n=9)	8.54

2. Liberia can be cited as a good case in point of this latter development with the John Kennedy hospital complex being developed in Monrovia during the 1960's and only in the last year or so has rural health facilities been seriously considered.

3. Unfortunately there is little comparative information available from developed countries or from other developing countries in other regions - Asia and Latin America - on capital expenditures in health. The World Health Organization in its Monthly Statistical Bulletin started in 1968 to annually publish figures on recurrent health expenditures by governments. However, there are no international data available on either private recurrent health expenditures or capital expenditures irrespective of source private or public. The only international comparable data available on recurrent and capital expenditure on health are found in Able-Smith, Brian, An International Study of Health Expenditure and its Relevance for Health Planning, Public Health Papers #32, World Health Organization, Geneva, 1967. In Chapter 3, pp. 40-75, he systematically analyzes recurrent and capital health expenditure data collected in a special WHO survey conducted in 1963. From his sample of 29 countries he found a statistically significant positive relationship between per capita income and total recurrent health expenditures as a proportion of national income (pp. 44) but no statistically significant relationship was apparent between per capita income and total capital expenditures on health as a proportion of national income (inferred from data shown in Chapter 3, especially tables six and twenty; and discussion on pp. 67 & 68.

4. See Republic of Uganda, Uganda's Plan III: Third Five Year Development Plan 1971/72 - 1975/76 (Entebbe: Government Printer 1971), Table II - 1, p. 28; Republic of Uganda, Background to the Budget 1970/71 (Entebbe: Government Printer, 1970), p. 4; the Republic of Uganda, The Real Growth of the Economy of Uganda, 1954-1962 (Entebbe: Government Printer, 1964).

5. Republic of Uganda, Uganda's Plan III, Table III - 1, p. 42.

6. Republic of Uganda, Uganda's Plan III, Table III - 1, p. 42.

7. Republic of Uganda, Background to the Budget, 1968/69 (Entebbe: Government Printer, 1968), p. 15.

8. See Republic of Uganda, Uganda's Plan III, Chapter 10, for the specific proposals developed for implementation during this period.

9. Republic of Uganda, Second Five Year Development Plan, 1966-1971: Work for Progress (Entebbe: Government Printer, 1966), paragraph 1.63, p. 14.

10. Republic of Uganda, Work for Progress, paragraph 1.65, p. 15.

11. If the separately listed expenditures on water supplies is included as a health expenditure the estimated total expenditure during the period was 465.3 million shs. or 22% of total plan expenditures. These figures also do not include the developmental expenditures incurred by local governments on health facilities.

12. Republic of Uganda, Uganda's Plan III, p. 301.

13. The single most important publication on the epidemiology of diseases in Uganda is S. A. Hall and B. W. Langlands, eds., Uganda Atlas of Disease Distribution, Occasional Paper no. 12 (Kampala: Department of Preventive Medicine and Department of Geography, Mekerere University College, 1968).

14. This is seen by noting the difference between the upper line, which aggregates both recurrent and capital expenditures on health, and the lower line, which shows the percent which recurrent health expenditures comprise of total government recurrent and capital expenditures.

15. Uganda Protectorate Government, Report of the Committee to Examine Medical and Health Services in Uganda (Frazer Committee Report), (Entebbe: Government Printer, 1956).

16. For an analysis of this period in the political history of Uganda, see David Apter, The Political Kindom of Buganda: A Study of Bureaucratic Nationalism (Princeton, New Jersey: Princeton University Press, 1961).

17. See Republic of Uganda, Work for Progress, paragraph 13:14; and Republic of Uganda, Uganda's Plan III, p. 122. It was announced in the third development plan that rural health facilities will by interated with the government hospitals, forming a single health service system to be administered by the Ministry of Health. This policy is a major shift toward a centralized health system.

CHAPTER TWO

In this chapter, the salient features of the health service system in Uganda are examined. The institutional, financial and manpower resources of the system are considered, particularly since they comprise the primary mechanisms through which government policy can operate.

The health services system has two sub-sectors: the preventive and the curative. These sectors are related to one another in that (a) both have a similar goal - improvement of the "level of health" in the population and (b) both are based on the assumption that the effectiveness of each in working toward this goal can reduce the demand for the others sector's services. Each sector is distinct, however, in its approach to achieving the similar goal. Preventive services are directed primarily at reducing the causes of disease whereas curative services are related primarily to the treatment of persons already afflicted with disease.

Preventive Health Services

Environmental Health

In Uganda, preventive health services include malaria vector control, water purification, sewage treatment, air pollution reduction, food cleanliness and meat inspection, building and land use standards, occupational health, and transportation safety. Within urban areas,[1] such services are normally provided by the town's department of public health. Water supplies are ordinarily administered separately and occupational and transportation safety are administered by the central government. In rural areas, environmental health comes under the jurisdiction of the district medical department; with the exception of market cleanliness, meat inspection, and improvement of water sources. Environmental health services provided in rural areas are limited however.

Although financial and manpower matters related to the provision of all health services are discussed later, it is useful to note here the government's resource commitment to environmental health services. Approximately 34 million shs. were spent on preventive health services in 1968-69; of that sum, approximately 13.5 million shs. (6% of all expenditures on health) were spent on environmental health.[2] Approximately 9% of the total Ministry of Health's budgeted positions from 1966/67 to 1970/71 were engaged in environmental preventive health services. (Table 2.1). Although a decline in establishment positions allocated to hygiene and sanitation is discernable over this period, an increasing number of hygiene and sanitation personnel were being hired directly by district and town health departments, indicating that the responsibility for such services is shifting away from the central government to local governments.

Immunization Services

Immunization programs have focused on eradication of specific infective or parasitic diseases such as smallpox, yaws, polio, diptheria, tentanus, whooping cough, tuberculosis and, to a minor extent, measles. In recent years, both poliomyelitis and smallpox have been the focus of major immunization campaigns.[3] As a result of the national immunization program, the incidence of several diseases has been reduced to a very low level, particularly in areas of the country where a high proportion (80%-90%) of total population has been immunized. In certain districts of the country, (e.g., Ankole and Busoga) there are very few reported cases of yaws, polio, whooping cough, smallpox, diptheria and typhoid; this is a direct result of an immunization program which has been in effect since the early 1950's. It is believed that some progress is also being made in reducing the incidence of tuberculosis among young people through administration of BCG vaccinations, although there still exists a large reservoir of infection among inadequately or non treated persons.[4]

Table 2.1 Percentage of Total Budgeted Establishment of the Ministry of Health to Hygiene and Sanitation.

Year	Total Establishment	Percentage to Hygiene and Sanitation
1966/67	3,364 positions	11.0
1967/68	3,774 positions	10.9
1968/69	3,954 positions	8.3
1969/70	4,360 positions	7.5
1970/71	5,132 positions	6.9

Source: Draft Estimates of Recurrent Expenditures, (Entebbe: Uganda Government Printer), selected years.

Immunization services are primarily provided by government non-hospital units. (Table 2.2). In 1966/67, for example, most immunizations were provided either through specialized mobile clinics

Table 2.2 Number of People Receiving Various Types of Immunizations, 1966/67 (1)

Immunization Type	Govt. Health Units Excl. Hospitals (2)	% of Total	Non Govt. Units Excl. Hospitals (3)	Government Hospitals (4)	Total (5)
	Facility Type				
DPT Dose 1	172,312	92.3	4,194	10,631	187,137
DPT Dose 2	77,337	90.7	2,356	5,522	85,215
DPT Dose 3	41,831	89.0	1,670	3,477	46,978
Smallpox	305,598	96.2	1,767	9,449	316,814
BCG	98,085	88.5	2,855	9,899	110,839
Polio Dose 1	502,137	95.0	7,918	17,823	527,878
Polio Dose 2	226,102	93.7	3,762	12,017	241,881
Polio Dose 3	143,128	93.3	2,727	7,720	153,575

(1) The figures represent the number of people who received the particular type of vaccine or dose during 1966/67. It is likely that a number of persons receiving doses 2 or 3 of Polio or DPT also received the first dose during the year. A number of persons may also have received at least one other type of immunization during the year.

(2) The data were complied from Ministry of Health records and from Dr. J. Galea's "Inventory, Appraisal, and Assesment of the Basic Health Services of Uganda, Developments for a Malaria Eradication Programme", (Jinja, Uganda: Malaria Pre-eradication Programme, World Health Organization 1967), Appendix IVE. The figures presended here represent approximately 90% of all vaccinations given, inasmuch as some health facilities failed to submit returns for 1966/67.

(3) Data taken from Galea Basic Health Services, Appendix IVJ i.

(4) Data taken from Galea Basic Health Services, Appendix VF(i).

(5) Immunization services were also provided at non-governmental hospitals, but the figures are not available. The number of immunizations administered at such facilities, however, is so small relative to the total number provided by the other three types of facilities cited above, that the total figures given in the Table give a relatively accurate indication of the magnitude of the immunization services offered in the country.

conducted by the National Immunization Team or static rural health facilities--health centers and dispensaries.

Financial support for immunization services has come primarily from (a) the central government through the Ministry of Health, (b) international organizations such as W.H.O., UNESCO/UNICEF, and OXFAM (a British foundation) and (c) national foundations, such as the former A. M. Obote Foundation, which supported the polio immunization program. The exact amount of support for immunization services is not known, primarily because the extent of support provided by the Ministry of Health is not made clear.

Ante-natal Services

Ante-natal (pre-natal) services have been provided for some time in Uganda. Recently however, ante-natal clinic attendances have increased rapidly. This is due in part to the rapid growth in the number of health facilities providing such services. Presently, all government and mission hospitals, all governmental health centers and dispensary/maternity units, and most rural units operated by mission groups conduct at least one ante-natal clinic per week. Where the supply of maternity beds and mid-wifery services is minimal, one of the major functions of the ante-natal clinic is to determine the relative probability of delivery complications. If a patient is determined to be "at risk", she is advised to deliver at the health facility; if she is not "at risk", she may deliver at the facility, and is provided with simple sterile implements to help protect against infection in case she delivers at home.

The expansion of ante-natal services from the late 1940's to 1966-67 is documented in Table 2.3. Total attendances have increased at an annual rate of 4.0%; new attendances have increased even more rapidly - 5.7% per year, which is nearly double the estimated annual rate of increase of the population over the period. In 1950, only 45% of all pregnant women attended ante-natal clinics. By 1967, approximately 65-70% of pregnant women attended an ante-natal clinic at least once prior to delivery.[5]

Table 2.3 Ante-natal (Pre-natal) Services

Year	Estimated Total Births (in thous.)	New Cases (in thous.)	(2) New Cases as a % of Total Births	Old Cases (in thous.)	Total (in thous.)
1949	213.3	98.5	46.1	211.3	309.8
1952	229.1	113.5	49.6	163.7	277.2
1956	252.9	150.7	59.6	236.2	386.9
1960/61	320.6	156.6	48.8	235.6	392.1
1963/64 (1)	358.6	198.6	55.4	290.3	488.9
1965/66	386.4	276.1	71.5	465.5	741.6
1966/67	401.1	259.9	65.0	351.5	611.4

Source: Annual Reports or Statistical Reports from the Uganda Ministry of Health.

Notes: (1) Figures for Buganda Region, although included, are incomplete.

(2) A new case refers to the first visit a woman makes to a particular clinic for a new pregnancy. For each new pregnancy, the woman is counted as a new case.

Young Child Services and Health Education

Young child and health education services are often provided simutaneously. Although an estimate of the exact number of attendances at young child clinics is not available, there are probably as many attendances at such clinics as there are at ante-natal clinics.[6] Two important services provided at young child clinics, in addition to health education and immunization, are (a) diagnosis and treatment of illnesses and (b) weighing and measuring of children in order to chart growth in relation to age.[7]

Young child services are commonly provided at a weekly clinic. Between one to five members of a health facility's staff operate the clinic; the most sophisticated piece of equipment in use is a scale constructed to withstand the rigors of active children. Virtually all mission health facilities and most government facilities, with the exception of aid posts operate young child clinics.

The most intensive young child service program in Uganda, however, is not operated in static rural facilities. The Ankole Preschool Protection Programme, which focusses on children under the age of five, operates 40 different clinics throughout Ankole District with two mobile teams of six staff members. Each team travels daily from its base of operations to a new clinic site, returning once a month to that site. An average of 200 persons per day attend each clinic; the program thus has approximately 100,000 attendances per year.[8]

Health education has been used intensively in government health centers in an effort to spread preventive health measures throughout the country. Not only are special lectures and informal discussions an integral part of all clinics, but health education also comprises an important component of the center's daily curative services, particularly in regard to diseases related to malnutrition or poor sanitation. In addition, health centers have a particular responsibility for the health of the community adjacent to the center. The staff focuses on the health problems of its "defined area" and attempts to improve environmental health standards in that area through education and by example. Unfortunately, no systematic evaluation of this approach has been conducted as yet.

Family Planning Services

Family planning services are not widespread in Uganda at the present time, although there has been an increase in such services since they were initiated in 1957 by the Uganda Family Planning Association.[9] Although there are a number of doctors and midwives trained in contraceptive technology working in government and Protestant mission facilities, the number of persons receiving family planning services is not large, several thousand at most.

Until December 1971, the government of Uganda had not developed a definite stand on the issues related to demographic change. Before the results of the 1969 census became known, the general governmental attitude toward family planning was somewhat negative. This lack of a formulated policy and rather negative attitude can be related to at least three factors: (a) the religious balance in the country (approximately 40% Catholic, 40% Protestant, 15% Muslim and 5% other), (b) the general attitude of competition between the three East African countries relative to indicators of growth and size, one such indicator being total population, and (c) the widely held belief that Uganda has excess land and needs more people in order to increase total production. When the results of the 1969 census became known, however, the government established a "working party" to gather information and develop recommendations concerning population matters. Recently, the government announced its positive attitude toward family planning activities.

The general view among medical personnel in Uganda, at this time is that family planning services can be implemented only if integrated into a country-wide maternal and child health program. It is generally felt that only in this way can attitudinal problems toward family planning services be dealt with effectively. A single objective clinic -- operating solely to provide contraceptives and other medical advice related to family health and size -- is generally not considered to be a viable institutional arrangement for long-run maximization of the use of family planning services in Uganda.[10]

The present resource commitment to family planning services in Uganda is difficult to determine. The International Planned Parenthood Federation supports the activities of the National Family Planning Association in Uganda. The level of this support in fiscal year 1970 was U. S. $81,200.[11] The Rockefeller Foundation has supported a position in the Department of Obstetrics and Gynaecology at the Makerere Medical School in 1969-70, at U. S. $47,000, in order to further teaching and research related to (a) the medical aspects of contraception and (b) the clinical procedures necessary in the delivery of family planning services. Other international organizations have provided assistance of related to family planning; however, the amount of financial aid involved is unclear. Finally the Ugandan Government indicated in its Third Five Year Plan 1971/72 to 1975/76 that it would allocate at least 1.0 million shs. to a population program during that period.[12]

In sum, it can be said that although family planning services are available in Uganda, and although attendance at the Uganda Family Planning Association clinic in Kampala (the largest in the country) has risen in recent years,[13] the services have had no significant effect on fertility, birth rate, age structure, and infant and maternal mortality, because the attendances represent a very small proportion [14] of the total population "at risk" (i.e., women susceptible to becoming pregnant).

Curative Health Services

Health Service Facilities

Number of Facilities

The number of government health facilities (hospitals and rural units) rose from a total of 176 in 1950 to 342 in 1969-1970, (Table 2.4); the rate of increase over the last 10 years of the period has been in excess of 6.0% per year. The number of health service facilities has increased rapidly in the last decade primarily as a result of central government emphasis on the improvement of health services during the second development planning period, 1966-1971.[15]

While governmental units have increased in number mission units have been declining, from a high of 88 units in 1965-66 to 71 in 1969-70 (Table 2.5). This reduction in number of facilities can be attributed primarily to (a) re-evaluation by the missionary organizations of their role in providing health services and (b) the growing financial difficulty of operating non-hospital health facilities.

Distributional Mix of Facility Types

In 1950, approximately 15% of all government facilities were

Table 2.4 Distribution of Governmental Health Facilities in Uganda[1]

Year	Total Govt. Units (excl. Aid Posts)	Hospital % of Total	Rural Units With Beds % of Total (3)
1950	176	15.3	43.2
1955	183	12.0	62.3
1960 (2)	197	12.2	69.0
1965/66	257	8.9	59.1
1969/70	342	9.9	49.4

(1) The information presented in this table is derived from data compiled in Appendix D, Table D.1.

(2) Figures for 1960 are for January - June only. In that year, there was a change in the reporting period from a calendar to a fiscal year.

(3) Rural units with beds include health centers, dispensary/maternity units, dispensaries, and maternity units.

Table 2.5 Distribution of Voluntary Health Facilities in Uganda[1]

Year	Total Voluntary Units (excl. Aid Posts)	Hospital % of Total	Rural Units With Beds % of Total
1953	50	18.0	N.A.
1955	50	18.0	N.A.
1960 (2)	73	21.9	53.4
1965/66	88	29.5	35.2
1969/70	71	36.6	42.3

(1) The information presented in this table is derived from data compiled in Appendix D, Table D.1.

(2) Figures for 1960 are for January - June only. In that year there was a change in the reporting period from a calendar to fiscal year.

N.A.: not available

hospitals; the percentage of hospital units declined over the period however, to approximately 10% in 1969-1970 (Table 2.4). It is expected that the latter percentage will remain constant over the next several years, for although the number of government hospitals is rising, the number of other types of health facilities is also expected to increase proportionally.

The percentage of rural units with beds (i.e., with the capacity for inpatient care) has shown a slightly different pattern over this period. They comprised approximately 45% of all facilities in 1950; rose to approximately 70% in 1960, but declined to less than 50% in 1969-70 (Table 2.4) [16] This drop in percentage of rural bedded units is due primarily to governmental policy to expand rural health services, such that daily outpatient service will be available in every gombolola (sub-county) in as short a time as possible. The genesis of this focus lies at least in part in national political considerations and in the residual impact of the W.H.O. strategy to erradicate malaria and other infectious diseases (the strategy included, among other things, expansion of the basic health service system as widely and rapidly as possible.) [17]

Within the category of bedded rural units, however, the number of health centers grew rapidly after 1958 (from 3 to 40) relative to the number of dispensaries and dispensary/maternity units.[18] As a percentage of the total number of bedded rural units, health centers increased from 6.6% of all rural bedded units in 1960, to 23.6% of all such units in 1969-70.

Within the mission sector, the importance of hospital facilities relative to all other mission units has grown over the period 1953 to 1969-70. The number of hospitals nearly tripled between 1953 and 1962-63; but has remained constant since then. It is unlikely that the number will increase; in fact, a reduction is likely primarily as a result of (a) increasing financial pressure on Church organizations and (b) the growing number of government facilities. Political pressure from the government on the Churches to keep the facilities open, however, has been great.

Hospitals have increased in importance within the mission sector throughout the period, from 18% of all facilities in 1953, to 37% in 1969-70. This increase has been due to (a) a relatively slow rate of growth in the total number of mission facilities through 1966-67 and (b) an absolute drop in the number of non-hospital units between 1966-67 and 1969-70 (Table 2.5). The maintenance of a constant number of hospitals throughout the period 1960-1970 suggests that there is high priority placed by mission leaders on high quality, hospital care vis a vis preventive medicine and mass treatment. The fact that two new mission facilities, both hospitals, opened between 1968 and 1970 re-inforces this unannounced priority.

Size of Facilities

In 1951, there were 3,392 beds in government and mission hospitals, 80% of which were in government units (Table 2.6).[19] From 1951 to 1965-66, the greatest growth in number of beds occurred in mission hospitals, primarily because the number of mission hospitals doubled during that time. The average number of beds per mission hospital also increased during the period from 75 to 120. After 1965-66, however,

Table 2.6 Number of Government and Voluntary Hospital Beds and Average Number of Beds per Hospital in Uganda (1)

Year	Total # of Hospital Beds	Number of Govt. Hospital Beds	No. of Mission Hospital Beds	Average No. of Beds Government Hospital	Average No. of Beds Voluntary Hospital
1951	3392	2715	677	104.4	75.2
1955	3616	2932	684	133.3	76.0
1960	4826	3360	1466	140.0	91.6
1965/66	7282	4294	2988	186.7	144.9
1969/70	8792	5650 Est.	3142 Est.	166.2	120.8

(1) The information presented in this table is derived from data compiled in Appendix D, Table D.1.

Table 2.7 Number of Government Rural Health Facilities and Average Number of Beds Per Facility in Uganda (1)

Year	Number of Beds Including Maternity Beds in Govt. Rural Units	Average Number of Beds in Govt. Rural Units With Beds
1951	1458	14.9
1955	1718	15.1
1960	2477	18.2
1965/66	3158	20.8
1968/69	3512	21.8

(1) The information presented in this table is derived from data compiled in Appendix D, Table D.1.

the number of government hospitals increased more rapidly and by 1969/70, government hospital beds comprised 63% of the total (8,792). The increase in government facility beds is likely to continue into the near future as a result of the government's expansion of the hospital system during the Second Development Plan, 1966-1971. The average number of beds per hospital will continue to decline as a result as it did from 182 in 1966/67 to 166 in 1969/70, because the new hospitals only contain 100 beds.

The number of beds in government rural units rose from 1458 in 1951 to 3512 in 1968-69, representing an annual rate of increase of 5.1% per year. The average size of individual units also increased over the period 1951-1968/69, from 15 beds to 22 (approximately) which represents an increase of 46% in total size (Table 2.7). The steady increase in size of these facilities has been due primarily to the increasing number of maternity beds in rural units.

Estimated Expenditures on Health Services

Uganda has allocated substantial resources for health services (Table 2.8).[20] The magnitude of the commitment is indicated by the fact that the estimated total expenditure on health rose from approximately 85 million shs. in 1958/59 to 235 million shs. in 1968/69, an increase of 175% over the decade. By contrast, total government expenditures increased by 132% over the period. Also of significance is the fact that health expenditures as a percentage of gross domestic product (monetary sector in current prices) increased from approximately 2.7% in 1958/59, to 4.7% in 1968/69.[21]

Table 2.8 Estimated Total Expenditure on Health Services in Uganda: 1959, 1963/64, 1968/69 (1)

Source of Expenditure	1959 Amount (in Mill. shs.)	1959 % of Total Expt.	1963/64 Amount (in Mill. shs.)	1963/64 % of Total Expt.	1968/69 Amount (in Mill. shs.	1968/69 % of Total Expt.
(A) Government						
(1) Central Govt.(2)	52.47	62.4	52.61	48.0	118.41	50.1
(2) District Administration Govt.	7.71	9.2	17.43	15.9	31.53	13.3
(3) Urban Authorities(3)	0.50E	0.6	1.02	0.9	2.72	1.2
(4) Municipalities	1.30E	1.5	2.80	2.6	14.00E-1	5.9
Less Inter-Govt. transfer payments for health services	(2.91)	(3.5)	(7.05)	(6.4)	(9.26)	(3.9)
Total direct govt. expenditure (4)	59.07	70.2	66.81	60.9	157.40	66.6
(B) Mission Medical Services (5)						
Catholic	4.00E		7.00E		10.17	
Protestant	1.50E		3.02E		3.24	
Total Mission Expenditure	5.50	6.5	10.02	9.1	13.41	5.5
(C) Medical Training - Makerere	2.30E	2.7	3.00E	2.7	7.43	3.1
(D) Other Govt. Expenditure on Health(2)(7)	0.65E	0.8	1.00E	0.9	1.80	0.8
(E) UN Organizations (8)						
(1) WHO	0.42		0.84		4.61	
(2) UNESCO/UNICEF	----		0.97		----	
Total UN Expenditure	0.42	0.5	1.81	1.7	4.61	2.0
(F) Industrial Health - Private Firms (9)	2.00	2.4	2.53	2.3	3.82	1.6
(G) Other Voluntary & International Sources of Med. Service (10)	0.50	0.6	0.50	0.4	1.56	0.7
(H) East African Medical Research in Uganda(11)	1.88	2.2	1.82	1.7	2.86	1.2
(I) Private Consumption Expenditures on Health (12)	11.80	14.0	22.14	20.2	43.90	18.6
Total Expenditures	84.12		109.63		236.79	

For notes on the derivation of the figures presented, See Appendix D, Table D.1.

The central government, through the Ministry of Health, is the primary source of finance for health services, contributing approximately 50% of the country's total expenditures on health. Most of the resources expended by the Ministry are used to operate an maintain government hospitals throughout the country. District governments, which have primary responsibility for rural health services, spend approximately 15% of the total sum spent of health in the country. The health expenditures of the four municipalities have increased in recent years from approximately 1.5% to over 6% of the country's total expenditure on health. This increase in expenditure by the municipalities has gone primarily to the creation of urban health centers.

Mission organizations account for a relatively small proportion of the country's total expenditure on health. Over the period 1958/59 to 1968/69, mission expenditure was less than 10% of the total spent on health in the country. This low figure may be due in part, however, to underreporting. The fact alone that there were 26 mission hospitals in 1968/69 containing (40% of the total number of beds in the country) makes the low figure all the more surprising.

Total expenditure on private health services - private physicians, drugs, traditional healers - in Uganda is large. According to the estimate shown in Table 2.8 approximately 20% of the total expenditure on health occurs in the private sector of the health service industry, even though government curative health services are free.

The proportion of resources committed to curative vis a vis preventive health services are presented in Table 2.9, for the year

Table 2.9 Distribution of 1968/69 Expenditures on Health Between Preventive and Curative Services

Source of Expenditure	1968/69 Expenditure on Health(1)	Curative Health Services(1)	Preventive Health Services(1)	Non-Direct Service (Admin., Research, Training)(1-2)
(A) Government				
(1) Central Govt.(3)	118.41	104.14	7.99	6.28
(2) Dist. Administration Govt. (4)	31.53	24.13	7.17	0.23
(3) Urban Authorities	2.72	----	2.72	----
(4) Municipalities(5)	14.00	3.52	10.48	----
Less Intergovernmental transfer payments for health services	(9.26)	(9.26)	----	----
Total direct government expenditure	157.40	122.53	28.36	6.51
(B) Mission Medical Services (6)				
Catholic	10.17	9.70	----	0.47
Protestant	3.24	3.00	----	0.24
Total Mission Expenditure	13.41	12.70	----	0.71
(C) Medical Training - Makerere	7.43	----	----	7.43
(D) Other Governmental Expenditure on Health	1.80	0.80	1.00	----
(E) UN Organizations				
(1) WHO (7)	4.61	----	3.41	1.20
(2) UNESCO/UNICEF	----	----	----	----
Total UN Expenditure	4.61	----	3.41	1.20
(F) Industrial Health-Private Firms	3.82	3.82	----	----
(G) Other Voluntary and International Sources of Medical Service(8)	1.56	0.20	1.30	0.06
(H) East African Medical Research in Uganda	2.86	----	----	2.86
(I) Private Consumption Expenditures of Health	43.90	43.90	----	----
Total Expenditure	236.79	183.95	34.07	18.77

For notes on the derivation of the figures presented, see Appendix E.

1968/69. Although some of the figures shown are approximations, several points can be made. Curative health services command a large portion of total health resources. In 1968/69, approximately 77% of the total was used to provide curative health services; 14% went to preventive health services and approximately 8% was used for training of health manpower, medical research and administrative needs. Expenditures made by the Ministry of Health are even more heavily weighted toward curative health services. Approximately 88% of the Ministry's recurrent and capital expenditures are allocated to curative health services, while 7% are allocated to preventive services and 5% is allocated to other services.[22] The thrust of the analysis is evident; curative health services consume a large percentage of total resources available for health services in any given year.

Expenditure and Employment in Three Representative Government Health Facilities

One of the most important differences between (a) a large hospital, (b) a 100-bed hospital, and (c) a health center, is the level of recurrent expenditure required to operate the facility. The figures in Table 2.10, using the health center as the unit of comparison, indicates that for every shilling spent to operate the health center for one year, 12.6 shillings and 24.0 shillings are required to operate a 100-bed and a 250-300 bed hospital respectively.

The structure of expenditures in the three representative facilities, yields some further contrasts. Personnel costs comprised over 60% of total expenditures in the hospitals, whereas the figure for the health center was slightly over 50%. There were also notable

Table 2.10 Financial and Employment Structure of Three Representative Governmental Health Facilities for the Year 1968/69 or 1969 (1)

Expenditure Category	Large Hospital 250-300 beds	Hospital 100 beds	Health Center 25-30 beds
	(Expenditure category percentage of total est. expenditure)		
Personnel Emoluments for Skilled Labor	43.2	43.4	33.8
Personnel Emoluments for Unskilled Labor	18.9	19.9	18.9
Total Personnel Emoluments (2)	62.1	63.3	51.9
Drugs and Sundries	14.5	12.7	17.9
Food	6.8	5.8	0.8
Transport for Patients and Employees (3)	2.4	1.6	14.0
Power, Light, and Telephone	3.9	2.9	0.6
Depreciation	10.3	13.7	8.6
Repairs and Maintenance (est.) (4)	----	----	6.1
Other Charges (less than)	0.01	----	----
Total Estimated Annual Expenditures	1,944,000	1,025,000	81,000
Employment Category	(Percentage of total employment)		
Skilled Personnel (5)	38.5	35.4	28.6
Unskilled Personnel	61.5	64.6	71.4
Total Personnel (6)	260	147	14

For notes on the derivation of the figures presented, see Appendix E.

differences between both types of hospital on the one hand and the health center on the other in food, transport, and utilities. The smaller expenditure by the health center for food is due to the fact that it generally does not provide food for inpatients. There are almost no utilities in rural health centers, although in some districts, larger units have electricity. In hospitals on the other hand, where there is a wide range of equipment available, the use of electricity is essential. The most plausible explanation for the differences in percentage of total expenditures for transport is that transport represents a fixed cost; as the total cost of operating a health facility rises the amount used for transport services declines as a percentage of total expenditure.

The relative employment ratio between the health center and the two sizes of hospital is shown in Table 2.10. For every one person employed in the health center, 10.5 persons are employed in the 100-bed hospital and 18.6 persons are employed in the 250-300 bed hospital. In addition, the average expenditure per employee is greatest in the larger hospital, (7,500 shs.) declining in the smaller hospital, (7,000 shs.) and lowest in the rural health center, (5,800 shs.).

Demand for Curative Health Services

Attendances

Table 2.11 presents data on the number of attendances at government health facilities over a twenty year period, 1950 to 1969/70. The number of attendances increased during the first decade at an annual rate of 6.3% and at an even more rapid rate of 7.7% over the second half of the period. When the rate of increase in total

Table 2.11 Utilization of Governmental Health Facilities

Year	(1) Estimated Total Population (000)	(2) Total Number of Cases (000)	(3) Total No. of New Outpatient Cases (000)	(4) Total No. of Out-patient Re-attendances (000)	(5) Total No. of Inpatient Admissions (000)	(6) Estimated Average No. of cases per person per year
1951	5,322.0	4,873.0	2,329.0	2,422.0	122.0	0.92
1955	5,874.0	5,459.7	2,732.3	2,597.1	130.3	0.93
1960	6,573.0	7,784.8	4,335.2	3,245.4	204.2	1.18
1965/66	8,221.0	13,083.9	7,178.6	5,658.6	246.7	1.59
1968/69	9,191.0	17,826.5	9,537.3	7,884.0	405.2	1.94

The figures shown for 1960 are estimated from the data reported for the first six months of the year. In 1960, the Government changed from a calendar to a fiscal reporting year.

Total population estimates were derived from estimated rates of population growth between censuses.

Source: Republic of Uganda, Ministry of Health, Annual Reports and Statistical Records, (Entebbe: Government Printer, selected years).

attendance is related to population growth, the figures take on additional significance.

Even though the population is increasing at the present natural rate of increase of 3.3% per year, the average number of attendances at government facilities has increased from 0.92 attendances per person per year in 1951 to 1.94 attendances per person per year in 1968/69. During this period, 65% of all attendances were at rural health facilities. This attendance figure is particularly significant because rural facilities received only 20% of government financial support for curative health services during the same period (Tables 2.8 and 2.9). While health centers provide the majority of outpatient care, hospitals provide the majority of inpatient services, with admissions to government hospitals comprising 44%,of the total mission hospitals 18%, and rural units 38% in 1968/69.[23]

Both inpatient and outpatient attendances at government units increased rapidly between 1951 to 1968/69, by 365% over the entire period. Outpatient attendances, however, increased more rapidly than did inpatient attendance, 410% vis a vis 332%. The proportion of attendances at all government units thus shifted toward outpatient curative services -- from 97.5% in 1951 to 97.7% in 1968/69.

Data presented in Table 2.12 indicate the extent to which patients who enter the treatment process as outpatients at rural health facilities are (a) admitted to inpatient care in the facility, (b) transferred to the district hospital, or (c) die as inpatients in the rural health facility. Of the 587,000 new attendances in the years indicated, an average of 51.4 per thousand were admitted to inpatient care in the health facility; and average of 3.4 per thousand were transferred to

Table 2.12 Attendance Data from a Selected Sample of Rural Units for the Time Period 1969 or 1969/70

Facility (Type)	District	Total New Attendances	Admissions Relative to New Attendances (Rate per 1000)	Transfers Relative to New Attendances (Rate per 1000)	Deaths Relative to Admissions (Rate per 1000)	Time Period
Buikwe Health Center	E. Mengo	26,606	16.4	3.1	36.7	1969
Luwero Health Center	E. Mengo	38,515	34.9	1.9	15.6	1969
Semuto Dispensary	E. Mengo	26,301	52.1	5.6	11.0	1969
Buvuma Dispensary	E. Mengo	2,971	34.0	2.4	----	1969
Nawaikoke Health Center	Busoga	28,219	62.0	2.3	16.0	1969/70
Kiyunga Health Center	Busoga	42,616	90.1	4.3	15.4	1969/70
Namwendwa Health Center	Busoga	52,743	52.6	1.6	24.9	1969/70
Nsinze Health Center	Busoga	35,169	75.9	6.1	22.9	1961/70
Kidera Health Center	Busoga	19,765	78.8	5.4	27.6	1969/70
Namungalwe Health Center	Busoga	37,464	73.1	6.7	16.8	1969/70
Bugiri Dispensary	Busoga	40,667	34.4	2.6	34.4	1969/70
Kamuli Dispensary	Busoga	73,290	33.8	1.7	16.6	1969/70
Ikulwe Dispensary	Busoga	23,530	43.6	7.9	30.2	1969/70
Buyende Dispensary	Busoga	17,611	73.5	2.5	29.3	1969/70
Kaliro Dispensary	Busoga	38,840	49.2	3.6	20.4	1969/70
Kinoni Health Center	Ankole	22,493	32.1	1.9	22.1	1969/70
Bushenyi Health Center	Ankole	29,670	38.4	2.1	21.9	1969/70
Kiruhura Dispensary	Ankole	11,689	54.8	2.1	21.8	1969/70
Rwashamaire Dispensary	Ankole	18,913	52.1	4.8	12.2	1969/70
Total		587,072	51.4 (30,171)	3.4 (2,007)	20.6 (622)	

Data collected from facility records.

a hospital; and an average of 20.6 persons per thousand died while receiving inpatient care in the rural health facility.

Disease Mix

The Ministry of Health analyzes attendances at government and mission hospitals by 14 major disease categories adapted from World Health Organization classification standards.[24] Analysis of this summarized information over time yields a good idea of (a) the distribution of diseases treated, on inpatient and outpatient bases, at mission and government hospitals and (b) changes in the distribution over time. The following analysis of diseases treated in government and mission hospitals is based on the data presented in Tables 2.13 through 2.17.

Inpatient treatment process

The distribution of diseases treated as inpatient cases in government hospitals is presented in Table 2.13. Admissions for infectious and parasitic diseases (malaria, measles, helminthiases, tuberculosis, veneral disease, etc.), have dominated the entire period (1952-1968/69), but the percentage of the total comprised by infections and parasitic diseases has declined by 50% from 34% of the total in 1952 to 17% in 1968/69. The categories of normal delivery and complications of pregnancy and puerperium both grew more rapidly than any other over the period. In combination, these two categories grew from 12.4% of total admissions in 1952 to nearly 30% of admissions in 1968/69, an increase of 140% over the period. This increase is due at least in part to changes in traditional practices related to birth,

Table 2.13 Distribution of Diseases Treated in Uganda on an Inpatient Basis in Government Hospitals; Percentage of Total Cases by Disease Category in selected years.

Disease Category	1952	1955	1958	1961/62	1964/65	1968/69
Infective and Parasitic	33.8	28.2	21.3	19.6	15.8	16.8
New Growths	1.3	1.7	2.0	2.2	2.9	1.8
Allergic, Metabolic and Blood	2.1	2.5	3.7	5.3	4.5	4.7
Diseases of the Nervous System and Sense Organs	3.2	3.7	3.7	3.1	4.0	2.7
Circulatory	0.7	1.0	1.1	1.4	1.9	1.7
Respiratory	9.9	10.3	9.5	9.7	10.4	10.6
Alimentary	6.6	6.2	7.4	9.0	9.8	10.0
Genito-Urinary	2.9	4.8	5.5	5.6	5.2	3.9
Pregnancy and Puerprium	4.8	6.8	8.5	9.9	10.4	11.0
Delivery without Complication	7.6	10.6	13.4	14.1	13.6	18.7
Skin and Musculo-skeletal	8.6	6.2	5.2	5.1	5.5	4.6
Diseases of the New Born	1.2	1.0	0.9	0.8	1.2	0.9
Ill-defined Diseases	7.3	7.4	8.2	4.7	3.8	1.7
Injuries	10.0	9.7	9.7	9.5	11.0	10.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Calculated from Republic of Uganda, Ministry of Health, Annual Report or Statistical Records, (Entebbe: Government Printer, selected years).

increases in ante-natal preventive services, increases in the availability of maternity wards, and changes in demographic variables (e.g. an increased birth rate).

Allergic, metabolic and blood diseases (e.g. malnutrition, anemia, etc.) rose from approximately 2.1% in 1952 to approximately 5% in the 1960's. Alimentary cases (e.g. gastritis, hernias, etc.) increased continuously, from 6.6% in 1952 to 10.0% in 1968/69. Both skin and musculo-skeletal diseases and ill-defined diseases declined markedly over the period. The drop in ill-defined conditions may reflect (a) improvements in diagnostic procedures and/or (b) increased availability of laboratory services, such that a smaller percentage of all diseases remain ill-defined; it may also reflect the pressure of demand, with a certain self-selection process operating such that only more readily diagnosible conditions are treated today on an inpatient basis than in the past, given the limited supply of inpatient treatment facilities. Injuries remained a fairly constant 10.0% of all cases admitted to inpatient treatment in government hospitals; an increasing proportion of injury cases, however, were related to increased automobile traffic.

The distribution of mission hospital inpatient cases is shown in Table 2.14. As in government hospitals, infectious and parasitic diseases are most prevalent, comprising 33% in 1958 and 27% in 1968/69. Pregnancy-related cases, have seen no real trend in mission hospitals; they do, however, comprise a large percentage (approximately 24%) of total cases treated over the entire period.

Allergic, metabolic, and blood diseases as well as alimentary diseases, have increased as a percentage of all inpatient cases over

Table 2.14 Distribution of Diseases Treated in Uganda on an Inpatient Basis in Mission Hospitals; Percentage of Total Cases by Disease Category in selected years.

Disease Category	1958	1961/62	1964/65	1968/69
Infective and Parasitic	33.2	33.9	26.8	26.9
New Growths	1.6	1.9	2.4	1.7
Allergic, Metabolic and Blood	5.2	5.1	6.8	8.2
Diseases of the Nervous System and Sense Organs	2.2	2.4	2.2	2.8
Circulatory	1.2	1.4	1.5	1.5
Respiratory	10.3	10.4	9.5	10.6
Alimentary	7.2	8.1	10.2	10.2
Genito-Urinary	5.0	4.3	4.6	2.7
Pregnancy and Puerprium	8.9	8.4	8.3	8.2
Delivery without Complication	13.2	14.2	17.3	15.1
Skin and Musculo-skeletal	4.1	3.2	3.3	3.7
Diseases of the New Born	1.1	1.7	2.2	2.4
Ill-Defined Diseases	3.9	2.6	2.5	3.2
Injuries	2.9	2.4	2.5	2.8
Total	100.0	100.0	100.0	100.0

Calculated from Republic of Uganda, Ministry of Health, Annual Report or Statistical Records, (Entebbe: Government Printer, selected years).

the period. Diseases of new born infants have increased rapidly as a percentage of total cases in mission hospitals, although they do not constitute a large percentage of total cases treated. There appears to have been a fairly significant drop in the percentage of genito-urinary cases treated in mission hospitals, from 5.0% in 1958 to 2.7% at the end of the period, although close examination of the figures reveals that the drop in the last year may have been a random event. Injury cases, as a percentage of the total cases treated, were fairly stable over the period (2.5% to 2.9%) but comprise a much smaller percentage of total cases treated than in government hospitals.

Outpatient Treatment

As was true in the case of the distribution of inpatient cases, infective and parasitic diseases account for the largest percentage of cases treated on an outpatient basis in government hospitals (Table 2.15). Again, however, this group of diseases has declined as a percentage of total cases treated from 38% in 1952 to approximately 30% throughout most of the 1960's. Other important shifts in the structure of government hospital outpatient cases include (a) an increase in allergic, metabolic, and blood cases (0.6% of the total in 1952 to 1.3% in 1968/69), (b) a large increase in the number of nervous system and sense organ diseases (from 1.8% to 6.1%); (c) an increase in respiratory and alimentary diseases (respiratory: from 12.9% to 17.2%; alimentary: from 12.7% to 15.5%); and (d) decreases in both skin and musculo-skeletal diseases and injuries as a percentage of total cases treated (each, however, still comprises a 10% of the total).

Table 2.15 Distribution of Diseases Treated in Uganda on an Outpatient Basis in Government Hospitals; Percentage of Total Cases by Disease Category in selected years.

Disease Category	1952	1955	1958	1961/62	1964/65	1968/69
Infective and Parasitic	38.4	37.7	33.4	28.7	28.7	31.8
New Growths	0.1	0.1	0.1	0.1	0.1	0.1
Allergic, Metabolic and Blood	0.6	0.7	0.7	1.2	1.0	1.3
Diseases of the Nervous System and Sense Organs	1.8	2.0	2.5	5.9	5.4	6.1
Circulatory	0.1	0.2	0.2	0.2	0.2	0.2
Respiratory	12.0	12.9	13.9	15.8	12.6	17.2
Alimentary	12.7	16.8	14.4	14.8	15.3	15.5
Genito-Urinary	0.6	1.0	1.5	1.8	3.4	3.1
Pregnancy and Puerprium	0.2	0.2	0.7	0.6	1.6	0.8
Delivery Without Complication	----	----	----	----	----	----
Skin and Musculo-skeletal	14.4	11.3	12.2	14.2	13.0	10.5
Diseases of New Born	0.6	0.2	0.2	0.4	0.7	0.3
Ill-Defined Diseases	4.5	3.8	7.3	5.6	7.7	3.5
Injuries	13.0	13.0	12.9	10.8	10.5	9.5
Total & (excl. Exams Innoculations)	100.0	100.0	100.0	100.0	100.0	100.0
Examinations and Innoculations	17.3	16.1	12.1	17.5	12.4	10.5
Total (incl. Exams & Innoculations) (1)	769.2	811.2	1200.0	1522.9	1781.5	3288.5

Calculated from Republic of Uganda, Ministry of Health, Annual Report or Statistical Records, (Entebbe: Government Printer, selected years).

(1) Total in thousands of recorded diagnoses.

In mission hospitals, the structure of diseases treated on an outpatient basis remained basically stable over the period 1958 to 1968/69, (Table 2.16). The decline in ill-defined conditions as a percentage of total cases, from 13.2% in 1958 to approximately 2.0% for the remainder of the period, is indicative of a change in disease reporting by mission units after 1958, the first year in which the government required reports from mission health facilities.

Infective and parasitic diseases are most prevalent among the outpatient cases treated at mission hospitals, comprising approximately 40% of all cases. Other important disease groups treated in the mission hospitals include respiratory diseases, alimentary diseases, skin and musculo-skeletal diseases, the diseases of the nervous system and sense organs. The percentage of injury cases treated in mission hospitals is very small, and declined, in fact, from approximately 3.5% of all cases treated in the years prior to 1968/69 to less than 1.0% in that year.

Comparison of Disease Mix Between (a) Inpatient and Outpatient and (b) Government and Mission Hospitals

Table 2.17 provides a comparison of the distribution of diseases between (a) government and mission facilities and (b) inpatient and outpatient treatment processes. The standard of comparison is the government hospital disease mix for both inpatients and outpatients; the mission hospital disease mix is compared to this standard.

The disease mix structure for mission hospitals in both periods contained a larger proportion of infective and parasitic diseases; allergic, metabolic, and blood diseases; respiratory diseases and

Table 2.16 Distribution of Diseases Treated in Uganda on an Outpatient Basis in Mission Hospitals; Percentage of Total Cases by Disease Category in selected years.

Disease Category	1958	1961/62	1965/65	1968/69
Infective and Parasitic	41.8	40.7	41.7	41.5
New Growths	0.6	0.4	0.6	0.3
Allergic, Metabolic and Blood	3.5	4.5	6.1	5.3
Diseases of the Nervous System & Sense Organs	1.6	5.3	5.4	6.2
Circulatory	0.5	0.6	0.6	0.8
Respiratory	9.5	13.1	11.1	13.4
Alimentary	9.8	13.8	12.8	13.1
Genito-Urinary	2.3	4.0	3.6	3.9
Pregnancy and Puerprium	6.1	1.8	2.1	1.9
Delivery without Complication	----	----	----	----
Skin & Musculo-skeletal	6.8	9.2	8.9	9.6
Diseases of New Born	0.6	1.1	1.0	0.8
Ill-Defined Diseases	13.3	2.0	2.4	2.3
Injuries	3.6	3.5	3.7	0.9
Total (Excl. Exams & Innoculations)	100.0	100.0	100.0	100.0
Examinations and Innoculations	23.3	25.2	32.6	35.7
Total (Incl. Exams & Innoculations) (1)	166.6	164.5	497.6	640.6

Calculated from the Republic of Uganda, Ministry of Health, Annual Report or Statistical Records, (Entebbe: Government Printer, selected years).

(1) Total in thousands of recorded diagnoses.

Table 2.17 Comparison of Disease Distributions

Disease Type	Mission Compared to Government				Inpatient Compared to Outpatient			
	Inpatient Comparison		Outpatient Comparison		Government Hospitals		Mission Hospitals	
	1958	1968/69	1961/62	1968/69	1958	1968/69	1961/62	1968/69
Infective and Parasitic	155.9	160.1	141.8	130.5	63.8	52.8	83.3	64.8
New Growths	95.0	94.4	400.0	300.0	2000.0	1800.0	475.0	566.7
Allergic, Metabolic and Blood	140.5	174.5	375.0	407.7	528.6	361.5	113.3	154.7
Diseases of the Nervous System and Sense Organs	59.5	103.7	89.9	101.6	148.0	44.3	45.3	45.2
Circulatory	109.1	88.2	300.0	400.0	550.0	850.0	223.3	187.5
Respiratory	108.4	100.0	82.9	77.9	68.3	61.6	79.4	79.1
Alimentary	97.3	102.0	93.2	84.5	51.4	64.5	58.6	77.9
Genito-Urinary	90.0	69.2	222.2	125.8	366.7	125.8	107.5	69.2
Pregnancy and Puerprium	104.7	74.5	300.0	237.5	1214.3	1375.0	466.7	431.6
Delivery without Complication	98.5	80.7	----	----	----	----	----	----
Skin and Musculo-skeletal	78.8	80.4	64.8	91.4	42.6	43.8	34.8	38.5
Diseases of the New Born	122.2	266.7	275.0	266.7	450.0	300.0	154.5	300.0
Ill-Defined Diseases	47.6	188.2	35.7	64.7	122.3	48.6	130.0	139.1
Injuries	29.9	25.9	32.4	9.5	75.2	113.6	68.6	311.1

Note: Figures are given in percentage form. Figures are derived from data presented in Tables 2.13, 2.14, 2.15, and 2.16.

diseases of the new born. Government hospitals, on the other hand, had a higher proportion of new growths; genito-urinary diseases; normal deliveries; skin and musculo-skeletal diseases; and injury cases.

The inpatient disease mix in both government and mission hospitals in 1968/69 contained a greater proportion of cases in the following disease categories than in the outpatient case: new growths; allergic, metabolic, and blood diseases; circulatory diseases; diseases of pregnancy and puerprium; diseases of the new born and injuries. The outpatient structure in both types of hospitals, however, contained a greater proportion of infective and parasitic diseases; nervous system and sense diseases; respiratory diseases; alimentary diseases; and skin and musculo-skeletal diseases.

Employment

Total Employment

Trends in total employment in the health services industry are presented in Table 2.18. In 1951, approximately 7,500 persons were employed in both the public and private sectors of the health services industry. By 1968, total employment in the health services industry had risen to over 17,000 persons, representing an annual rate of increase of 4.9% over the period. The rate of increase in employment was greater than the increase in total recorded employment in the country over the same period; the health services industry increased its percentage of total recorded employment from 3.8% in 1958 to 6.0% in 1968. From 1958 to 1968/69 recorded employment in the government sector of the health service industry increased by 81% while it increased in the private sector by 133%. Since 1964, however, employment

Table 2.18 Employment in Uganda's Health Services Industry

Year	Total	Employment (in thousands) Government	Private*	Total Medical Earnings Government and Private (in million shs.)
1951	7.48			
1958	9.18	8.39	0.80	24.36
1959	9.87	8.80	1.07	27.93
1960	10.27	9.00	1.27	38.72
1961	10.07	8.61	1.46	31.28
1962	10.57	8.87	1.69	37.26
1963	10.55	8.95	1.61	37.44
1964	12.66	10.60	2.06	45.59
1965	13.42	11.50	1.91	45.38
1966	14.36	12.37	1.98	52.68
1967	15.29	13.42	1.86	61.14
1968	17.03	15.17	1.86	65.52

Sources: Data for 1951 taken from Uganda Protectorate, Report on the Enumberation of African Employees in Uganda, March 1951; East African Statistical Department, March 1952.

Data for 1958-1968 provided by Ministry of Planning and Economic Development.

* Unfortunately, the data regarding employment in the private sector of the health services industry may be suspect, due to inconsistencies in mission reports of employment allocation between their activities in health services and education. Personal communication from the Government Statistican, January 27, 1970.

in the public sector has increased more rapidly than the private sector, the latter showing a decline since 1964.

Earnings in both the public and private sectors of the health service system increased by 169% from 24.36 million shillings in 1958 to 65.52 million shs. in 1968. During the same period, total reported earnings for all sectors of the economy increased by 125%. The share of total earnings represented by the health services sector of the economy thus increased from 5.1% to 6.1% over the period. Average annual earnings per worker in the health services sector of the economy also increased during the period, from 2,653 shs. per year to 3,848 shs. per year--a 45% increase. This increase, however, was smaller than the increase recorded for average earnings per worker in the total economy, which rose from 1,960 shs. per year to 3,800 shs. per year--a gain of 94%. There was therefore, an increase in earnings parity for all workers in the economy relative to health service employees.

Ministry of Health Establishment

During the period 1967/68 to 1970/71, the proportion of positions allocated to each employment category remained fairly constant, although the total number of positions increased by 36% (Table 2.19). Approximately 75% of all positions were allocated to direct curative medical services over the four year period. The allocation of positions to public health services has shown a slight decline over the period, from approximately 8.5% to 7.0% of all positions.

Mulago Hospital and Butabika Mental Hospital are listed by the Ministry as separate categories. Mulago Hospital, the national teaching and referral hospital with approximately 1,000 beds, has consistently

Table 2.19 Ministry of Health Establishment

Year	Total Establishment	Number of Establishment Positions Allocated to: Mulago Hospital	Butabika Medical Hospital	Central (1) Administration	Public Health(2)	Supporting Services(3)	Other Medical (doctors, nurses)
1967/68	3774	611	97	350	326	281	2151
1968/69	3954	633	147	366	327	292	2189
1969/70	4360	692	166	395	327	347	2433
1970/71	5132	800	186	441	355	379	2971

Source: Republic of Uganda, Estimates of Recurrent Expenditure, (Entebbe: Government Printer) selected years.

(1) Included in the Central Administration Category are positions allocated to "Office of the Minister" and "Administrative and General Staff".

(2) The category of Public Health includes positions allocated to Sanitation and Hygiene.

(3) The category of Supporting Services includes positions listed under (a) laboratory, vector control, radiological and physiotherapy staff; (b) pharmaceutical and supplies staff; and (c) chemotherapeutic laboratory staff.

taken approximately 16% of total Ministry positions. On the other hand, Butabika Hospital, the only mental hospital in the country and also with nearly 1,000 beds, has been allocated approximately 3.8% of all Ministry positions over the last four years.

Registered Medical Manpower

Table 2.20 provides information on the number of trained medical manpower of various types, registered in Uganda. Although the data imply that there has been an increase in the number of doctors and dentists in Uganda registration lists of medical manpower in East Africa are greatly inflated for the following factors: (a) registered expatriate personnel often leave the country after a short-term assignment; (b) registrants die, but are not promptly removed from the lists; (c) some registrants practice medicine in one of the other East African countries, but not in Uganda; (d) some registrants leave the labor force or obtain alternative employment.[25] Unfortunately, the manpower registration figures also offer no insight into rural/urban differentials in availability of medical personnel.[26]

Employment in Rural Health Facilities

Table 2.21 presents information in the employment structure of rural health facilities in two districts, Busoga and East Mengo. The units represent four types of facilities and the personnel in each type of facility are categorized into three groups: trained medical employees, untrained medical employees, and others.

The average number of employees in the group of health centers is 19.2 persons per unit; the average in dispensaries is 12 persons, in sub-dispensaries 5.5 persons, and in maternity centers 9.7 persons.

Table 2.20 Medical Manpower Registered to Practice in Uganda

Year	Doctors Registered	Doctors Licensed	Doctors Total	Dentists	Midwives	Nurses	Pharmacists
1951	151	81	232	10	732		
1952	167	82	249	9	755		
1953	178	79	257	11	775		
1954	223	53	276	13	836		
1955	255	41	296	14	897		
1956	292	53	345	15	980		27
1957	305	54	359	17	1023		34
1958	371	52	423	19	890(1)	174(2)	34
1959	422	54	476	19	907	301	40
1960	441	43	484	18	968	366	60
1960/61	476	52	528	18	1060	410	61
1961/62	479	73	552	28	1156	1354(3)	72
1962/63	504	80	584	22	1290	1557	84
1963/64	538	113	651	28	1430	1748	95
1964/65	588	140	728	31	1565	2271	85
1965/66	642	171	813	39	1911	2682	61
1966/67	727	214	941	40	2199	3040	104
1967/68	797	181	978	42	2551	3277	116
1968/69							
1969/70							

Source: Republic of Uganda, Statistical Abstract, (Entebbe: Government Pr inter, selected years.)

(1) A new ordinance for the registration of midwives was iniciated in 1958. As a result, the series is discontinuous from that date.

(2) State Registered Nurses only.

(3) Includes State Registered Nurses, Enrolled Nurses, and Male Nurses.

These variations reflect both the range of service provided at each type of facility and the total demand for service.

Table 2.21 Employment Structure of Four Types of Rural Health Facilities in Uganda: 1969/70

Facility Type	Total	Average Employment Trained	Untrained	Other	Sample Size
Health Centers	19.2	6.25	7.5	5.4	8
Dispensaries	12.0	2.2	5.8	4.0	12
Sub-dispensaries	5.5	1.1	1.4	3.0	8
Maternity Centers	9.7	3.0	3.3	3.3	3

Information derived from facility records.

The sub-dispensary provides daily outpatient clinic services only. Employees here are likely to be distributed as follows: 1 diagnostician, 1 or 2 persons providing treatment and 3 persons engaged in maintainance work. In a dispensary, both inpatient and outpatient services are provided, and speciality preventive clinics (e.g., ante-natal, young child, etc.) are usually offered. The increased range of services requires additional personnel; there is an average of one trained person above the staffing requirements of the sub-dispensary, an average of 4.4 more untrained medical personnel and one additional untrained employee providing other services. Maternity centers provide inpatient maternal care, ante-natal services, and young child services. The three trained employees in the maternity center are midwives, and the three untrained medical employees assist in providing inpatient care.

The health center offers the full range of services provided by the other three types of facilities, and engages in a more intensive program of health education and public health program than in the other units. As a result, the health centers in the sample employed an average of 6.3 trained medical employees per unit, 7.5 untrained medical personnel and 5.4 employees engaged in other, non-medical activities. The implications of the varying personnel requirements of the different types of rural health facilities are as follows. First, since district governments are primarily responsible for building and staffing rural units, they should have information about different employment patterns existing in different types of health facilities. Even the decision to upgrade a facility is likely to lead to a different pattern of demand upon the labor market; the upgrading of a sub-dispensary to a dispensary, for example, is likely to increase the demand for untrained medical personnel, while the decision to upgrade a dispensary to a health center would increase the demand for trained medical personnel.

Second, employment patterns amongst facility types imply differing financial obligations to districts when they decide whether to build or upgrade facilities. This factor is particularly true in the case of future recurrent cost obligations, particularly in view of the fact that personal emoluments in health centers and possibly in other units are likely to comprise at least 50% of total recurrent costs.

Finally, employment mixes of rural health facilities have implications for the central government's training programs for non-professional medical personnel. Not only must the central government analyze manpower requirements for hospitals, but needs also to consider the variability of demand by districts for trained medical personnel; the demand variability in turn is dependent upon the districts' investment mix in various types of facilities.

Summary

In this chapter, Uganda's health service system was examined. An overview of preventive health services was presented. The discussion centered on the extent to which environmental health, immunization, ante-natal services, child health services, health education, and family planning services are used by Ugandans.

The curative health service system was then analyzed, focusing on four important aspects. First, the government and mission health facility structure was analyzed. Second the analysis centered on financial matters, with attention given to the rapid increase in cost of all health services and the large percentage of total health resources committed to curative service. Third, the structure of demand for curative health services was examined; the rise in attendance was noted and analysis was made of the shifts and differences in disease mix among government and mission hospitals. Finally, the pattern of employment in health was discussed. In this context, some of the manpower implications of possible expansion of the service system was noted.

Footnotes

1. Urban areas include the four municipalities - Kampala, Jinja, Mbale, and Masaka - as well as the 15 urban authorities and nine town boards. The terms municipalities, urban authorities, and town boards are used in Uganda in reference to the various levels of urban or city development. Municipalities are the largest units, usually have a relatively high percentage of non-African residents, and are very wealthy relative to other parts of the country. All of the municipalities are focal points of economic activity, governmental administration, and social and cultural amenities. They each have a population of more than 20,000 persons. Towns classified as urban authorities are the next most sophisticated urban areas. They are free to run their own affairs with minimal supervision from the Ministry of Regional Administrations. Some are nearly as large as the two smaller municipalities, Masaka and Mbale, but have not been chartered and are not nearly as wealthy as the municipalities. Most of these towns have less than 10,000 population, and serve as regional or district urban centers from which many government activities emanate. Town boards govern small urban areas which are closely controlled by the Ministry of Regional Administrations. Most of the town boards' personnel and virtually all financial support is determined (or seconded, in the case of personnel) by the Ministry. The towns governed by town boards are focal points for a part of a larger district, and many of them have large markets and perhaps two or three streets with permanent buildings; most have a population of 2,000 to 5,000.

2. The figures do not include resources committed to water development and sewage treatment.

3. To what extent are immunization services disseminated during any given year? The population of Uganda in 1966/67 was approximately 8.5 million, increasing at approximately 3.5 percent per year. (See Steven R. Taber, "A First Look at the Provisional Results of the 1969 Uganda Census," a paper delivered at the Seminar on Population Growth and Economic Development, Nairobi, Kenya, December 15 - 22, 1969, (Nairobi: unpublished paper, 1969). This rate of increase implies an annual net increase of approximately 390,000 - a birth rate of 45 per 1,000. The difference between 390,000 and 310,000 is comprised of approximately 120,000 deaths and net in migration of 40,000. See Taber, Provisional Results of the 1969 Uganda Census," p. 12.)

   Assuming that approximately 580,000 persons were vaccinated against Polio (Table 2.2)and that some underreporting did occur, approximately 7.0% of the total population was immunized during that year. However, if one takes into account (a) the dynamic aspects of population change, (b) the fact that the portion of the population most at risk consists of those people under 25, and (c) the fact that the largest proportion of immunization services is provided to children under five years of age, perhaps 11% of the at-risk population were immunized against Polio, although the percentage of the total population immunized is less than 6.5 percent. (There are approximately 5.1 million persons in the at risk population and approximately 530,000 persons were innoculated against polio in 1966/67).

4. For a discussion of the problem of tuberculosis in Uganda and possible ways to control the disease, see R. H. Morrow, "Tuberculosis Control in East Africa", (unpublished paper, Makerere Medical School, Kampala, Uganda, 1969) and R. H. Morrow, "Tuberculosis", in Uganda Atlas of Disease Distribution, Occasional Paper no. 12, edited by S. A. Hall and B. W. Langlands (Kampala: Department of Preventive Medicine and Department of Geography, Makerere University College, 1968).

5. The percentage figures have an upward bias for two reasons: (a) the percental computations were made comparing the total number of ante-natal cases in time t_0 with the estimated number of births in time t_0; a more appropriate comparison would use new ante-natal visits in time t_0 and the number of births in time $t_{0+0.75}$ to reflect the lagged effect of birth; and (b) not all women with first visits to ante-natal clinics have live, viable births; some result in abortions or other problems leading to fetal or new-born death.

6. This statement is based on personal observation at numerous clinics and on a cursory analysis of several different facilities' monthly statistical returns. Often the young child clinic and the ante-natal clinic is held on the same day.

7. The latter is a means of detecting malnutrition, even though some of the obvious clinical symptoms may not yet be manifest.

8. For more information on the Ankole Preschool Protection Program, see Malcom Moffat, Mobile Young Child Clinics in Rural Uganda: A Report on the Ankole Preschool Protection Programme, 1967-69, (Kampala: Department of Pediatrics and Child Health, Makerere University College, 1970).

9. Although the Uganda Family Planning Association was established in 1957, with a grant from the International Planned Parenthood Association, a full range of family planning services was not offered until 1962.

The information compiled in this section results from many formal and informal discussions with numerous people involved or interested in population issues in Uganda. The points of view represented included medical, demographic, and socioeconomic. Principal among these individuals were Dr. George Saxton, Dr. Donald Minkler, Dr. Keith Masters, Dr. Michel Thuriaux, Dr. Steven Taber, Mr. Kenneth Hill, and Dr. Richard Trussell. A good deal of further background information on family planning services in Uganda and East Africa has been assembled as a result of the Ford Foundation sponsored Workshop on Needed Research in Family Planning and Population Growth in East Africa, Nairobi, July, 1970. See David Radel and Shelley Ross-Larson, eds., Proceedings of the Workshop on Needed Research in Eastern Africa on Family Planning: Medical Research and Programme Trials, Nairobi, Kenya, 23-25 July 1970, Sponsored by the Ford Foundation, July 1971, (mimeoed document).

10. No research has yet been conducted in Uganda or in East Africa on the relative effectiveness of any institutional arrangement. A research project on this problem may develop in Kenya as a result of that country's recent commitment to a mass family planning program.

11. International Planned Parenthood Federation, Report to Donors; Programme Development and Financial Statements 1970-72, International Planned Parenthood Federation, London, England, September 1971, page 190.

12. See Republic of Uganda, Uganda's Plan III, page 119.

13. Attendances at the clinic are approximately 300 persons per month; of that number, 60-70 percent are new attendances. See U. S., Agency for International Development, Population Program Assistance; Aid to the Developing Countries by the United States, Other Nations and International and Private Agencies, (Washington, D. C.: Agency for International Development, 1969), page 137.

14. This statement is based on the assumption that an attendance represents a new "protected" woman, which is obviously not the case for a variety of reasons. See the following on the operations and problems involved in contraception method effectiveness: Robert G. Potter, "The Multiple Decrement Life Table as an Approach to Measurement of Use Effectiveness and Demographic Effectiveness of Contraception," a paper presented at the Conference of the International Union for Scientific Study of Population, Sydney, Australia, 1967, (unpublished paper, Sydney, Australia, 1967); George Saxton and M. C. Pike, "Followup Study of 921 Women Using IUCD's in Kampala," (unpublished paper, Kampala, Uganda, 1967); and "Family Planning Technology: Present Status and Limitations" in Population Control: Implications Trends, and Prospects, edited by Nafis Sadik et al. (Islamabad: Pakistan Family Planning Council, 1969).

15. Refer to the 22 100-bed rural hospital scheme of the second development plan, Work for Progress. 10 of these facilities had been opened by October 1970, and construction of most of

the remaining 12 units had been started by that time. The rapid expansion of the number of rural health facilities occurred after 1968/69, when this development project began.

16. Although there is some evidence to suggest that there have been several changes in classification criteria over the period, such changes were adjusted for through the author's use of constant criteria throughout the period.

17. See J. Galea, "Inventory, Appraisal and Assessment of the Basic Health Services of Uganda: Developments for a Malaria Eradication Programme," (Jinja, Uganda: Malaria Pre-eradication Programme, World Health Organization, 1967), and World Health Organization, Planning Rural Health Services, Technical Report Series no. 215 (Geneva: World Health Organization, 1961).

18. The health center in Uganda had its genesis in the Frazer Committee Report (Uganda Protectorate, 1956). The establishment of such a rural facility, however, did not occur until three years later. The growth in the number of health centers had occurred in two ways: (1) upgrading of existing smaller rural units and (2) development of a complete new facility. The former of the two is the more common way of creating a new health center. See Appendix D, Table D.1 for the number of health centers in the country from 1958 on.

19. The analysis does not include mental hospital beds.

20. There has been one other recent attempt to estimate the total expenditure on health in Uganda; see F. J. Bennett and G. Saxton, "Utilization of the Social Sciences for Some Aspects of Health Planning in East Africa", a paper presented at the Conference on Africa in World Affairs: the Next Thirty Years, Makerere University, Kampala, Uganda, 1969, (unpublished paper, Kampala, Uganda, 1969). For a discussion of the problems involved in estimating the total health expenditures in any country, see Brian Abel-Smith, Paying For Health Services: a Study of the Costs and Sources of Finance in Six Countries, Public Health Papers No. 17, (Geneva: Worth Health Organization, 1963) and Dorothy P. Rice, Estimating the Cost of Illness, Health Economics Series, No. 6 (Washington, D. C.: U. S. Department of Health, Education and Welfare, 1966).

21. The gross domestic product figures are taken from the revised series in Republic of Uganda, Background to the Budget, 1970/71 (Entebbe: Government Printer, 1970). The revised figures show an increase in total economic activity when compared to the old series; the percentage of total GDP comprised the health expenditures was approximately one percent larger when compared to the old series figures. Data for the new series were revised to 1961, so that the 1958/59 figure for GDP had to be estimated. In estimating, the percentage that the old series figure comprised of the new series figure was calculated. From 1961 to

1968 (the overlapping period), the percentage consistently moved from 71.5 percent to 81.8 percent. This trend was extended to the earlier years and was used to derive a new series gross domestic product estimate for 1958/59.

22. These percentages must be viewed with some caution, as they are first approximations. No attempt has been made to isolate the extent to which certain hospital costs may be related to preventive services, such as ante-natal care, child welfare clinics, and immunizations. Even if such information were available, however, it would not significantly change the major thrust of this analysis.

23. See Republic of Uganda, Ministry of Health, Medical Services Statistical Records, 1st July 1968 to 30th June 1969 (Entebbe: Government Printer, 1969), Table 12, page 17. The changing pattern of in patient admissions between the different facility type during the period 1958-1966/67 is interesting to consider. The apportionment of admissions between the various types of facilities in 1958 was as follows: government hospitals, 47%; government rural units, 38%; and mission hospitals, 15%. This pattern shifted in 1962/63 as a result of a rapid rise in number of attendances at rural units and an increase in number of mission hospitals in 1962-63, 37% of total admissions were to government hospitals, 40% to government rural units, and 23% to mission hospitals. As more government hospital beds became available, however, and as mission hospitals slowed their expansion, the structure of inpatient admissions shifted again; in 1966/67, 44% of total inpatient cases were admitted to government hospitals, 30% to government rural units, and 26% to mission hospitals.

24. See World Health Organization, International Classification of Diseases (Geneva: World Health Organization, 1955, and revisions, 1965). All diseases have been grouped by WHO into 17 different major classifications which (a) conform to basic life systems (circulatory, respiratory, alimentary, etc.), (b) are related to a specific major disease (e.g., cancer), or (c) are related to the causality of disease (e.g., parasites, accidents, etc.).

Appendix F, Table F.1 indicates the correlation between W.H.O. classification of diseases, Uganda's classification, and the author's classification, which deviates in only one respect from Uganda's.

25. The extent of the discrepancy between manpower registration and manpower actually practicing in some form of medical service in Uganda is indicated by Bennett's estimation in 1964 that there were 375 doctors practicing in Uganda which the registration list for the same year shows 651 doctors. See F. J. Bennett; S. A. Hall; J. S. Lutwama; and E. R. Rado, "Medical Manpower in East Africa: Prospects and Problems," East African

Medical Journal, 42, 4 (April 1965), 149-161; and Mark Wheeler, "Medical Manpower in Kenya: A Projection and Some of Its Implications," East African Medical Journal, 46,2 (February 1969), 93-101.

26. Bennett et al., Medical Manpower, p. 151, estimates the urban ratio for Uganda at one doctor per 4,000 persons; the estimated rural ratio was one doctor per 26,000 persons. The ratios for Kenya and Tanzania were even more inequitable.

CHAPTER THREE

In this chapter, a relevant concept of output for health sector planning (particularly in regard to curative health services) is developed. This issue must be addressed, for without a conceptually sound theoretical formulation of the nature of the product of the health service system, a case study of the allocation of resources to such a system has little validity. The concept of output developed in this chapter will be amenable to quantitative estimation so that changes in output may be determined.[1]

Perhaps the most desirable conceptualization of health services output would relate changes in inputs into the industry (such as (a) a larger number of doctors or more hospital facilities, (b) an increase in new preventive programs, or (c) changes in the larger socio-economic environment such as increased economic output, increased literacy, etc.) to changes in an overall index of the health of the society.[2] Such an index would be desirable for any society engaged in planning its socio-economic development. Even if an optimal theoretical measure were agreed upon, however, the statistical and data collection problems are overwhelming; even the most wealthy countries have not yet developed such an index. What are the alternatives, then, that are both feasible from a statistical point of view and have theoretical support?

In the field of health economics, several measures have been used as indicators of output. Measures relating population to various types of health resources (such as doctors and other personnel, as well as facilities) have been used frequently either for health planning purposes or for international comparisons. In such contexts, a "need" perspective has permeated the planning process and has considerably reduced the analytical usefulness of the exercise.[3] These ratio measures have been utilized without reflection since they provide gross measures of the distribution of resource inputs and have no direct relation to any output measure. The use of such input measures as planning goals and, subsequently, the criteria for evaluation of implemented projects, not only assumes fixed proportions between inputs and outputs but also indicates a lack of conceptual understanding of the nature of the problem.[4] Development of an adequate conceptual framework requires clear answers to the following questions:

What are the objectives of a health service system?

What are the resource inputs into the system?

What is the production process?

What is the process producing?

Before discussing other output measures that have been used in economic studies of health services, it is important to distinguish between several types of sectors which exist within the entire health services industry. Each sector has its own resource requirements, production processes, and outputs, which develop from the principle objectives of each sector. For purposes of the analysis presented here it is appropriate to distinguish between curative and preventive health services.

In the case of preventive health services, an output concept may be derived rather readily from the rationale or objective for providing the service in the first place. Given an effective immunization program, for example, reductions in disease-specific mortality and morbidity rates comprise a fairly precise measure of the output of that particular program. An economist, however, would add another dimension to that output concept: an estimate of the economic production gained (as a proxy for an increase in welfare) as a result of the reduction in mortality and morbidity rates.[5] This gain is most commonly measured in terms of the present value of foregone income streams.[6] In cases where a given public health project is designed to eradicate a wide-spread disease such as malaria, or to change significantly an important population or demographic variable such as the infant mortality or fertility rate, it may be more important to analyze the program's effect on a society from a broader perspective which would not only take into account the program's effect on specific objectives such as disease-specific incidence rates, but also the multiple social and economic effects resulting from a major change in the incidence of the disease. In such cases, it would be important not only to identify properly the primary "outputs" of a particular project, but also to identify how these outputs are related and how the resulting effects can be measured in terms of a single variable. In the case of economic analysis, the most common variable used to measure the impact of a multiplicity of economic effects is per capita GNP.[7]

In discussing curative health services, we are primarily interested in the set of diagnostic and treatment services which are most commonly provided in the hospital or health center facility. It is within the confines of such facilities that most, if not all, curative services are provided.[8] The question which is of primary interest here is the following: what does the curative health service system produce, and what is an appropriate output measure of this production?

Review of Past Conceptual Development

In previous studies of the economics of medical care where an indicator of output was essential to the analysis, a primary objective of the analysis has been a determination of whether or not economies of scale exist in the set of medical services provided in a hospital setting.[9] In addition to such empirical studies, other analyses have focused on the concept of output from theoretical or planning perspectives.[10] Upon reading these empirical, theoretical and planning studies, several features manifest themselves. They are important in understanding the type of output concept which has been developed for a curative health services firm or industry.

First, a homogeneous measure of output has been used for two major reasons: (a) ease in analyzing the economics of a hospital within the framework of the microeconomic theory of the multi-product firm,[11] and (b) ease in applying statistical or econometric models to hospital data. The requirement of homogenity has led to the frequent utilization of one or more of the following indicators as a measure of the output of a hospital (particularly where the analysis has been limited to those services rendered to inpatients): (a) number of cases, (b) patient days, (c) bed days, or (d) patient weeks.

In analyses which have included outpatient services, common output measures used have included either (a) the number of patients, or (b) the number of patient visits.

A second feature of the commonly used "output" measures is that most of them have only an obscure relationship to the set of individuals who are the recipients of service. In measures such as patient days or number of visits, the emphasis is placed on the extent of the resources used to provide service (i.e., inputs) rather than on the recipients of service (i.e., outputs). Such measures may have a useful function in the development of certain internal management control procedures, but in the context of a broader conceptual perspective, the measures lack both comprehensiveness and adequate focus on the rationale for providing health services.

Use of one of the above-mentioned indicators of output implies that one or more of the following issues will be given only cursory attention: (a) to whom are curative health services provided; (b) why are health services demanded in the first place; (c) if human beings are the recipients of health services, is it possible then to conceive of the situation where one individual may require a different set of services than another individual, depending upon disease, age and sex characteristics; and (d) is it possible to conceive of the possibility where, for a variety of reasons, individuals may respond differently to the same set of services provided? The use of measures such as patient days, bed days, patient weeks, and patient visits do not seriously consider that health services were produced for human beings. How can the situation be improved?

Martin Feldstein, in a study of the British National Health Service, provides an important beginning towards improving the situation by rejecting the need for a homogeneous output concept and uses an output mix concept, where the mix is specified according to the type of case treated.[12] For practical reasons, Feldstein's specification of case type was defined as a result of the way in which British hospitals group patients according to major service department, or service rendered within the hospital, such as surgical, gynaecological, E, N & T, medical, etc. He suggests that specifying ouput mix according to the characteristics of disease type, age and sex may also be a theoretical improvement.

Further Conceptual Development

In discussing conceptual development, it is useful to explore a rather fundamental question, alluded to above: what is the raison d'etre of curative health services? Individuals and, increasingly, entire societies, place a rather high value on human life; when life is jeopardized by illness, resources have been committed increasingly to restoring, to the extent possible, a prior state of well-being. Most resources so committed today are for the provision of curative health services. Such services thus do not exist for themselves, but rather for the restoration of individuals who have contracted an illness.[13]

Given that curative health services have a rationale only to the extent that human beings have been afflicted and will continue to be afflicted with disease, it is important to consider the possiblity that a logically sound measure of the output of curative health services would have a direct relationship to the number of human beings who have comsumed such services. The following discussion focuses on an economic rationale for the provision of curative health services and reinforces the idea that the individual (the patient), or a set of individuals, comprises the essential basis of a relevant output concept. Additional information, related to the individual characteristics of those receiving service, as we shall see, can greatly improve the level of understanding derived from any study of health services, but the individual is primary.

The economic rationale for health services can be presented best as follows. Let us assume that there is a set of individuals -- perhaps called a society -- which, for ease of understanding, is not expanding (i.e., we rule out population growth). This set comprises the labor input for the production of all goods and services consumed by that society, assuming a closed economy. These individuals can be viewed as a stock of human capital, which presumably can be augmented by the application of education but which can also depreciate primarily as a result of aging and illness. One way to reduce the rate of depreciation is to interject a set of health services designed either to prevent certain illnesses, or to restore individuals experiencing a sickness episode, as much as possible, to their prior state of health. The latter restorative process is commonly provided by curative health services. It provides a "repair" or maintenance function for the continuance of a certain stock of human capital. Thus, in an analysis of the economic performance of the curative health services industry, an appropriate output measure must be based on the number of individuals successfully maintained or repaired during a given period of time; this group, whose rate of depreciation has been reduced, comprises a portion of the human capital stock of the society.

In addition to emphasizing the restored individual in the conceptualization of the output of a health services firm, it is also important to consider that variations in the quality of the services rendered during the treatment process can have an important impact upon the output of the health services firm. Understanding of the production process of curative health services thus is important in the development of an improved output concept.[14]

Output Specification for the Health Services Firm

An analysis of the production process can be undertaken in the following way. Each day, a number of persons with perceived sickness episodes arrive at a health facility. They seek some diagnostic service in order to determine (a) the nature of the illness and (b) the appropriate treatment services for curing or reducing the discomfort (either physically or mentally), in order to return to their primary activities and responsibilities. The number of persons seeking and securing at least one such service during a specified period of time is represented by S.

Some persons, upon receipt of one or more diagnostic services, are considered to be very sick and, assuming the resources required are available, are admitted for further services provided on an inpatient basis. Such individuals are likely to consume a different set of curative services, or at least a different amount of any given set of services, than those who are treated on an outpatient basis, primarily because the illness episode is more severe. In such cases it is useful to distinguish between the two groups initially demanding service, on the basis of treatment provided.

Returning to an analysis of the entire curative treatment process without distinguishing between the treatment intensities, we note that there are other individuals who are referred to a different facility for various reasons, such as distance from home and the availability of special types of services which cannot be provided at the original facility due to lack of staff, treatment equipment, or drugs. These individuals may receive partial treatment as outpatients in the initial facility, but cannot be considered a completed unit of output and, must be deducted from S. The potential for transfers from another facility to the given facility must also be recognized, but for convenience can be considered a part of the initial group of S individuals seeking service.[15]

There are still other persons who die as a result of their illness, regardless of the curative services rendered. (Empirically speaking, virtually all persons who die at a health facility in Uganda have been admitted to the inpatient treatment process. The location of death, however, is not important for present conceptual considerations.) Given the fact that some persons die at the health facility while in receipt of some set of curative services, it is necessary to adjust potential output to account for this occurance.

One final adjustment, proceeding from an analysis of the entire treatment process, is theoretically useful to explore. As noted in the discussion of the economic rationale for the provision of curative health services, an important objective of such services is to restore the capacity of an individual to resume his major activity. Thus, one must investigate the extent to which persons seeking and receiving medical services are able to resume their major activity subsequent to a normal recovery period. Those who are unable to resume major activities after such a period have consumed a certain set of health service resources, but cannot be viewed as economically viable output. Therefore, the cost of producing a "successfully treated" patient, e.g., one who can resume his major activity, must include the cost of those who did not benefit to the extent that they were able to resume their major activities.[16] This unsuccessfully treated set of individuals must also be deducted from S.[17]

By reducing the initial set of individuals by these groups, a net output concept for the health services firm (facility) is derived. Symbolically,

$$P = S - S_t - S_d - S_u \tag{1}$$

where S is defined as above, and

P = output of a curative health services production unit (i.e., hospital, health center, or dispensary),

S_t = the number of persons provided with a curative health service who are transferred to another health service facility for further treatment.

S_d = the number of deaths of S

S_u = the number of persons who were treated but were unable to resume their major activity subsequent to treatment.

It must be noted that the last set of individuals deducted from the initial group of persons seeking services implicitly involves a measure of the quality of medical care. The literature is lengthy on this issue and the quality of medical care has been analyzed from many points of view and by several disciplines. Physicians, for example, have been interested in whether patients receive the appropriate diagnostic and treatment services from appropriately trained staff. Nurses have been concerned with the quality of the care they provide to patients primarily on an inpatient basis. Pharmacists have been concerned with the rate of improper drug use as well as dosage. Administrators and public health officials have a general concern for the quality of the entire set of health services provided either within a given type of health firm or by the service system in general. Economists as well have considered medical care quality and changes in the quality as an important cause of relatively rapid increases in costs of medical care services.[18] It is likely that each approach to the quality of care has a rationale of its own, depending upon the objectives of the investigator and his field of specialization. Whether any approach has developed an adequate empirical measure is another issue to be determined by the available evidence.

From the perspective developed in this investigation, however, it is consistent to introduce a quality variable into the analysis which has, as its rationale, an output derivation. It seems logical for purposes of economic analysis to view the quality of any given curative health services treatment center as dependent upon the extent to which the individuals receiving services are rendered able to resume their normal major activities. In using such a measure of quality, it is recognized that persons may, for reasons other than the health services received, "get well" or remain ill. However, it is theoretically possible to measure the frequency of such occurances and thus allow for that possibility by acknowledging the asymptotic nature of the measure. By using the method of follow-up surveys of service recipients, one can derive the necessary information required to estimate values for the quality variable defined. Instead of defining the variable in terms of absolute numbers of persons who have regained the ability to perform their previous major activities, the variable may also be expressed as a probability of occurance of successful treatment among the number of initial demanders S. This method of expression generally has greater usefulness in analytical models and it is incorporated in such a manner in subsequent chapters.

Specification of the Output of Each Treatment Process

As indicated earlier, it is useful to analyze the output of the two treatment processes separately. In many countries, as in Uganda, the two basic treatment processes of a health services firm have several differences which provide an important rationale for developing a conceptual framework for determining the output of each treatment process separately. These differences induce (a) the relative seriousness of the illness of individuals treated, (b) the range of services available, and (c) differences in technical training of the manpower providing the services. The output of the total firm, thus, can be specified as some combination of outputs of the two primary treatment processes, such that,

(2) $$P = \alpha P_i + \beta P_o$$

where P is defined as above,

P_i = output of the inpatient treatment process,

P_o = output of the outpatient treatment process,

and where α and β are non-specific weights which derive meaning when a clearly defined set of objectives for the health sector has been specified. (In a typical multi-product firm, the weights would assume the values of each product's price).

A further analysis of the production process provides one with the insight necessary to specify the output of each method of treatment, P_i and P_o. Let us assume that all demanders of service enter the system as outpatient cases where initial diagnostic services are provided. Given this perspective, it is convenient to specify the output of the outpatient treatment process.

After the patient receives diagnostic services, a decision is made as to the appropriate method of treatment. For two groups of persons, subsequent outpatient treatment is considered inappropriate, particularly for those persons requiring inpatient care and those persons transferred to another facility for reasons mentioned above. These groups are deducted from the initial group of persons demanding services. Those treated on an outpatient basis but who are unable to resume their major activities subsequent to treatment must also be deducted. Thus,

(3) $$P_o = S - S_i - S_{to} - S_{uo}$$

where P_o and S are defined as above, and

S_i = the number of persons provided with at least one curative health service on an inpatient basis at a given health service facility,

S_{to} = the number of persons provided with a curative health service who are transferred, at some point in the out-patient treatment process, to another health service facility for further treatment,

S_{uo} = the number of persons who were treated on an outpatient basis but were unable to resume their major activity subsequent to treatment.

A similar derivation process can be undertaken to determine analytically an appropriate concept of output for the inpatient treatment process. The relationship between the outpatient and inpatient processes, as referred to above, takes on added significance in the development of the inpatient output concept. Some authors have noted, in analyzing the health service delivery system in the U. S., that the demand for hospital services in that country is a derived demand -- derived from the additional service requirements doctors deem essential for some of their patients in order that the individuals' major activities may be resumed.[19] A parallel situation exists in the curative health service system of Uganda, where the demand for inpatient health services is a demand derived from the provision of certain diagnostic services which are provided primarily in the initial stages of the outpatient treatment process. Thus, those persons who were deducted from the output of the outpatient treatment process due to a determination that inpatient care was required become the total potential output of the inpatient treatment process.

It is possible to determine -- in the same manner as for the outpatient treatment process -- the adjustments necessary to derive a measure of net output from the total potential output for the inpatient treatment process. In certain cases, it may be necessary to transfer patients to a more sophisticated treatment facility. (The most frequent cause of such transfers in Uganda are obstetrical or gynaecological complications). Other persons who are admitted to the inpatient treatment process die, regardless of the curative services rendered. (Without great loss of empirical validity, it is assumed that all deaths occuring at a health facility do so during or subsequent to admission for inpatient care). Still other persons are unable to resume their normal activities after receiving treatment services and for that reason, must be deducted from the initial group of inpatient health service recipients.

Symbolically, the derivation of a net output concept for the inpatient treatment process can be stated as follows:

(4) $$P_i = S_i - S_{ti} - S_d - S_{ui}$$

where P_i, S_i, and S_d are defined as above, and S_{ti} and S_{ui} are the same as S_{to} and S_{uo}, except that they refer to the inpatient treatment process rather than the outpatient process.

The Issue of Output Homogeneity

To this point, it has not been made clear whether P is a homogeneous or non-homogeneous variable. Given the specification of equation (1) and the subsidiary treatment process equations (3) and (4), it has been implied that all variables are homogeneous. However, by excluding non-homogeneous characteristics from the analysis of the output composition of a health service firm it is difficult to understand why the cost of providing service may vary between otherwise similar health services firms. Let us explore a means through which these characteristics, in accordance with Feldstein's concept of output mix, can be introduced into the analytic conceptualization of output of the treatment processes described above.

For conceptual purposes, three individual characteristics will improve the analytical usefulness of output: age, sex, and disease type. It is possible to specify a facility's output as a combination of the individual subsets of patients -- subsets which are defined by the three characteristics of interest. Let us begin by specifying a particular subset of a facility's total output. The specification of a subset of either or both treatment processes is analogous in its methodological development.

A subset of a facility's output can be denoted as follows: P_j, where the subscript j specifies the particular age, sex, and disease characteristics of that subset. Thus, $j = (1, \ldots, n)$ which includes the j possible combinations of the three characteristics of interest. Total output can thus be specified as follows: $P = \Sigma_j \gamma_j P_j$, where γ_j represents some non-specified weight of the importance or value of each P_j of the total output.

In order to determine the subset outputs, i.e., each P_j, it is necessary to disaggregate the other terms in equation (1). For example, in order to determine the net output of the subset P_{15}, which may represent the output of successfully treated males, aged 0-5 years, who suffer from a respiratory disease, it is necessary to know what proportion of the other variables, S, S_t, S_d, and S_u are males, aged 0-5 years, suffering from a respiratory disease. In a generalized form, any output subset can be determined by

(5) $$P_j = S_j - S_{tj} - S_{dj} - S_{uj}$$

The output subset for both treatment processes is similarly defined by disaggregating the variables in equations (3) and (4) for the outpatient and inpatient treatment processes respectively. Thus, for any outpatient output subset P_{oj},

(6) $$P_{oj} = S_j - S_{ij} - S_{toj} - S_{uoj}$$

and for any inpatient output subset P_{ij},

(7) $$P_{ij} = S_{ij} - S_{tij} - S_{dj} - S_{uij}$$

With the development of an age, sex, and disease-specific output, it is useful to analyze health service facilities as multiproduct firms whose total cost function is not only related to the total number of persons successfully treated (i.e., consistent with a homogeneous output concept), but more importantly, to the output mix, i.e., the proportion of total output represented by each output subset. By using this approach, one can analyze the impact which the following factors have on total cost: (1) different proportions of output as defined by the patient characteristics of that output; (2) differing proportions of output from the two treatment processes which may exist in the facility; and (3) different proportions of persons who seek health services -- assuming there is no change in the output mix in terms of treatment process proportion of total output and patient characteristics -- who are transferred, die, or are unsuccessfully treated. By using such an output conceptualization, it is also possible, from a planning perspective, to improve upon present analyses of the effect on cost of potential policy changes in the curative health services sector such as: (1) changes in emphasis as between health center and hospital development; (2) changes in government-voluntary institution relationships; (3) changes in staffing patterns; and (4) changes in the availability of (a) supporting diagnostic services, such as laboratory and radiographic facilities, and (b) drugs. In the chapter which follows, the analytical framework necessary to focus on the effects of output and policy change on the cost of delivering curative health services is developed.

Footnotes

1. It is significant that Rothenberg suggested in 1962 that increased attention be given to improving upon the output concepts then in use when analyzing health service systems. To date, this research priority has generally received only cursory attention. See, Rothenberg, J., "Agenda for Research in the Economics of Health", in The Economics of Health and Medical Care, Proceedings of the Conference on the Economics of Health and Medical Care, May 10-12, 1962, (Ann Arbor, Michigan: The University of Michigan, 1964) p. 314.

2. See Sullivan, D. F., Conceptual Problems in Developing an Index of Health, National Center for Health Statistics, Series 2, No. 17, Washington, D. C., 1966, for a discussion of the conceptualization problems involved in (and a practical second-best method for) developing such an index in one of the more economically developed countries of the world.

   The scope of this paper does not include a discussion on conceptualization problems related to the definition of health. The World Health Organization definition is admirable but unmanagable from a quantitative point of view. We concur with Wylie, M., "The Definition and Measurement of Health and Disease", Public Health Reports, 85, 2 (February 1970), pp. 100-104, and Sullivan, D. F., op. cit., that a more limited definition of health which focuses on changes in mortality and morbidity, or on what may be termed minimization of sickness episodes, is a positive first step in developing more adequate indices.

3. See Boulding, K. E., "The Concept of Need for Health Services," Milbank Memorial Fund Quarterly, 44, 4, Part 2 (October 1962), pp. 202-224.

4. See King, M., editor, Medical Care in Developing Countries: A Primer on the Medicine of Poverty and a Symposium from Makerere, London, Oxford Univeristy Press, 1966, p. 1:10a. King describes the conceptual problem in the following way: it "is equivalent to a motor manufacturer trying to maximize not his output of vehicles, but the number of his workers and the size of his factory." It is unfortunate that a subsequent study of the development of health services in Malawi, he commits the mistake he earlier warned against by defining objectives in terms of input measures.

5. See Feldstein, M., "Health Sector Planning in Developing Countries," Economica, New Series, 37, 146 (May 1970), pp. 139-163 and Weisbrod, B., Economics of Public Health: Measuring the Economic Impact of Diseases, Philadelphia, University Press, 1968.

6. In addition to mortality and morbidity (in terms of a loss in the ability to perform major activities such as work), Selma Mushkin identifies another way in which sickness can effect labor productivity. She describes it as debility -- the loss of productive

capacity to perform a major activity even though one is still able to perform it. Unfortunately, the debility concept has not been defined operationally nor have indices been developed to measure its magnitude. See Mushkin, S. J., "Health as an Investment," Journal of Political Economy, 70, 5, Part 2 (October 1962), pp. 138-143.

7. See Barlow, R., The Economic Effects of Malaria Eradication, Ann Arbor, Michigan School of Public Health, University of Michigan 1968, and Coale, A., and Hoover, E., Population Growth and Economic Development in Low Income Countries, Princeton, New Jersey, Princeton University Press, 1958, as examples of empirical studies using per capita income as the primary variable of analysis.

8. I am aware that in some western countries, e.g., the U. S., a great number of diagnostic services are provided by doctors outside the confines of such facilities, but for the purposes of the present analysis, it is easy to conceive of an institutional situation where all diagnostic services occur within the confines of the hospital or health center framework. Alternatively, one may view private doctors' offices as adjuncts to the rest of the curative service framework.

9. For example, see Feldstein, M. S., Economic Analysis for Health Service Efficiency: Econometric Studies of the British National Health Service, Amsterdam, North-Holland Publishing Co., 1967; Feldstein, P. J., An Empirical Investigation of the Marginal Cost of Hospital Services, Chicago, University of Chicago, 1961; Lave, J., and Lave, L., "Hospital Cost Functions," American Economic Review, 60, 3 (June 1970), pp. 379-396; and Ingbar, M. L., and Taylor, L. D., Hospital Costs in Massachusetts: An Econmetric Study, Cambridge, Massachusetts, Harvard University Press, 1968.

10. See Abel-Smith, B., Paying for Health Services, A Study of the Costs and Sources of Finance in Six Countries, Public Health Papers No. 17, Geneva, World Health Organization, 1963; Feldstein, M. S., Economic Analysis for Health Service Efficiency: Econometric Studies of the British National Health Service, Amsterdam, North-Holland Publishing Co., 1967; Feldstein, J., Research on the Demand for Health Services, reprinted from Milbank Memorial Fund Quarterly, 44, 3, Part 2 (July 1966), by the Health Services Research Study Section of the United States Public Health Services, 1966; King, M., op. cit.; Newhouse, J. P., "Toward a Theory of Non-profit Institutions: An Economic Model of a Hospital," American Economic Review, 60, 1 (March 1970), pp. 64-75; Health Planning: Problems of Concept and Method, Washington, D. C., Pan American Health Organization, Pan American Sanitary Bureau, Regional Office of the World Health Organization, April 1965 (scientific publication No. 111); and Statistics of Health Services and of their Activities, Thirteenth Report of the WHO Expert Committee on Health Statistics, Geneva, World Health Organigation, 1969 (Technical Report Series No. 429).

11. This is not meant to imply that all such applications are not useful for developing a better understanding of certain aspects of the economics of hospitals.

12. Feldstein, M. S., Economic Analysis for Health Service Efficiency: Econometric Studies of the British National Health Service, Amsterdam, North-Holland Publishing Co., 1967. The output mix concept was introduced into the literature at this same time by P. D. Bonnet, "Increased Production and Better Utilization", Report of the National Conference on Medical Costs, June 27-28, 1967, U. S. Department of Health, Education and Welfare, Washington, D. C., 1969.

13. I am aware that some illnesses may not be thought of as "real", but demands are placed on the service system irrespective of the scientific reality of some conditions.

14. See Donabedian, A., "Evaluating the Quality of Medical Care", in Shulberg, H. C.; Sheldon, A.; and Baker, F., eds., Program Evaluation in the Health Fields, New York, Behavioral Publications, 1959, pp. 214 and 215 for a similar point of view. The essence of Donabedian's view is as follows. "Greater neutrality and detachment are needed in studies of quality. More often one needs to ask, 'What goes on here?' rather than, 'What is wrong; and how can it be made better?' ....Emphasis must be shifted from preoccupation with evaluating quality to concentration on understanding the medical care process itself".

15. For certain analytical purposes, however, it may be useful to include them in the analysis as a specific group, to be included in a final net transfers figure.

16. The major activities concept has been developed by the National Center for Health Statistics for the United States National Health Survey. It can be operationally defined for any society to conform to the social and cultural roles expected of each age and sex group. The concept does not specify a minimum level of role performance, nor, if the activity is basically an economic one, does it specify a minimum productivity performance. Thus the concept as presently defined and as it is used in the present research, is related solely to a morbidity measure, rather than to a measure combining morbidity and debility. See footnote 6.

17. This argument does not imply that certain persons, as a result of a poor initial prognosis or any other reason, should be denied health services; they are unfortunate, as determined by the technical capabilities of the given set of health services. However, if the age, sex and disease specific rate of occurance is known and monitored over time by staff involved in the delivery of health services, perhaps incentives -- internal or otherwise -- would develop to initiate a reduction in such rates.

18. See Barker, K., Kimbrough, W., and Heller, W., _A Study of Medication Errors in a Hospital_, University of Arkansas, University of Mississippi Press, 1968; Donabedian, op. cit., Feldstein, M. S., _Economic Analysis for Health Service Efficiency: Econometric Studies of the British National Health Service_, Amsterdam, North-Holland Publishing Co., 1967; Shapiro, S., "End Result Measurements of Quality of Medical Care", _Milbank Memorial Fund Quarterly_, 45, 7 (1967); Sheps M. D., "Approaches to the Quality of Hospital Care", in Shulberg, H. C.; Sheldon A. and Baker, F., eds., _op. cit._, pp. 286-303, and Thompson, J. D., Marquis, D. B., Woodward, R. L., and Yeomans, R. C., "End-Result Measurement of the Quality of Obstetrical Care in Two U. S. Air Force Hospitals", Medical Care, 6, 2 (March-April 1968), p. 131. On the issue of quality, see also, _Statistics of Health Services and Their Activities_, WHO Technical Report Series #429, pp. 29-31.

19. See Feldstein, P. J., _Research on the Demand for Health Services_, reprinted from _Milbank Memorial Fund Quarterly_, 44, 3, Part 2 (July 1966), and Hixson, J. S., _The Demand and Supply of Professional Hospital Nurses_: _Intra-Hospital Resource Allocation_, an unpublished Ph.D., dissertation, Michigan State University, East Lansing, Michigan, 1969.

CHAPTER FOUR

In Chapter Three, the production process of a health facility was discussed in order to focus on the concept of output for the health service industry; this chapter will explore the relationship between outputs, inputs, and services which exist in the health service firms of Uganda. At the present time little empirical or theoretical work has been conducted on these basic relationships to improve the understanding of how this service system operates. Without this basic knowledge, attempts at planning the future development of the health services - in light of the government's recently announced rural development strategy - or analyses of potential health policy changes will be conducted on an *ad hoc* basis.

Thus, the objectives for this chapter are (a) to develop a theoretical framework which will enable health and economic planners to understand the relationships between the inputs and outputs of the curative health service system and (b) to develop the theoretical framework which will encourage health planners to consider changes in population growth, disease mix, and the rate of economic growth as they evaluate the short and long run effects of health policy. In the next chapter empirical investigations are conducted which use the methodology developed in this chapter.

Statement of the Problem and a Consideration of Alternative Methodologies

In order to improve the understanding of the relationship between the output produced and the resources used in providing health services, it is useful to analyze the production processes which are found in differing health service firms. An introduction to this analysis is found in the previous chapter and these relationships are formalized later in this chapter.

Given that the production relationships existing in Uganda's health service system can be adequately described, the theoretical development turns to an exploration of potential performance indicators which can be used by society to determine the efficacy of alternative institutional mechanisms which provide health services. Assuming that certain economic and curative health policies have been and will be implemented in the country, the analysis then turns to exploring the output and cost implications of these policies. The analytical framework is specified such that the implications can be made explicit for a ten year planning horizon.

The relevant question to raise at this point is, given the problem objectives formulated above, what are the potential methodological frameworks which can be employed and which is the most efficient? Although the question posed above can be formulated as a fairly standard production problem faced by the optimizing firm or industry, the fact that (a) the problem is complicated by the multi-product nature of health services firm and (b) the exercise has a raison dêtre in terms of improving the managerial and planning capacity of the Ministry of Health and other health sector decision makers, it is useful to explore a methodology appropriate for the attainment of such objectives. Therefore, instead of employing the analytical framework based on usual theoretical and mathematical assumptions such as (1) continuous and differentiable and (2) convexity, which was done by Pfouts[1] and further explored by Weil[2] for a multi-product firm, the application of programming methodologies is more appropriate.[3]

In recent years a body of literature has developed in which the problems of resource allocation in the health care sector has become subject to increasing analysis. The techniques of linear programming, operation, research, and systems analysis have been increasingly used to conduct such analyses.[4] Although it is argued in Chapter Three that most analyses of health services conducted in the past have not adequately specified the output of curative health services, and as a result have not adequately specified the objective function of health services, the formulation of the resource allocation problem in a programming framework has assisted in developing a better understanding of some of the production relationships existing in different types of organizations used in the provision of health services. By respecifying the objective function in a more appropriate manner for use in linear programming analyses of the health service system, it is envisioned that the problems of previous studies which have employed programming techniques can be overcome, thus enabling such techniques to be profitably employed.

After an initial section of the chapter in which the formal production relationships found in Uganda's three main types of curative health service firms - the hospital, the health center, and the sub-dispensary - are schematically developed, the analysis turns to developing a linear programming framework for use in analyzing the curative health service system. In the first instance, the production activities and constraints are described, after which, a detailed statement explores alternative objectives which may be used in developing a maximand for the model. The model is then specified in such a way that it incorporates both the importance of quality of the health services in the objective function, as well as the cost of providing the services for purposes of managerial control and planning. Finally, the model is respecified in order to analyze some of the important factors affecting the health service system over time. In this context, the use of such techniques as recursive and parametric linear programming can be employed as a "...useful tool for both descriptive and predictive inquiry". [5]

Production Process of the Health Service System

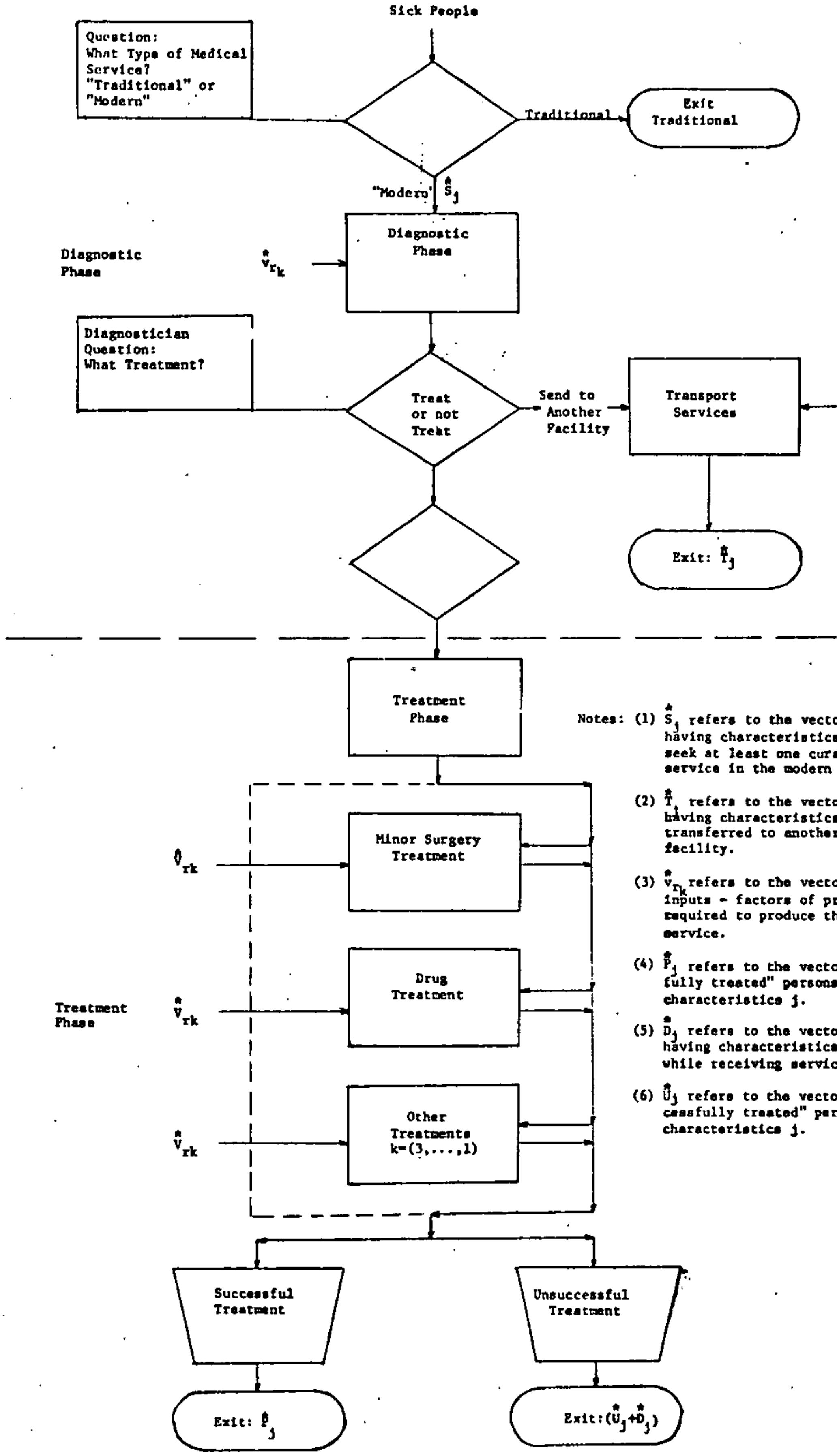
As noted in the previous chapter, the production of curative health services in all facilities can be viewed as a process consisting of two phases: the diagnostic phase and the treatment phase. Resources (denoted v_r, where $r=(1,\ldots,m)$) such as medical personnel and supplies are allocated between these two phases of the production process.

Within each phase of the production process, a set of services is provided to a certain proportion of the total number of persons demanding curative service. In the rural facilities (Figures 4.1 and 4.2), the only service provided in the diagnostic phase is the diagnostic consultation by trained auxiliary personnel (medical assistants). This diagnostic service has the following components:

(a) discussion related to the patient's medical history;

(b) notation of primary symptoms;

(c) a decision to treat at the local facility; and if treatment



Notes: (1) $\hat{S}_j$ refers to the vector of persons having characteristics j, and who seek at least one curative health service in the modern sector.

(2) $\hat{T}_j$ refers to the vector of persons having characteristics j who are transferred to another health facility.

(3) $\hat{V}_{r_k}$ refers to the vector of medical inputs - factors of production - required to produce the k^{th} curative service.

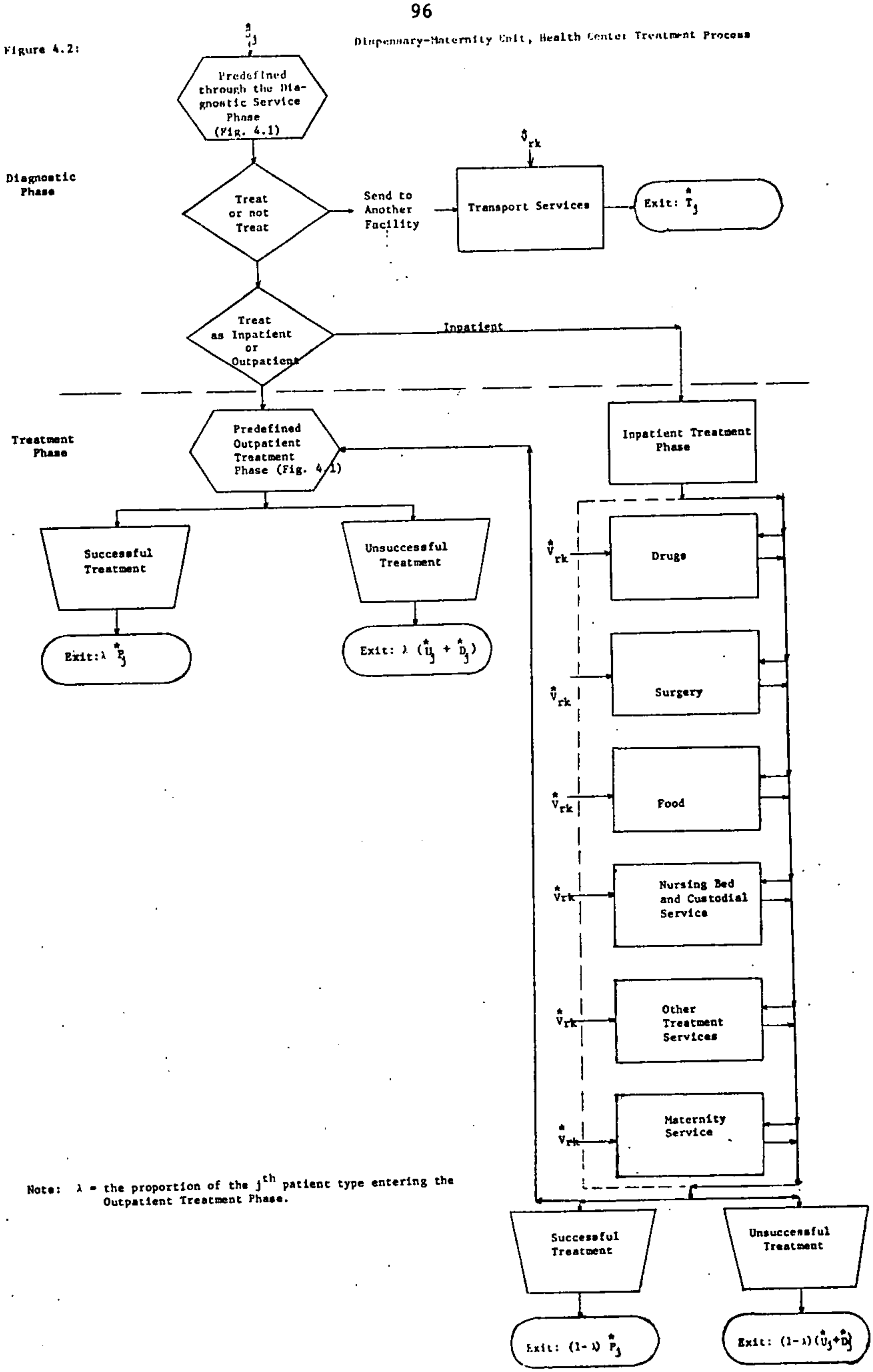
(4) $\hat{P}_j$ refers to the vector of "successfully treated" persons having characteristics j.

(5) $\hat{D}_j$ refers to the vector of persons having characteristics j who die while receiving services.

(6) $\hat{U}_j$ refers to the vector of "unsuccessfully treated" persons having characteristics j.

Figure 4.1: Sub-dispensary and Aid Post Outpatient Treatment Process

Figure 4.2: Dispensary-Maternity Unit, Health Center Treatment Process



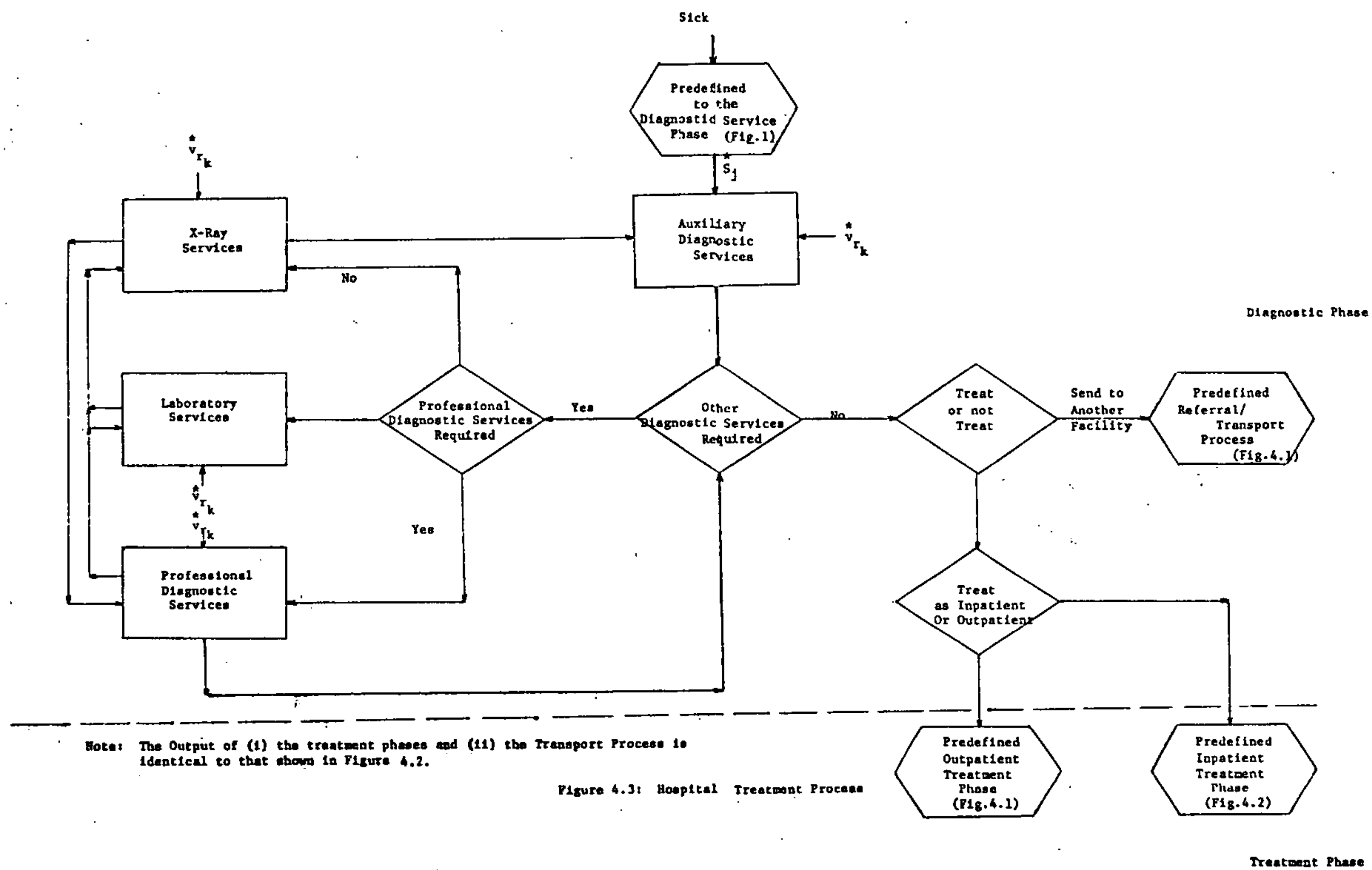
Note: λ = the proportion of the j^{th} patient type entering the Outpatient Treatment Phase.

is to occur,

(d) a decision concerning the amount and type of treatment services.[6]

In both government and mission hospitals, the diagnostic phase is not only characterized by the diagnostic services performed by auxiliary (non-professional) manpower, but also includes supporting services: professional diagnostic, laboratory, and radiographic services. As noted in Figure 4.3, all persons demanding curative service at a hospital first receive diagnostic services from trained auxiliary personnel. The auxiliary then must decide whether to use one or more supporting services. If the patient receives laboratory or radiographic services, he returns to the diagnostician who requested such services. Upon completion of the diagnosis, a decision is made whether to treat, and, if it is to treat, then the appropriate set of treatments is determined.

In the treatment phase, services are designed to restore health or minimize the effect of the illness episode. The demands placed upon the various treatment services available at the health facility are determined by the diagnostician. As a result of training and practice, medical personnel--both professional and auxiliary--have developed a standardized set of treatments for given diagnoses.[7] In the Figures 4.1, 4.2, and 4.3, however, a specific set of treatment services for a given disease has not been specified; the range of the important treatment services is noted, and the direction of flow indicates that a person may receive any one or all of these services in a variety of sequences (depending upon decisions made by the diagnostician) while in the treatment phase.



Note: The Output of (i) the treatment phases and (ii) the Transport Process is identical to that shown in Figure 4.2.

Figure 4.3: Hospital Treatment Process

The diagnostician in hospitals and larger rural units has one additional decision to make; he must determine whether to treat the individual on an inpatient or outpatient basis. If he decides to admit the individual for inpatient treatment, two additional treatment services are provided: (a) a composite nursing, bed, and custodial service, and (b) food services. (In addition to these services, there is a separate maternity service).

Upon receipt of the prescribed treatment services, the patient leaves the health service system. After passage of a normal recovery period, the output of the system can be determined: some individuals respond to treatment and recover, while others, for a variety of reasons (discussed in Chapter Three) do not recover. Exit from the system for each firm type is shown in each figure; each type of exit is specified as some proportion of the total number entering the system.

In each of the three figures, transportation to another health facility (necessitated by a diagnostician's decision not to treat an individual at the given facility) is shown as a supporting service.[8] The availability of this particular service, however, is subject to substantial variability throughout the country. All government hospitals have one or more ambulances which are used to transport patients from one facility to another; in addition, each district has one or more ambulances, the number depending primarily on the districts' budget constraints. Where a district has more than one ambulance, some are usually stationed at specific rural units. Where government ambulance transport is not available or cannot be relied upon, use is made of private transport (busses or taxis) which operate throughout the country.

Linear Programming Model

Assumptions

Before analyzing Uganda's health service system in the context of a linear programming model, it is important to discuss two central assumptions - linearity and certainty - which underlie this methodology. The assumption of linearity is particularly important, as it implies a production process characterized by constant returns to scale. It is assumed here that constant returns to scale are realized by each major firm type over the relevant range of production.[9] The assumption of linearity also requires that constraint relationships be expressed in a linear manner (or at least that linear approximation procedures be used) and that there be some approximation of reality.

The second assumption, certainty, requires that the values of parameters such as prices are known and do not vary. This assumption is important for determining a particular solution to a problem. The assumption can be relaxed, however, by using parametric programming or an other nonlinear programming technique to analyze consequences of changes in important policy parameters. Although no real world system completely conforms to the two assumptions of the linear model, it provides a convenient framework for understanding some of the important production relationships of health services and highlights some of the policy issues which must be confronted in the years ahead.

Constraints Related to the Production Process

Over any time period, a certain number of persons demand services from a given health service firm i, $i=(1,\ldots,o)$. As noted in Chapter Three, these persons, P, can be subdivided into subsets according to age, sex and disease, denoted by the subscript j. (Each $j\underline{th}$ subset of P is specified as p_j.) Each firm can then be viewed as engaging in the production of j curative activities, $j=(1,\ldots,n)$, where the intensity of each activity is measured in terms of thousands of successfully treated persons who have received health services at that firm.[10]

In order to operate any set of health services for the production of j activities, each firm requires a set of inputs, r. In the short run, (e.g., a year) some inputs, such as trained medical manpower and buildings to house the firm's operations, are limited and cannot be increased by increased expenditure (i.e., the short run supply function is inelastic). Other inputs, such as drugs and equipment, can be increased by increased expenditure to the point where the relevant budget constraint (central government, local government, or mission) limits the procurement of these inputs. Thus, for any given firm i in the health service system, there exists some maximum quantity of each input v_{ri}, $r=(1,\ldots,m)$ available for the production of a set of health services k, $k=(1,\ldots,l)$ leading to the successful treatment of persons demanding medical care. One subset of elements in the input vector is comprised of persons initially demanding service...,i.e., S where $S=\Sigma_j S_j$. Thus, for $\overset{*}{V}$ (vector of inputs with m elements), the first set of elements $V_1=(1,\ldots,(m-n))$, comprise the service providing inputs: i.e., medical personnel, drugs, equipment, etc. The second set of elements, $V_2=\overset{*}{S}=((m-(n-1)),\ldots,m)$, represents the number of each j type person demanding curative health care.

For a given firm i, some quantity of the $r\underline{th}$ input is required to provide one unit of curative service k. This quantity is denoted m_{rk}. In order to operate each j activity at unit intensity (i.e., 1,000 persons with the set of characteristics successfully treated) in firm i, some quantity (defined in units of service) of service k is required. This quantity is specified c_{kj}. Each c_{kj} reflects present medical knowledge about the diagnostic and treatment services required for the successful treatment of each j activity.

In the case of the multi-product health service firm, where each output may require a different definition of the term "one unit of service k" and where the specified service (as in the case of drugs) is an amalgamation of related services, it may be required that the concept of one unit of service for each k service be standardized in terms of one of the j activities. For example, in the case of diagnostic service, one unit of service can be defined as the amount of a diagnostician's time required to diagnose a case of clinical malaria; in the case of a heterogeneous service such as drugs, however, there are at least two possible methods for dealing with the situation: (a) divide the heterogeneous service into homogeneous sub-sets, such as by detailed drug type and strength, or (b) homogenize the service by the use of prices and weights, and standardize the unit of service according to one of the j output activities. The standardized unit of service is specified operationally in the next chapter for each service.

Finally, for any firm i, a_{rj} is the amount of input r required to operate activity j at unit intensity. The magnitude of each a_{rj}, is thus determined as follows:

(1) $a_{rj} = \Sigma_k\ m_{rk}\ c_{kj}$

In the production of the j activities, the health service firm can use any one or all of the r inputs to the point where it has exhausted the maximum available quantity of that input. This relationship is formally expressed in the following way:

(2) $\Sigma_j\ a_{rj}\ p_j < v_r$

or, using matrix notation,

$A\overset{*}{P} < \overset{*}{V}$

where $\overset{*}{V}$ = vector of elements v_r,

$\overset{*}{P}$ = vector of elements p_j, and

A = matrix of elements a_{rj}.

For the second set of elements of vector $\overset{*}{V}=\overset{*}{S}=(m-(n-1),\ldots,m)$ which can also be more conveniently specified $\overset{*}{S}=(1,\ldots,n)$, the available quantity of each j type person must be exhausted in the production process. This requirement formalizes the situation in Uganda in which all persons demanding medical care are provided with some service.[11] Equation (2) can be rewritten to account for such a requirement as follows:

(2a) $\Sigma_j\ a_{rj}\ p_j < v_r$ and where $r=(1,\ldots,(m-n))$ and $m>n$,

(2b) $\Sigma_j\ a_{rj}\ p_j = v_r$ where $r=((m-(n-1)),\ldots,m)$.

Equation (2b) can be simplified by splitting the input vector $\overset{*}{V}$ into its 2 component parts. It was shown above that the second set of elements in vector $\overset{*}{V}$ can be respecified as $\overset{*}{S}$ which is comprised of n elements. Therefore, it is possible to rewrite (2b) as follows:

(2c) $\Sigma_j\ a_{rj}\ p_j = s_j$ where $j=(1,\ldots,n)$ and where the elements $s_j=v_r$ for every $r=((m-(n-1)),\ldots,m)$.

Significance of the Technical Coefficients a_{rj} of the Second Set of Elements of the $\vec{V}$ Vector

The a_{rj}'s in equation (2b) and (2c) are significant in that they represent a technical relationship between successfully treated persons and the total number of persons initially demanding service. Using the formulation of (2c), each a_{rj} represents the inverse of the proportion that each p_j is of the corresponding s_j, such that $\frac{1}{a_{rj}} = \frac{p_j}{s_j}$, where $j=(1,\ldots,n)$ and where $\frac{p_j}{s_j}$ = the rate of successful treatment.[12]

Those persons who exit from the system prior to (or without) being successfully treated, comprise a proportion of p_j equal to $a_{rj} -1$. This group of unsuccessfully treated persons for any activity j, $1-a_{rj}$, can be disaggregated into its component parts: (a) T_j - the number of persons transferred to another health services firm for treatment, (b) U_j - the number of persons unsuccessfully treated,[13] and (c) D_j - the number of persons who die in the process of treatment. Thus,

$$(3) \qquad a_{rj} - 1 = \frac{s_j}{p_j} - 1 = \frac{T_j+U_j+D_j}{p_j} .$$

Since the p_j are, in practice, not readily observable, it is useful to specify the a_{rj}'s in terms of other variables. With a little algebraic manipulation, it can be seen that:

$$(4) \qquad a_{rj} = \frac{s_j}{s_j-(T_j+U_j+D_j)}.$$

The s_j's, T_j's and D_j's are readily observable from data available at each health facility, and an estimate of U_j can be derived from patient follow up studies.[14]

The production constraints for the health service system as a whole, i.e., all i firms or production units, can be written as in equation (2).[15] The summation of firms will take the following form:[16]

i = firms $(1,\ldots,o)$,

$i = (1,\ldots,h)$ where $i<h$ = hospitals,

$i = (h+1,\ldots,q)$, where $h<i<q$ = rural units with inpatient treatment services, and

$i = (q+1,\ldots,o)$, where $q<i<o$ = rural units with no inpatient treatment services.

Objective Function of the Health Service System

In order to evaluate the performance of any organization or activity of society, criteria for evaluation must be established. In the case of business organizations, the criterion most often used is profit performance. Thus, in most economic models, profit maximization (or cost minimization) has been incorporated into the objective function for performance evaluation. From an economic point of view, the use of such a uni-dimensional objective function provides a powerful tool for analyzing the economic consequences of various strategies of operation.

Optimally, it would be useful to specify a similar objective function for evaluating the health service system in Uganda, where the objective could be specified in terms of maximizing net benefits associated with the output of health services, or in terms of maximizing the rate of economic growth measured by GDP or GDP per capita.[17] Feldstein recently specified an objective function for the allocation of scarce resources in the health sector, particularly among disease-specific control programs as a maximization of benefits derived from (a) reduced mortality, (b) reduced morbidity, and (c) reduced economic loss resulting from (a) and (b).[18] By including more than one item in his objective function, Feldstein allows for the fact that health services are not provided solely on economic grounds, although he translates the benefits of the reduced mortality and morbidity into a single economic measure in this third item.[19] Unfortunately, detailed epidemiological data (such as age and disease specific mortality and morbidity rates, by type of treatment) are not readily available in Uganda or in many other less developed countries. In addition, detailed information on (1) employment and earnings, (2) labor force participation rates, and (3) physical capacity impairment which are comparable across disease groups is difficult to acquire in most less developed countries. Thus, it is not yet possible to develop indices which can monitor changes in future income streams.

It is even more difficult to conceptualize the potential economic benefits derived from the provision of curative (rather than preventive) services. Theoretically, administration of an appropriate set of curative services to an individual suffering from a particular illness should reduce the length of the illness episode and the probability of death caused by the illness; subsequent debilitating effects of an illness episode would also, in theory, be reduced by the administration of curative services.[20] As a practical matter, however, there is no epidemiological data to support the existence of the relationships as postulated. Until additional research is conducted on the effects of health services on economic development, particularly in regard to developing sensitive measures of economic activity in rural areas,[21] specification of the objective function of health services in terms of maximizing a set of economic benefits or in terms of their contribution to economic growth is not realistic.

Inability to specify the objective function in terms of the net contribution of curative health services to economic growth, however, does not diminish the necessity for evaluating the performance of the health service system. During the last five years, several statements have been made by Ugandan officials indicating a variety of objectives for the health sector. These objectives as related to curative services are:

(a) equality of access to health facilities, a medical unit in every sub-county (gombolola);[22]

(b) minimization of costs;[23]

(c) expansion of facilities;[24]

(d) reduction of uncertainty, inconvenience, and misery resulting from inadequate health facilities; (a quality maximization goal is implied in this objective);[25]

(e) equalization of the delivery of medical care, i.e., a balanced expansion of all factors of production;[26]

(f) equalization of per capita expenditures, (and, implicitly, resource distribution) on health between districts.[27]

These six objectives can be restated in broad goals for the curative health service system: (a) equity of access to facilities and equality of geographic distribution of expenditures; (b) quality care; (c) cost minimization; and (d) system expansion. Two other policies underlie the curative health service system; (a) all persons are provided at least some service upon demand, and (b) no fee is charged for medical services at government facilities, except for extra amenities.[28]

At any given point in time, where investment decisions are not being considered, objectives for performance evaluation of Uganda's health service system can be reduced to quality of care and cost minimization. Over time, however, the two other objectives, equity and expansion (which are affected by investment decisions) must also be considered, particularly in light of their potential impact on the objectives of quality and cost minimization. By specifying the objective function in terms of these items and related constraints, the linear programming model of the health services system is complete for any time period t.

If we follow M. Feldstein's lead [29] and specify the budget as one of the production constraint variables for every firm in the curative health service system,[30] then part of the incentive to minimize costs in any firm in the industry is reduced, given a constant production technology. The incentive for any firm to minimize treatment costs manifests itself only when the number of persons demanding service is so large that there is a high possibility of exhausting the supply of certain important treatment items such as drugs (e.g., penicillin or chloroquine) or diagnostic time (which usually manifests itself in the length of the que). Although the potential for cost minimization across firm types at any point in time is constrained by the administrative structure of the health service system in Uganda, it can be assumed that the budget for each firm in any given year encompasses the cost minimizing objective. Over time, this objective manifests itself in the development of expansion strategies and in the extent to which the two basic levels of governmental administration (national and district) cooperate.[31] This cooperation can be measured by the extent of (a) intergovernmental financial flows, (b) staff secondment, (c) priorities for competing health manpower training programs, and (d) the relative rates of expansion of different types of health services firms, i.e., health centers visa vie hospitals.

The objective function for any firm i in time period t, thus, can be stated in terms of the quality objective, with the other items entering the situation over time or as constraints on the maximization of the rate of successful treatment.

Specification of the Quality Objective

There are at least three ways in which the objective function can be specified in terms of quality. If the objective within each health facility is to maximize the rate of successful treatment, it is necessary for policy-makers to decide whether the rate to be maximized is (a) the aggregate rate of successful treatment for the entire output set, (b) the rate of successful treatment of every jth type of disease, or (c) an equal rate of successful treatment for each jth type of output.

The first possibility implies a bias toward diseases which are most common, where medical technology is available to provide ready cures. Such an objective would likely encourage health service personnel to reduce the number of persons who attend having diseases which are more difficult to diagnose or which require lengthy treatment or expensive inputs.

The second possibility implies an incentive to diagnose and treat each person demanding service with great care - the individualistic approach to medicine. In this case, there would likely develop a preference to send persons to more sophisticated facilities if there is a possibility that the person cannot receive appropriate services at the initial facility. Difficult cases, as perceived by those responsible for treatment, could well be discouraged from seeking modern medical treatment at government facilities.

The first two possibilities, however, are mitigated by the requirement that all demanders of curative care receive some service. Also, any desire to discourage people from attending is likely lessened by the following factors: (a) interpersonal equity, i.e., political and humanitarian consideration, (b) lack of options for alternative modern medical treatment (this situation pertains in certain areas of the country), and (c) other medical and public health goals, which aim at reducing the incidence of disease.

The third possibility, an equal rate of success applied to all j activities, also has some problems. The main difficulty is that medical technology has not developed treatments which have a high probability of cure for some diseases as cancer or cardiovascular disease or in some infectious and parasitic diseases, such as bilharziosia or cholera.[32] This is opposed to the situation of some uncomplicated cases, such as conjunctivitis or minor infections, where certain available medications can quickly and effectively treat the disease such that there is a high medical probability of success.

An alternative strategy implying a quality objective is that which maximizes the total number of successfully treated patients, given the vector of initial demanders. This strategy not only incorporates the quality variable (rate of successful treatment) but does so by maximizing output. By couching the objective function in this manner, the quality variable maximized is an overall rate of successful treatment which may differ across firms, depending on the age, sex and disease characteristics of the initial demanders of service. This approach to the quality objective is consistent with the rationale presented in Chapter Three (for providing curative health services) which focussed on a conceptualization of human capital stock.

Unfortunately, the implied quality variable maximized suffers from the bias leveled at the first possibility discussed above, namely that "easy to cure" diseases are favored over others. However, the factors enunciated above which mitigate against that bias can be explicitly incorporated as constraints into the model. In addition, the rate of transfer for particular disease, age, and sex subsets of initial demanders from rural health facilities to hospitals can be monitored in order to determine the extent to which quality medical care is being provided to all service demanders. Also, the objective of output maximization provides an incentive for the staff to provide high quality care in order to continue to attract large numbers of initial service demanders. Finally, if the personal characteristics of the vector of initial service demanders and successfully treated patients change in any significant way, particularly in terms of significant deviations from epidemiological research findings about disease specific incidence rates, then modifications must be made in terms of imposing minimum service targets to specific populations.

Where the objective function is consistent with output maximization, the objective of the curative health services industry is to maximize the value Z for any time period t, where $Z = Z(\overset{*}{P})$. In linear form, the function can be stated as follows:

(5) $$\max Z = \Sigma_j \; P_j = \overset{*}{P}.$$

When specified in this manner, each jth activity is valued equally in the objective function.[33] However, we know from the above discussion that $\overset{*}{S}=\overset{*}{A}\overset{*}{P}$ for elements j, j=(1,...,n). Thus, for a given vector of j types of persons demanding health services, the output vector $\overset{*}{P}$ is determined by the vector of individual rates of successful treatment for every jth patient category. When the objective function is re-specified as follows,

$$\text{(6)} \qquad \text{Max } Z = \frac{\overset{*}{S}}{\overset{*}{A}}$$

it can be seen that the values of the individual rates of successful treatment which comprises the elements of vector $\overset{*}{A}$ act as a set of weights which manifest themselves as a result of (a) past and present decisions as to resource allocation in the health field, and (b) past and present medical technology, embodied in the equipment and facilities presently available and in the medical knowledge of the present supply of medical manpower.

Individual rates of successful treatment may be changed by administrative and medical decisions related to resource allocation. Presumably with more intensive application of resources or a greater range of services available, in addition to increased use of auxiliary services in the diagnostic phase (e.g., laboratory services), the rates are manipulable, given appropriate changes in medical policy. Most changes in policy, however, are not without corresponding increases in total cost. Therefore, change in any given a_j has an implicit price, i.e., the marginal cost of a change in quality as measured by the rate of successful treatment.

Graphic Example of the Analysis

The implications of the above analysis can be made clearer by turning to the three quadrant diagram 4.4. In order to present the analysis in diagramatic form, it is necessary to make several simplifying assumptions. First, one can either view the output P in quadrants (1) and (2) as a homogeneous output, such as the total number of successfully treated patients (disregarding for the present the disease mix and other distingishing personal characteristics), or as one of the elements of the activity vector p_j, holding the other n-1 activity elements constant. For purposes of exposition, let us assume the former, that P is a homogeneous output. Secondly, it is necessary to assume that those who initially demand service comprise a homogeneous input denoted s_j. This simplification is synonymous with the assumption made above for output. Although the immediate analysis is couched in terms of an individual health services firm, industry-wide implications of the analysis are discussed.

In quadrant (1), an assumed production relationship between outputs P and the health service producing inputs v_r is shown for a given health service firm operating with a given medical technology, e_o.[34] If an improvement in medical technology occurs, e.g., to e_1, such that $e_1 > e_o$, then the production relationship shown in quadrant (1) would shift up to the locus denoted e_1.

Turning to the quadrant (3), a set of alternative relationships between the service providing inputs v_r and the initial service demanders s_j is shown. For illustrative purposes, three relationships are included where $(\frac{v_r}{s_j})_o > (\frac{v_r}{s_j})_1 > (\frac{v_r}{s_j})_2$. The ratio of the two inputs v_r and s_j is constant along the entire ray. If, during any given time period t, where the level of v_r is fixed at $(v_r)_o$, the

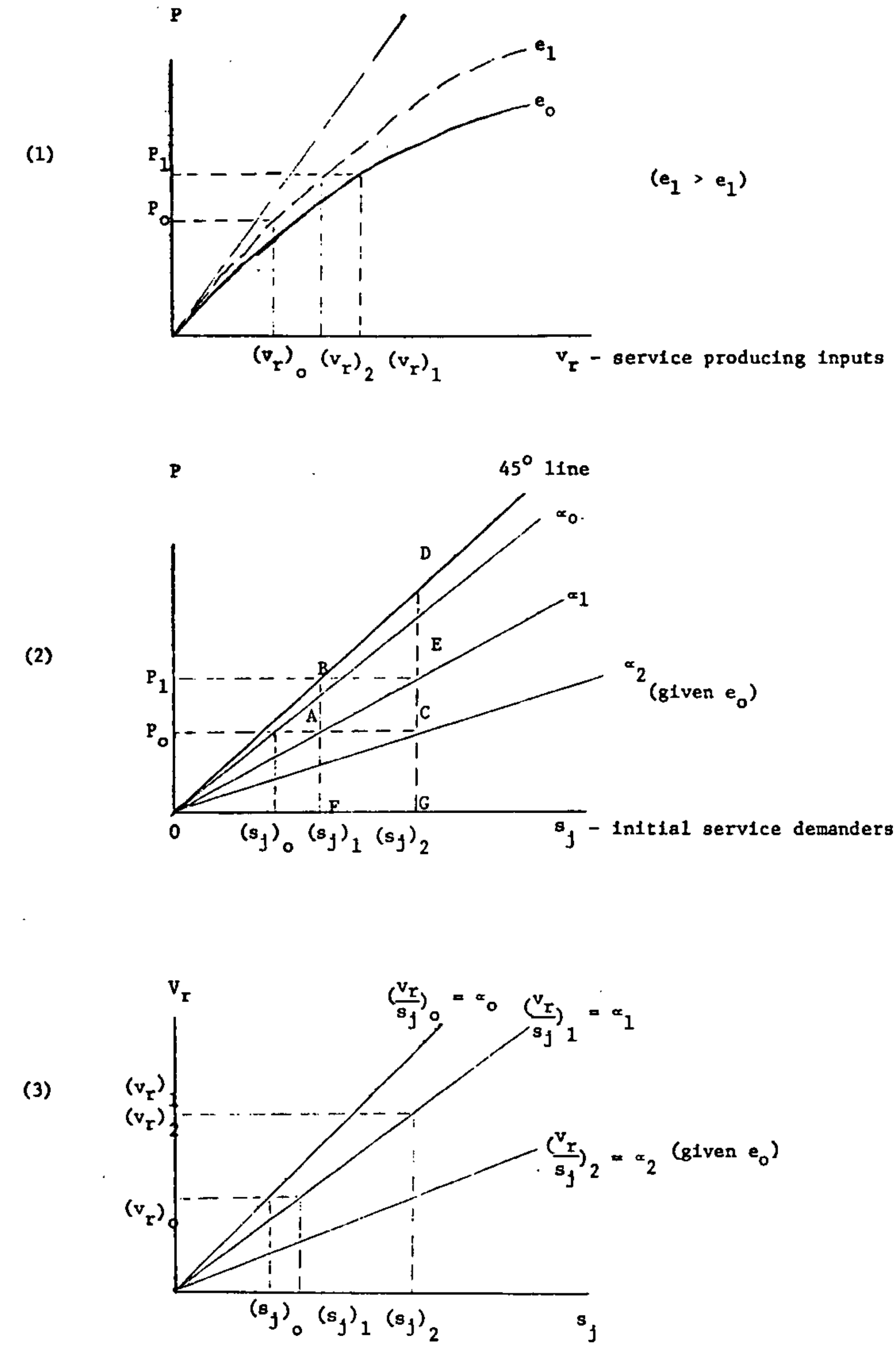


Figure 4.4: Relationship Between Output and Quality in the Production of Health Services

number of initial demanders of health services increases from value $(sj)_o$ to $(sj)_1$, (shown in quadrant (3)), the ratio between the two inputs falls and one moves to a lower ray, say from α_o to α_1.

Given the production function relationship in quadrant (1) and the value of $v_r = (v_r)_o$, output can be determined such that $P=P_o$. Transferring the value P_o and $(s_j)_o$ to quadrant (2), it is possible to specify the relationship between initial demanders and total output.

Given the production function e_o, a relationship between output P and initial demanders s_j can be developed for each ray in quadrant (3). This relationship is developed in quadrant (2) with the α_i reflecting a constant ratio between v_r and s_j. The 45^o line in quadrant (2) imposes an upper constraint on the feasible relationships due to the fact that output P cannot be greater than initial demanders s_j. This constraint in turn imposes a constraint on the feasible rays in quadrant (3). The constraint ray in quadrant (3) is also dependent on the given production function. If, for example, the production function shifts up to e_1 as a result of improved medical technology, the maximum feasible ratio v_r/s_j must fall; for any other ratio of v_r and s_j not subject to the constraint, the rays in quadrant (2) consistent with a given ratio of the two inputs in quadrant (3) would rise.

Let us turn to the implications of this analytical framework in determining the firm's level of output and quality. Assume the budgetary process has established a budget constraint for the firm at level $(v_r)_o$. If the number of initial demanders at the start of period t is $(s_j)_1$, the ratio of v_r and $s_j = oc_1$. Output level P_o is determined by the production function and is transferred to quadrant (2). As noted in quadrant (2), output P_o is less than the total number of initial demanders $(s_j)_1$. At $(s_j)_1$, P_o is equal to the distance AF, which is some proportion of BF (BF equals the number of initial demanders): the rate of successful treatment (the measure of quality), is thus equal to the ratio AF/BF. If during the course of period t, there is an increase in the number of persons attending the facility, for example, to $(s_j)_2$ (and assuming no increase occurs in the availability of service providing resources $(v_r)_o$), the ratio of v_r to s_j must fall to ray α in quadrant (3), which indicates a spreading of the service-providing resources over a larger number of initial demanders. When this increase in s_j is reflected in quadrant (2), the relationships between output and initial demanders has shifted from point A to point C. At point C, total output has remained constant, CG = AF, whereas the number of initial demanders has increased DG > BF, such that the rate of successful treatment a, has fallen;

$a_1 > a_2$ where,

$a_1 = \frac{AF}{BF}$, and $a_2 = \frac{CG}{DG}$.

Assuming no upward shift in the production function e_o, improvement in quality can occur only through an increase in the ratio of productive service inputs v_r to initial demanders s_j. This can occur by (a) increasing v_r, holding s_j constant (for example, at level $(s_j)_1$), (b) reducing the level of initial demanders, for example, from $(s_j)_2$ to $(s_j)_1$, holding v_r constant at $(v_r)_o$; or (c) by some combination of changes in v_r or s_j, such that $\alpha_2 < \alpha \frac{1}{2}$ where α_2 =

$(\frac{v_r}{s_j})_2$ and $\alpha\frac{1}{2} = (\frac{v_r^1}{s_j})_2$, which is some ray from the origin with a slope greater than α_2.

If output maximization as well as quality maintenance is an objective, then at least two of the possibilities discussed above are not feasible, assuming constant technology. Output maximization is realized only where v_r increases from an initial point, say $(v_r)_o$, given the production function e_o. Thus (b) and any combination in (c) above, where v_r declines, are not feasible, if output is to be maximized.

In the case where the number of initial demanders s_j remain constant throughout a given period t (for example, at level $(s_j)_2$), however, it can be shown that the two objectives of quality and output maximization are complementary. For example, assuming an initial budget constraint $(v_r)_o$ and production function e_o, the initial level of output is P_o, such that point C in quadrant (2) represents the initial position with a rate of successful treatment $a_2 = \frac{CG}{DG}$. If additional resources enter the firm or health service system, such that v_r rises to $(v_r)_1$, output will rise to P_o. Output P_1 can also be attained with an increase in inputs v_r from $(v_r)_o$ to $(v_r)_2 < (v_r)_1$, with a concommitant increase in medical technology to e_1. Regardless of the method of output increase from P_o to P_1 the quality of the medical care also increases from $a_2 = \frac{CG}{DG}$ to $a_3 = \frac{EG}{DG}$, where $EG > CG$, such that $a_3 > a_2$.

A Summary of the Quality Specification in the Objective Function

The problem facing the curative health service system during any given time period t is to Max $Z = \overset{*}{P} = \frac{\overset{*}{S}}{\overset{*}{A}}$, subject to the constraints,

(a) $A\overset{*}{P} < \overset{*}{V}$

(b) every element $v_r > o$, $p_j > o$, where

A = technological matrix and,

$\overset{*}{A}$ = a diagonal submatrix of the A matrix and is comprised of elements a_{rj}, which are the inverse of the rate of successful treatment.

For humanitarian and equity reasons, a minimum value restriction must be imposed on rates of successful treatment such that

$$\frac{1}{a_{rj}} > o, \text{ where } r=((m-(n-1)),\ldots,m).$$

In the graphical analysis above, the quality variable - rate of successful treatment - was discussed as an endogenous function of the ratio of the two parts of the input vector $\overset{*}{V}$: (1) that part comprised of service - providing inputs v_r, $r < (m-n)$, and (2) that part comprised of initial demanders s_j, $r=((m-(n-1)),\ldots,m)$. It was shown that quality is also dependent upon the level of medical technology e, underlying the production function. Taking the later consideration into account, the functional relationship can be formally stated, such that within any given facility i, the rate of successful treatment, $\frac{1}{a_{ij}}$, is a function of $(\frac{v_r}{s_j})$ and e, such that

$$(7) \qquad \frac{1}{a_{ij}} = a\left(\left(\frac{v_r}{s_j}\right), e\right).$$

In order to obtain an aggregate measure of the quality of activity j for all i firms, the a_{ij}'s can be summed and each weighted by the ith firm's proportion of total output of activity j, p_{ij}. Thus,

$$(8) \qquad a_j = \Sigma_i \left(\frac{p_{ij}}{p_i}\right) a_{ij}.$$

To conclude, it is possible to determine the value of the output vector $\overset{*}{P}$ for Uganda's health service system, given (a) the existing structure of health service firms, (b) a constant medical technology, and (c) knowledge of the elements of the technological matrix A.

Cost of Curative Health Services

In any firm i, the total cost of production of the output vector $\overset{*}{P}$ can be determined from the production relationship specified in the previous section. Thus, the total cost of the i^{th} firm's output vector C_i may be specified as follows:

$$(9) \qquad C_i = \sum_{r=1}^{(m-n)} w_r v_{ri}$$

where w_r equals the price or wage of the r^{th} input. (For $r=((m-(n-1)), \ldots, m)$, $w_r = 0$.) For the hospital subsector,

$$(9a) \qquad C_i = \sum_{i=1}^{h} \sum_{r=1}^{(m-n)} w_r v_{ri}.$$

Similarly for the other two sub-sectors,

$$(9b) \qquad C_i = \sum_{i=h+1}^{q} \sum_{r=1}^{(m-h)} w_r v_{ri}$$

for rural units with inpatient services and

$$(9c) \qquad C_i = \sum_{i=q+1}^{o} \sum_{r=1}^{(m-n)} w_r v_{ri}$$

for rural units with no inpatient services.

To estimate the total cost for any given activity j in firm i, the total cost of firm C_i must be allocated among the several activities. The process of allocating costs, however, is facilitated when the elements (a_{rj}) of the technological matrix A are known. Assuming for the moment that the elements are known, the total cost of operating the j^{th} activity in firm i can be specified as follows:[35]

$$(10) \qquad C_{ij} = \sum_{r=1}^{(m-n)} a_{rji} w_r v_{ri}.$$

Total cost of operating the j^{th} activity in the system as a whole may be specified:

$$C_j = \Sigma_i C_{ij} = \Sigma_i \sum_{r=1}^{(m-n)} a_{rji} w_r v_{ri}. \tag{11}$$

It is important to note that the specification of the total cost of operating the j^{th} activity in equation (11) includes the costs of the persons who, for reasons mentioned above, are not treated successfully. This is because every a_{rj}, where $r < (m-n)$, reflects the usage of inputs in operating activity j at unit intensity. Where the rate of successful treatment $\frac{1}{a_{rj}} = \frac{1}{a_j}$, where $r=((m-(n-1)),\ldots,m)$, is less than 1, $(\frac{1}{a_j} < 1)$, some service-providing resource v_r will be used in providing one or more curative services to those unsuccessfully treated.

Dynamic Factors Affecting the Model

An objective of this research is to develop an appropriate methodology for estimating future trends in total cost of the curative health service system. The methodology must incorporate the impact of factors such as (a) population growth, (b) changes in income, (c) changes in input prices, (d) changes in quality standards, (e) shifts in the health services facilities mix, (which includes both shifts in the mix of government units between hospitals and non-hospital units, as well as the mix of government units and mission units), (f) changes in the disease mix of initial demanders, (g) changes in the total number of health facilities and (h) increased usage of existing facilities.

The impact of decisions by the Ministry of Health have long-term affects, and once decisions are made relative to facility expansion, health manpower training programs, relationships with voluntary units, and standards of care, the cost implications manifest themselves in subsequent periods. Only under conditions of extreme financial crisis (resulting, for example, from a major crop failure), would the government seriously consider the possibility of decreasing its commitment to health service provision.

In the static model developed above, the primary endogeneous variables are (a) the output vector $\overset{*}{P}$ and (b) total cost C. Given the output vector $\overset{*}{P}$, the elements of the technological matrix a_{rj}, and the input price vector w_r, the cost of the curative services can be determined. However, once dynamic considerations are introduced, it cannot be assumed that exogeneous variables, such as (a) service providing inputs (v_r, $r <$ (m-n)) and (b) initial demanders s_j, remain constant. In addition, if the possibility exists for some substitutability between one or more of the v_r inputs as a result of relative input price changes or changes in medical technology, the elements of the technological matrix a_{rj} will change as a result of the impact of the change on the technological elements u_{rk} and c_{kj}.

During each time period t, the problem can be reformulated as follows for the health service system as a whole:

(12) $\quad \text{Max } Z = \overset{*}{P}(t)$

subject to the constraints

$$A(t)\ \overset{*}{P}(t) < \overset{*}{V}(t)$$

where $v_r(t) > o$; $p_j(t) > o$; and $a_{rj}(t) = \bar{a}_{rj}(t)$, where $\{\frac{1}{\bar{a}_{rj}(t)}\} > o$,

when $r = ((m-(n-1)), \ldots, m)$ and $\frac{1}{a_{rj}(t)}$ is a target rate of successful treatment.

Given the solution of the problem for time t, the matrix of a_{rj}'s and the vector of v_r can be used to determine the total cost at time t of each activity j as well as the total cost for the entire curative health service system. Thus, the total cost of activity j,

$$(13) \qquad C_j(t) = \sum_{r=1}^{(m-n)} a_{rj}(t)w_r(t)v_r(t)$$

and total cost

$$(14) \qquad C(t) = \Sigma_j C_j(t) = \Sigma_j \sum_{r=1}^{(m-n)} a_{rj}(t)\ w_r(t)\ v_r(t).$$

If the planning horizon extends beyond the single period t, it is important to determine whether the desired objectives are to be attained by the end of the planning horizon or whether the time path of attainment is an important component of the objectives. In some circumstances the two perspectives may be synonymous with respect to the end result, but such is not necessarily the case.[36] This problem is particularly critical in the development of a consistent health policy which takes into consideration the integration of preventive and curative services.

Given that a primary economic rationale for providing curative health services is to maintain the existing stock of human capital (see Chapter Three), it can be argued that a strategy which seeks to maximize output during each sub-period will maximize the stock of human capital over the entire period to a greater extent than will a strategy which does not necessarily require maximization in each sub-period of a planning period. If one assumes that there are no material shifts in the age and sex specific incidence of disease episodes over the planning period, regardless of the shifts which may occur in the distribution of diseases[37], a strategy which seeks to maximize output in each sub-period will maintain the human capital stock at a higher level than will alternative strategies. Thus, the objective function may be specified such that

(15) $$\text{Max } Z(\tau) = \sum_{t=1}^{\tau} \overset{*}{P}(t),$$

where $\overset{*}{P}(\tau)$ is the output vector over the entire planning period τ, $t=(1,\ldots,\tau)$.

Factors Affecting the Vector of Initial Demanders

During a given time period t, it is assumed that the total number of initial demanders $S=\Sigma_j s_j$ is a function of (a) the size of population, (b) the availability of health facilities, (c) income, (d) perceived quality of service, (e) price of service, and (f) the incidence of illness episodes. For purposes of projecting changes in the number of initial demanders over time, the functional relationship will be specified in terms of the rates of change in these variables, however, for expository purposes, the variables are expressed in terms of absolute values. The relationship may be specified as follows:

(16) $$S=S(O,Y,a,b,I,d)$$

where

S = the total number of initial demanders

O = population size

Y = GDP per capita (used as a proxy for per capita income)

a = the rate of successful treatment (quality, given the disease mix of initial demanders)

b = the price of a set of curative health services,

I = the incidence of illness episodes,

d = the average distance to health facilities as a measure of availability.

Over the usual planning period of five to ten years, it is reasonable to assume that the variables mentioned above with the exception of (a) the rate of successful treatment (a), (b) the average distance to health facilities (d), and, to a certain extent, (c) the price of a set of services (b), are exogeneous variables and thus are not affected by decisions related to the expansion or operation of the system.

The variables b (the price of health services) and d (average distance) are determined by changes in the mix of facilities and d is additionally affected by policies related to the expansion of the entire service system. In the case of the price variable b, the shift in the mix of health services away from mission units (assuming no change in the price policy of mission units with their present financial requirements) will lead to a decline in the average price charged initial demanders.

The availability of health facilities, as measured by the average distance to the nearest facility, changes as the number of facilities increases - assuming that the new facilities are not built in close proximity to existing ones. If the mix of governmental units shifts toward a relatively larger share of rural units (rather than hospitals), not only will there be an increase in availability, but also more rapid expansion (in terms of total numbers of units) may take place since the largest rural facility requires approximately 5% of the initial capital cost of the one one-hundred bed hospital.[38] A reasonable proxy variable for availability and average distance may be the average number of attendances per person which is negatively correlated with distance from the health facility.[39]

The relationships may be formalized as follows:

(17) $b = b\,(\frac{M}{H})$

and

(18) $d = d\,(H, (\frac{GR}{G}), (\frac{M}{H}))$

where H = total number of health facilities,

$(\frac{M}{H})$ = the ratio of mission units to all health facilities,

$(\frac{GR}{G})$ = the ratio of rural government units to all government facilities.

In addition, the above discussion implies the following a priori relationships:

$$\frac{\partial d}{\partial (\frac{M}{H})} > o; \quad \frac{\partial d}{\partial H} < o; \quad \frac{\partial d}{\partial (\frac{GR}{G})} < o; \quad \text{and } \frac{\partial H}{\partial (\frac{GR}{G})} > o.$$

Factors Affecting the Rate of Successful Treatment

Discussion earlier in this chapter and in Chapter Three provide insight into the nature of this quality variable and provide some rationale as to why it may vary over time. As noted above, at any given point in time t, the rate of successful treatment is defined as some function of (a) the ratio of service providing inputs v_r to service demanding inputs s_j, and (b) the level of medical technology. By taking into account the non-homogeneity of output, additional variables must be included in the analysis to explain the differences in the rate of successful treatment. It is thus hypothesized that this quality variable can be specified more precisely as a function of (a) differences in the ratio of inputs providing diagnostic services, (b) medical technology, (c) disease mix of initial demanders, and (d) differences in the ratio of service-providing inputs to initial demanders. Symbolically, the relationship can be expressed in the following way:

$$(19) \qquad a = a\left(\left(\frac{v_r}{v_{r^1}}\right),\ e,\ \overset{*}{S},\ \left(\frac{v_r}{s_j}\right)\right),$$

where a is defined as above,

$\left(\frac{v_r}{v_{r^1}}\right)$ = the ratio of inputs providing diagnostic services, where $r \neq r^1$,

e = medical technology,

$\overset{*}{S}$ = the vector of initial demanders s_j, and

$\left(\frac{v_r}{s_j}\right)$ = the ratio of service providing inputs to initial demanders.

It must be noted that the rate of successful treatment, is a function of both the service-providing and initial demander input constraint subsets. Thus, it is possible to analyze changes in the elements of the constraint vector in order to determine the impact of such changes on the rates of successful treatment.

Factors Affecting the Service Providing Subset of the Input Vector

In general it can be said that the service providing input vector is a function of each r^{th} input, particularly (a) financial resources from (i) governmental allocations, (ii) individual demanders through fees paid for services consumed, and (iii) gifts from third parties, and (b) the supply of direct service-providing inputs such as medical manpower, drugs, equipment, and facilities.

The first factor (which, for convenience, will be called the budget input), is controlled in large part by the central and local government's ability to generate revenue; this in turn is dependent on the over-all economic performance of the country. Governmental medical policy on the issue of fees for services (i.e., no charge will be made for normal services rendered in governmental facilities) has placed a constraint on the level and rate of increase in fees charged by non-governmental health facilities. Gifts, made primarily by external church groups, can be considered exogenous in the present model, although political stability and general governmental attitude toward mission activities may be important factors in the external donor's decision to give.

The second factor, the supply of individual inputs, is largely determined by decisions related to (a) manpower development, (b) salary levels, (c) the number of facilities, and (d) the availability of other inputs, particularly drugs and medical equipment. In the area of manpower development, there are two questions of importance: (a) What types of medical training programs are being and should be developed, and (b) how large should such programs be? In determining the salary levels for each type of health manpower, decision-makers must consider not only previous levels of pay, but also the potential mobility of each type of manpower, given the amount of training received and the skills which have been developed through experience. Levels of pay received in jobs with similar training and skill requirements, both in and out of government and the health field, must also be considered. In determining the number of facilities in which curative health services will be provided, four factors are particularly important: (a) development plan strategy in the health field; (b) availability of financing (from internal as well as external sources, for both government and mission facility construction); (c) government attitude toward mission expansion;

and (d) relative emphasis on rural unit v. hospital construction. The availability of other inputs (non-labor, non-capital, e.g. drugs and other operating expenses) is largely determined by (a) total economic activity as measured by G.D.P., (b) the capacity to import, (c) the internal production capacity, and (d) the prices of such inputs. These relationships can be specified as follows:

for the budgetary input B:

(20) $$v_B = v_B\ (GB, MB, F, Q),$$

where v_B = the budget input for curative heatlh services,

GB = the government budget,

MB = the mission budget for operating curative health services,

F = the quantity of fees collected for services rendered, and

Q = the quantity of gifts received;

for the manpower inputs L:

(21) $$v_L = v_L\ (w_L, J_L),$$

where v_L = the quantity of manpower inputs L, where $L=(1,\ldots,\sigma)$

w_L = the price (wage) of the manpower inputs,

J_L = the output of health manpower training programs operated by the government and missions;

for capital inputs K:[40]

(22) $$v_K = v_K\ (EG, EM, GB, (\frac{DBH}{DB}), (\frac{GR}{G}), GAM),$$

where GB and $(\frac{GR}{G})$ are defined above, and

v_K = the amount of capital inputs K, where $K=(1,\ldots,\rho)$,

EG = the amount of external assistance to government,

EM = the amount of external assistance to missions,

$(\frac{DBH}{DB})$ = the proportion of the development plan's expenditures for health services, and

GAM = a dummy variable indicating whether the government has a positive attitude to missions in the delivery of health services;

and for the non-labor, non-capital inputs N:[41]

(23) $v_N = v_N\ (Y,\ CI,\ W_N,\ CAPD)$

where v_N = the quantity of non-labor, non-capital inputs N, where N= (1,...,ℰ),

Y = Total Monetary G.D.P.,

CI = the capacity to import,

w_N = the prices of the N inputs, and

CAPD = the existence of domestic production capacity.

To conclude, the service providing input vector $\overset{*}{V}_r$ is a function of the four primary input components specified above. It is possible to write this relationship in the following way:

$$\overset{*}{V}_r = v_r\ (v_B,\ v_L,\ v_K,\ v_N),$$

where the variables are defined above.

In Chapter Five, the postulated relationships between service-providing inputs and the factors affecting the supply of these inputs will be subjected to empirical verification through standard regression techniques. The significance of the estimated relationships will also be explored.

Summary

A theoretical framework, using linear programming concepts, was developed in this chapter for analysis of the relationship between the inputs and outputs of the curative health service system. The importance of the quality index (rate of successful treatment) and the multiproduct nature of health service facilities were stressed and were incorporated into the analytical framework. A further framework for analyzing the important factors affecting (a) service-providing inputs, (b) service demanders, and (c) rate of successful treatment over time was developed. In Chapter Five, the framework developed here is used in empirical analysis.

Footnotes

1. Pfouts, Ralph W., "The Theory of Cost and Production in the Multi-Product Firm", Econometrica, Vol. 29, No. 4, October 1961, pp. 650-658.

2. Weil, Roman L. Jr., "Allocating Joint Costs", American Economic Review, Vol. 58, No. 5, Part 1, December 1968, pp. 1342-1345.

3. See page 654, Pfouts op. cit. for a statement about the relative usefulness of each approach, particularly for decision making purposes. On this point also see Dorfman R., Samuelson P., Solow R. W., Linear Programming and Economic Analysis, (New York: McGraw-Hill Book Co., Inc., 1954), and Dano S., Industrial Production Models, (New York: Springer-Verlag Inc., 1966).

4. Important examples of the use of such methodology-all of which are describing basically the same approach include: Feldstein, Martin S., Economic Analysis for Health Service Efficiency,(Amsterdam: North Holland Publishing Co., 1967) Chapter Six; Feldstein, Martin S., "Health Sector Planning in Developing Countries," Economica, Vol. 37, No. 146, May 1970; and Taylor, Carl, et al., Functional Analysis of Health Needs and Services, A Report Compiled by Johns Hopkins University, School of Hygiene and Public Health, Department of International Health, December 1970. See recent issues of Medical Care and Inquiry for related articles focusing on resource allocation in the health field in the United States.

5. Day, Richard H., Recursive Programming and Production Response, (Amsterdam: North Holland Publishing Co., 1963) pp. 109.

6. In some larger rural health centers (e.g., in Busoga District) a small laboratory service has been developed over the last five years. Thus, in addition to the diagnostic services described, some persons, whose condition has not been adequately diagnosed from historical and symptomatic information in conjunction with a physical examination, may be given laboratory tests to improve diagnostic precision. Although this supporting diagnostic service is not yet widespread in rural health units, it could easily become part of a program whose policy objective is to improve the quality of medical care in rural areas by improving the rate of successful treatment.

7. The book by J. R. Billinghurst, Trowell's Diagnosis and Treatment of Diseases in the Tropics, (London: Bailliere, Tindall and Cassell, 1968) is an excellent example of the extent to which standardized medical treatment procedures have been catalogued for a country such as Uganda. The National Formulary, 1966 (Entebbe: Government Printer, 1967) written for the Uganda government and Ministry of Health, provides standard dosages for a number of different drugs and diagnoses.

8. The decision may also be made to refer a patient already receiving treatment services to another facility if it becomes apparent that more intensive care is required. This flow is not included on the diagrams primarily because it would tend to overly complicate them.

9. Dano, S., Industrial Production Models (New York: Springer - Verlag, New York, Inc. 1966)and Hixson, Jesse, "A Model of Hospital Production, Cost and Capacity Determination", Workshop Paper 7009, Econometrics Workshop Papers, Michigan State University, East Lansing, Michigan, April 1971.

10. As the analysis is expanded, the activity intensity is defined in terms of the entire set of firms comprising the health service system.

11. Although every person demanding medical care receives some service, and in the process consumes a certain amount of service providing resources, the statement does not intend to imply that every person receives enough service for every one to be successfully treated as determined in a subsequent analysis, for everyone to obtain the services deemed medically appropriate at the time of initial demand.

12. In terms of Equation (2b) specification, each a_{rj} shows the proportion that each p_j is of the corresponding v_r, such that $a_{rj} = \frac{p_j}{v_r}$, where $r=((m-(n-1)),\ldots,m)$.

13. This set of unsuccessfully treated persons theoretically can include those persons who sought medical help but leave prior to the receipt of service and yet recover. Such individuals reflect the fact that there is an opportunity cost of receiving "free" medical care. If one were to observe that this set were increasing over time, a plausible inference could be made that the opportunity cost was rising over time.

14. See Appendix F for a description of the methodology employed in a patient follow-up study carried out in conjunction with this study. See also Taylor, Carl, et al., Functional Analysis of Health Needs and Services, a report compiled by Johns Hopkins University School of Hygiene and Public Health, Department of International Health, December 1970, where the methodology of a patient follow-up study conducted in rural India is described.

15. In that case, the vectors and matrices denoted in equation (2) will thus be a summation of the elements of the i firms. Thus, v for all firms will be a column vector of r elements, with each element $v_r = \Sigma_i v_{ri}$. It may be required that the elements of the A matrix for all firms, a_{rj}, be weighted in some fashion to reflect the relative importance of larger firms in the health service system. Where this is the case the method of calculation of each a_{rj}, may be denoted as follows: $a_{rj} = \Sigma_i \theta_i a_{rji}$, where θ_i is the weight given to the i^{th} firm's technical production relationship.

16. Since a primary interest of this analysis centers on comparisons between several of the subsectors of firms in terms of input ratios, output mixes and total costs, it is important that the i firms

within the system are grouped according to an appropriate taxonomy. The categorization developed takes into account the administrative structure as it relates to the structure and financing of Uganda's health service system and takes into account also the existence of inpatient treatment services, which significantly raise the number of diagnostic and treatment service options and, pari passu, the cost.

17. This kind of objective function has been used in analyzing educational systems in less developed countries. See Samuel Bowles, Planning Educational Systems for Economic Growth, Harvard Economic Studies, Vol. 113, (Cambridge, Mass.: Harvard University Press, 1969).

18. See Martin Feldstein, "Health Sector Planning in Developing Countries", Economica, Vol. 37, No. 146, May 1970.

19. In the P.A.H.O. planning model, the objective function contains a single item, a measure of reduced mortality. This is much too simplistic in terms of the possible health objectives that people and societies may desire at any one time. See P.A.H.O., Health Planning: Problems of Concept and Method, Washington, D. C.: Pan American Health Organization, Pan American Sanitary Bureau, Regional Office of the World Health Organization, April, 1965, (Scientific Publications No. 111).

20. Data of this type have been collected to some extent in India. See Taylor, Carl, Functional Analysis of Health Needs and Services, A Report Compiled by Johns Hopkins University, School of Hygiene and Public Health, Department of International Health, December, 1970.

21. See Dunlop, David W., "Research on the Economics of Health Services in East Africa", Rural Africana, No. 13, Winter 1970, pp. 77-84.

22. Republic of Uganda, Work for Progress: Uganda's Second Development Plan, 1966-1971, Government Printer, Entebbe, 1966, pp. 13; King, Maurice, ed., Medical Care in Developing Countries, Oxford University Press, London, 1966, pp. 2.6 and 2.7; personal interview with Dr. Semambo, Medical Superintendent of Mulago Hospital 1970; and Republic of Uganda, Uganda's Plan III: Third Five-Year Development Plan, 1971/72 - 1975/76, Government Printer, Entebbe, 1972, pp. 301 and 308.

23. Republic of Uganda, Work for Progress, p. 18.

24. Republic of Uganda, Work for Progress, pp. 151 and Plan III, pp. 308.

25. Republic of Uganda, Work for Progress, pp. 18, 51.

26. Nathan Epenu, Uganda Argus, 25 February 1971.

27. Sharpston, Michael - Ghana Harvard Advisory Service, no date, approx. 1967/68, mimeoed document.

28. See *Work for Progress*, Statement 13.6, p. 15. The Ugandan government takes the position that by maintaining a policy of free medical service, the country is medically and socially advanced. This long-standing positon has been questioned on occasion in the past, but has not been changed for political and public health reasons. See Frazer Committee Report, *Medical and Health Services in Uganda*, Government Printer, Entebbe, 1956, and International Bank for Reconstruction and Development, *Economic Development of Uganda* (Baltimore: Johns Hopkins Press, 1962).

29. Feldstein, Martin S., *Economic Analysis for Health Service Efficiency*, (Amsterdam: North Holland Publishing Co., 1967) Chapter Six.

30. This procedure is followed for all government hospitals for most variable cost items such as local employees, food, transport, and electricity.

31. The problem of intergovernmental cooperation may not be as important in the health field today as it was before the change in policy announced in Uganda's Third Development Plan 1971/72 - 1975/76 where the Ministry of Health was placed in charge of all rural health facilities. See Republic of Uganda, (1972), *Uganda's Plan III*, op. cit., pp. 203, 204.

32. Some public press reports indicate that a relatively effective regime has been developed treating cholera in Bangaladesh refugees.

33. In the initial set of constraint conditions discussed above, the elements in vector $\overset{*}{A}$ comprise a diagonal submatrix of the A matrix.

34. Included in the concept of medical technology as used in this context are organizational and administrative changes which affect the productivity of existing resources, as well as qualitative changes in one or more of the medical inputs.

35. The methodological problems of estimating a_{rj} will be examined in a subsequent chapter of this dissertation. The problems involved are related to issues in the area of cost accounting. The conventions of time and space are used; sample data are also used to indicate the magnitude of certain stable relationships such as standard drug treatments (given the diagnosis) or the proportion of total costs which are administrative overhead costs. In Taylor, *et*. *al*., *Functional Analysis of Health Needs and Services*, Report Compiled by Johns Hopkins University School of Hygiene and Public Health, Department of International Health, December, 1970, 493 pages, xeroxed, four health centers in India were studied and some tentative efforts were made to allocate the cost of operating a health center to the several activities in which it is engaged. See Chapter Five, Part II, especially pp. 351-412 of the study.

36. See Bowles, Samuel, Planning Education Systems for Economic Growth, (Cambridge Massachusetts: Harvard University Press, 1969).

37. The assumption of no significant shifts in the incidence of disease episodes over the most normal planning periods of 5-10 years has considerable epidemiological validity except in situations where a major infectious disease - such as malaria - is erradicated or its incidence substantially reduced by the introduction of a series of preventive health measures, including the widespread use of prophylactic medicines. In the case of Uganda, it does not appear likely that any major breakthrough will occur to materially affect the incidence of illness episodes during the next five years, although steady progress is likely to be made to reduce the number of people who have not been immunized. Given that a sizeable proportion of Uganda's population is impoverished, however, the overall incidence of illness episodes, particularly among the population over five years of age, is not likely to change materially in the near future.

38. Figures taken from author's working papers.

39. See Maurice King, ed., Medical Care in Developing Countries: A Primer on the Medicine of Poverty, A Symposium from Makerere,(London, Oxford University Press, 1966);Haskell, Mark, "Medical Service in Masaka District", Unpublished paper, New York University, 1971, 21 pages; Galea, J., "Assessment of Uganda's Basic Health Service System", World Health Organization, Malaria Erradication Program, Jinja, 1967, Mimeoed; and Taylor, Carl et. al., Functional Analysis of Health Needs and Services, A Report compiled by Johns Hopkins University School of Hygiene and Public Health, Department of International Health, December, 1970.

40. Capital inputs include facilities, transportation equipment, and other medical equipment, such as x-ray machines, surgical room equipment, and a complement of beds and laboratory equipment.

41. Such inputs include drugs, sundries, small equipment replacement, transport expenses, electricity and telephone.

CHAPTER FIVE

In this chapter, Uganda's health service system is empirically analyzed. The chapter is divided into four sections. The first section contains (1) an empirical specification of the analytical model developed in Chapter Four, (2) a discussion of the sources and methods used in obtaining data and (3) a description of the procedures used in estimating the value of the model's parameters. The second section of the chapter presents the linear programming results for the three major health service delivery systems in Uganda -- government hospitals, mission hospitals, and government rural health units with inpatient care. A comparative analysis of the findings for each sector follows, focussing on the similarities and differences in the outputs, resources, and costs of the three systems.

The third section of the chapter discusses the empirical analysis of the factors affecting the output, resources and cost of health services over time. In section four, projections are made to 1980/81 -- the end of the fourth five-year planning period -- utilizing the linear programming model. The results of this analysis are presented in order to examine some of the long range implications of certain health policies recommended by the Third Plan.

Empirical Specification of the Model

The Model

The linear programming model used in the empirical analysis is schematically presented in Figure 5.1 and Table 5.1. The system has three basic components. First, there are the input constraints, v_r, depicted down the left-hand side of the figure. For each sector of the system (government hospitals, mission

Figure 5.1 Conceptual Specification of the Linear Programming Model of Uganda's Three Sectors of the Health Service System

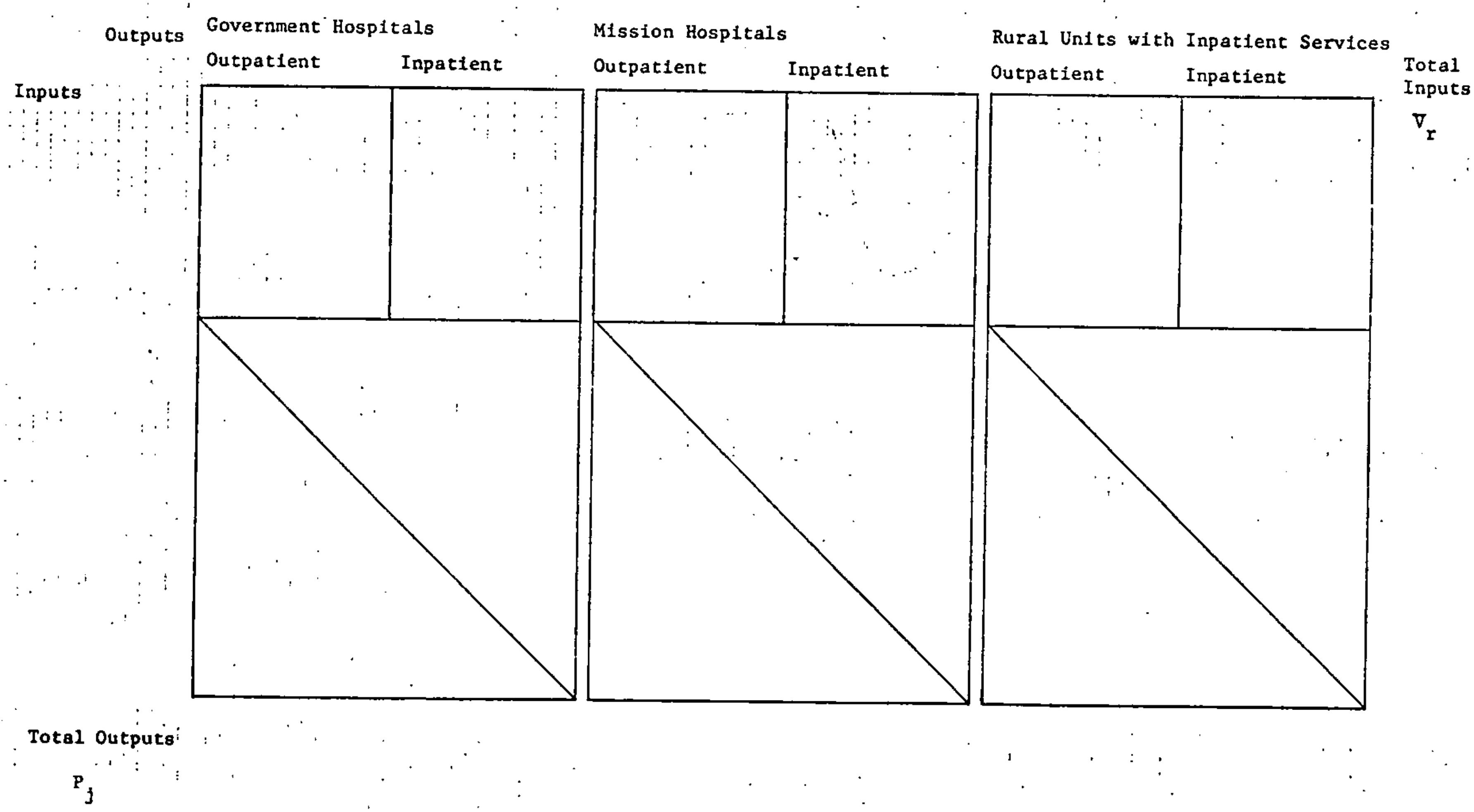


Table 5.1 Summarization of Output and Input Variable Specification

A.	Output Variable - Disease Characteristics (j)[1]	B.	Service Providing - Input Variables (r)
(1)	Infectious and Parasitic	I.	Manpower[2]
(2)	New Growths	(1)	Medical Officers
		(2)	Medical or Nursing Assistants
(3)	Allergic, Metabolic and Blood	(3)	Professional Nurses or Midwives
		(4)	Enrolled Nurses or Midwives
		(5)	Trained Lab Staff
(4)	Nervous System and Sense	(6)	Trained X-Ray Staff
		(7)	Other Trained Medical Staff
(5)	Circulatory	(8)	Other Trained Non-Medical Staff
		(9)	Non-Trained Medical Staff
(6)	Respiratory	(10)	Other Non-Trained, Non-Medical Staff
(7)	Alimentary	(11)	Student Staff
(8)	Genito-Urinary	II.	Capital
(9)	Pregnancy and Puerperium	(12)	Beds
		III.	Intermediate
(10)	Delivery without Complication	(13)	Drugs and Medical Supplies
		(14)	Food
(11)	Skin and Musculo-Skeletal	(15)	Vehicle Operation and Maintenance
		(16)	Electricity
		(17)	Other Operating and Maintenance Expenses
(12)	New Born		
(13)	Ill Defined	IV.	Service Demanding Inputs
(14)	Injuries		(See the Output Variable Specification for the 14 categories of service demanding inputs, numbered from (18,...,45), to reflect the two treatment processes.

Notes: (1) See Table F.1, Appendix F, for a precise enumeration as to how the output variable corresponds to the WHO International Classification of Diseases.

(2) In Appendix C, the specific job classifications are presented which are included in the manpower input categories (5-10).

hospitals and government rural units with beds), there exists a separate set of input constraints. Second, there are the outputs, p_j; these are depicted at the bottom of the figure. Finally, there is a technological matrix, A(i,j), i=(1,...,45), j=(1,...,28), for each of the sectors.

Each of these technological matrices can be divided into three sub-matrices for analytical purposes. The upper left-hand sub-matrix of each A(i,j) matrix, i=(1,...,17), j=(1,...14), depicts the quantity of service-providing input, i, required per case of type, j, treated on an outpatient basis. The upper right-hand sub-matrix, i=(1,...,17), j=(15,...,28), indicates the similar parameters for the inpatient treatment process. i=(18,...,45), j=(1,...,28), is a diagonal matrix. The elements of this matrix are the proportion of each element in the final output vector P^* comprised by initial demanders with type j characteristics. The inverse of the principal diagonal is the rate of successful treatment.[1]

The Variables

The output classification system employed in the model is disaggregated solely on the basis of disease category for each of the two treatment processes -- inpatient and outpatient -- employed in each sector of the health service system. As there are 14 categories of disease for each treatment process, the output mix contains 28 categories. This classification system does not include reference to age and sex in the determination of output, but is used to conform to the data available from all three sectors of the health service system.[2]

The inputs used in the production of curative health services are divided into two categories: (a) the resources used to produce the curative health services demanded and (b) the persons initially demanding service. The second set of elements in the input vector, the initial service demanders, is comprised of 28 elements corresponding to the vector of outputs described above. The first sub-set of inputs, however -- resources used to produce curative services -- is defined as follows. There are three main categories of service-providing inputs: (a) manpower, (b) capital, and (c) intermediate inputs such as drugs and transport (see Table 5.1). A fourth input, the budget, is not included in the linear programming model because it is reflected in the model by the specific amounts of all other inputs. Presumably if one or more of the inputs constitutes a binding constraint on the ability of the system to offer service at some point in time, a budgetary reallocation between inputs may be undertaken to alleviate the constraint.[3]

Unfortunately, capital budgets for Uganda during the period 1935 to 1970 could not be disaggregated to allow the separation of capital inputs. It is assumed that beds can be used as a proxy for all capital inputs, particularly those consumed in the process of treating patients on an inpatient basis. Very few capital inputs, with the exception of a building and minor supplies,are used in outpatient treatment. It is assumed, thus, that capital inputs are perfect complements to beds and are consumed in the production of health services in fixed proportions with that variable, specified in terms of bed days.

In summary, the input vector $\overset{*}{V}$ is defined as follows. there are eleven labor elements, one capital element, and five intermediate elements in the vector. In addition, the set of initial demanders (disaggregated into 28 elements) is included in the input vector. The input vector thus has 45 elements: 17 service-providing inputs and 28 initial-demander inputs.

The Data

Data for the empirical analysis were collected in the following ways. First, a follow-up study of persons who had recently demanded service from a nearby health facility in Ankole District was conducted. The data obtained from this set of surveys were used to develop estimates of the rate of successful treatment, disaggregated according to case type.[4] The second major source of data was the records of a selected number of health facilities in Ankole, Busoga, East Mengo, Karamoja and West Mengo districts; information on the inputs used in producing health services in rural facilities and hospitals were gathered from these records. District-wide data were also gathered on (a) the number of persons (disaggregated according to case type) attending specific health facilities,[5] (b) the rate of input usage disaggregated according to facility, and (c) drug dissemination and the use of transport facilities.

Data gathered from individual facility and district records were supplemented by data gathered previously by Dr. J. Galea, W.H.O. Basic Health Services Project Director from 1965-1967. In addition, the central government Ministry of Health and the Catholic and Protestant Medical Bureaus provided additional information on the initial demanders and resources used in their respective hospitals.[6]

Finally, the above sources of information were supplemented by published data sources. The most important include (a) the government's Annual Statistical Abstract, (b) the government's Annual Report of the Public Accounts and Budget Estimates, and (c) the Ministry of Health's Annual Report and Annual Statistical Report. These sources were used primarily in determining the value of various socio-economic variables affecting the development of Uganda's health service system.

Procedures Used to Determine the Value of the Elements of the Input Vector and Technological Matrix.

As in any statistical analysis, there exists a hierarchy of methods which can be used to estimate the value of desired parameters and variables. In the case of the linear programming framework, the most desirable method utilizes technologically determined values based on engineering studies of the production process being analyzed. Similarly, the most desirable information for the input vector is exact data on input use.

Where such information is unavailable, however, other estimation procedures must be employed. In applying linear programming to health services, Martin Feldstein used regression analysis techniques to estimate the values of the elements in the technological matrix.[7] Such methods are useful when the problem is formulated such that one is analyzing the "representative firm", as Feldstein was, and when one has the appropriate cost accounting data for all firms in the industry.

In Uganda, such cost accounting data did not exist for any sector of the health service system in 1969. With the assistance of the Ministry of

Health,[8] however, as well as that of mission medical bureaus and several District Medical Officers, budgets and cost-accounting data were obtained for a number of hospitals and rural facilities. This information was used in estimating the value of (a) the service-providing and service-demanding input vector and (b) the technological matrix.

The Input Vector

The elements of the input vector for each sector of the health service system are shown in Tables 5.2 and 5.3. Additional details concerning the estimation of the elements are presented in Appendix C, but several comments of a general nature are appropriate here.

In the case of the service-providing inputs (Table 5.2), the following procedures were used to estimate the value of each element. Estimates of the total supply of each input were developed from the data sources described above. The total supply estimates were adjusted in two ways in order to obtain an estimate of the actual supply of each input available for direct health service provision to specific initial demanders. The first adjustment deducted the proportion of the input used in the production of administrative services. Although administration is a necessary service which assists in the provision of all health services, there is no justifiable criterion which can be used to allocate administrative services to specific outputs. The second adjustment deducted an estimated proportion of the input consumed in the production of preventive health services and delivered through specialized clinics.

Table 5.2 1968/69 Service Providing Input Constraints for the Three Sectors of Uganda's Health Service System

Service Providing Inputs V_r =		Government Hospitals	Mission Hospitals	Government Rural Health Units W/Beds
(1) Doctors	hrs.	550,800	126,921	-------
(2) Med. Assts./ Nursing Assts.	hrs.	575,400	6,300	366,240
(3) Prof. Nurses/ Midwives	hrs.	529,920	292,608	-------
(4) Enrolled Nurses/ Midwives	hrs.	2,395,995	404,130	273,105
(5) Trained Lab Staff	hrs.	126,000	105,000	10,500
(6) Trained X-Ray Staff	hrs.	50,400	23,100	-------
(7) Other Trained Med. Staff	hrs.	396,900	13,965	61,110
(8) Other Trained Non-Medical Staff	hrs.	244,650	7,875	117,250
(9) Non-Trained Medical Staff	hrs.	2,691,255	895,775	897,750
(10) Non-Trained Non-Medical Staff	hrs.	4,178,160	845,502	1,593,900
(11) Students	hrs.	1,854,000	770,000	-------
(12) Beds	Bed Days	1,956,035	1,111,060	1,281,880
(13) Drugs/Medical Supplies	shs.	10,438,134	1,977,712	2,173,626
(14) Food	shs.	4,167,795	734,373	285,935
(15) Vehicle Operation and Maint.	shs.	747,723	393,242	1,757,191
(16) Electricity	shs.	2,880,252	656,442	122,676
(17) Other Operation and Maint. Exp.	shs.	1,945,927	978,549	969,392

Table 5.3 1968/69 Initial Demanders Input Constraints for the Three Sectors of Uganda's Health Service System

Service Demanding Inputs	Government Hospitals	Mission Hospitals	Government Rural Health Units W/Beds
Out Patient V_r =			
(18) I & P	1,856,893	357,826	2,524,020
(19) NG	4,969	1,245	153
(20) AMB	57,181	32,459	50,015
(21) NS	316,427	46,811	358,048
(22) Circ	5,422	3,157	136
(23) Resp.	1,080,744	125,270	1,670,109
(24) Alim	760,258	93,821	836,656
(25) GU	141,520	26,308	150,793
(26) Reg & Puer	30,838	10,720	65,725
(27) Del w/o	------	------	------
(28) S & MS	763,935	105,501	938,236
(29) NB	11,448	3,320	2,682
(30) Ill Def.	245,761	23,867	493,659
(31) Ins.	533,597	21,382	609,980
Inpatient			
(32) I & P	37,464	29,147	89,954
(33) NG	4,085	1,855	480
(34) AMB	10,467	8,876	1,570
(35) NS	6,107	2,971	480
(36) Circ	3,845	1,758	369
(37) Resp.	23,642	11,526	40,453
(38) Alim.	22,505	12,039	11,226
(39) GU	8,830	5,498	2,659
(40) Preg. & Puer.	25,017	8,888	21,872
(41) Del. w/o	41,911	16,359	57,995
(42) S & MS	10,379	3,980	7,976
(43) NB	1,979	2,558	129
(44) Ill. Def.	4,371	3.461	12,925
(45) Ins.	24,103	3,081	15,104
Total OP	5,808,993	851,687	7,710,212
IP	224,702	111,997	263,192
OP & IP	6,033,695	963,684	7,973,404

In addition to the use of government and mission health facility records to estimate the service-demanding input vector, special analyses were conducted in order to (1) disaggregate re-attendances by disease categories and (2) classify outpatient and inpatient data from rural units according to the major disease categories used in hospitals. The resulting estimates are shown in Table 5.3. The data presented in Tables 5.2 and 5.3 make it clear that while government hospitals command the largest proportion of the service-providing inputs, government rural units receive the largest number of initial demanders, both on an inpatient and outpatient basis. Mission hospitals command the greatest amount of professional manpower time on a per-initial-demander basis, and, although not completely in evidence in Table 5.3, service a different mix of initial demanders than do the other two sectors.[9]

The Technological Matrix

The Service-Providing Input Submatrices

The values of each element found in the technological matrix linking the service-providing inputs, $i=(1,\ldots,17)$, to the outputs, $j=(1,\ldots,28)$, were estimated in the following way. (The three submatrices, one for each sector of the health service system, are presented in Appendix C.) First, the proportion of each input used in treating persons on an inpatient or outpatient basis was determined. For certain inputs, a further disaggregation was made specific to the production of surgical, radiographic and laboratory services. Given the disaggregation of the input vector, the quantity of each input used in the delivery of service to each disease category of initial demander was estimated by using one of the following three criteria.

The first allocation criterion, used for inputs into the delivery of outpatient services, was the proportion of total available diagnostic time used by disease category j. This allocation criterion was utilized not only for the diagnostician's time but for other inputs used in the outpatient treatment process as well, since most of the other manpower and non-drug/ medical supply inputs are factors of production complementary to the diagnostic factor and hence, are consumed in fixed proportions. The second allocation criterion, used for inpatient care, was average length of stay. This criterion reflects the fact that inpatient care is often not disease-specific in the intensity of resource use. The third allocation criterion was service-specific input use. It was used to allocate (a) manpower engaged in the production of laboratory, radiographic, and surgical services, (b) drugs and medical supplies, (c) electricity used by laboratory, radiography, and operating theatres, and (d) transportation costs.

In the case of drugs and medical supplies, a detailed analysis was made of the quantities of each drug consumed in the treatment of each disease listed on the hospital outpatient medical form (MF75). The cost of drugs consumed in the treatment of each disease was calculated by using the Ministry of Health's drug price list. It was assumed (with the exception of injury cases) that medical supplies could be allocated in the same proportions as drugs. Although the distribution of diseases treated on an inpatient basis within each major disease classification is likely different than that treated on an outpatient basis, it was assumed that such differences would not materially affect the resulting calculations. As a consequence, the average cost of treating each major disease category on an outpatient basis was adjusted to reflect the average length of inpatient care received.[10]

The Service-Demanding Input Submatrices

As discussed earlier in this chapter, these three submatrices are diagonal, with the values of each element along the principal diagonal representing the inverse of the rate of successful treatment. The following formula was used to estimate these elements for the outpatient sub-set of elements:

(1) $$a_{opj} = \frac{S_j}{S_j - (T_j + U_j + S_{ipj})}, \text{ where } j=(1,\ldots,14), \text{ and}$$

a_{opj} = the inverse of the rate of successful treatment,

S_j = the number of initial demanders of the *j*th disease category,

S_{ipj} = the number of initial demanders of the *j*th disease category receiving inpatient care,

T_j = the number of initial demanders of the *j*th disease category transferred to another health facility for further treatment, and

U_j = the number of initial demanders of the *j*th disease category unsuccessfully treated.

A similar formula was used to estimate the value of the inpatient subset of elements:

(2) $$a_{ipj} = \frac{S_{ipj}}{S_{ipj} - (T_j + U_j + D_j)}, \text{ where } j=(15,\ldots,28) \text{ and}$$

a_{ipj}, S_{ipj}, and T_j, and U_j are defined as above but refer to the inpatient set of initial demanders, and D_j = the number of inpatients of the *j*th disease category who die in the health facility.[11]

Using the equations presented above, the inverse of the elements of the principal diagonal of the service-demanding input submatrices, i.e., the disease-specific rate of successful treatment for the outpatient and inpatient treatment processes of each sector, were calculated and are summarized in Tables 5.4 and 5.5. In both the outpatient and inpatient treatment processes, the rate of successful treatment for government rural units is lower than for either type of hospital (an average of 6.5% lower for all disease categories on an outpatient basis and 11.8% lower for inpatients). In the hospital sectors, government hospitals have a consistently higher rate of successful treatment for outpatients than do mission hospitals. However, mission hospitals have a higher rate of successful treatment for each disease group treated on an inpatient basis. These results may only reflect, however, the absence of evidence needed to estimate the number transferred or treated "unsuccessfully".

Finally, at least 5% of all outpatient initial demanders (with the exception of the government hospital treatment of skin and musculo-skeletal diseases), and in many cases more than 10%, are not treated in such a way that they can resume major activities. With the exception of mission hospitals in certain disease categories (pregnancy and puerperium, and skin and musculo-skeletal), this is true for inpatient care as well, although it appears that the overall rate of successful treatment for inpatient care is generally higher than that for outpatient care.

Table 5.4 Estimates of the Rate of Successful Treatment, $(\frac{1}{a_j})$, for the Outpatient Treatment Process.

Disease Category	Government Hospitals	Mission Hospitals	Government Rural Units W/Beds
I&P	0.92	0.86	0.87
NG	0.40	0.40	0.22
AMB	0.75	0.69	0.80
NS	0.86	0.85	0.78
Circ	0.22	0.39	0.26
Resp	0.95	0.89	0.83
Alim	0.94	0.86	0.67
GU	0.89	0.75	0.95
Preg & Puer	0.58	0.57	0.94
Del w/o	----	----	----
S&MS	0.96	0.95	0.89
NB	0.73	0.55	0.92
Ill Def	0.90	0.81	0.90
Inj	0.91	0.83	0.77

Table 5.5 Estimates of the Rate of Successful Treatment, $(\frac{1}{a_j})$, for the Inpatient Treatment Process.

Disease Category	Government Hospitals	Mission Hospitals	Government Rural Units W/Beds
I&P	0.90	0.94	0.86
NG	0.82	0.89	0.66
AMB	0.83	0.95	0.70
NS	0.84	0.90	0.83
Circ	0.84	0.90	0.72
Resp	0.91	0.95	0.87
Alim	0.92	0.96	0.81
GU	0.94	0.97	0.81
Preg & Puer	0.97	0.98	0.79
Del w/o	1.00	1.00	1.00
S&MS	0.96	0.98	0.77
NB	0.79	0.82	0.83
Ill Def	0.87	0.95	0.72
Inj	0.93	0.97	0.64

The Objective Function

As Martin Feldstein discusses,[12] there are a number of objective functions that can be specified with some justification when linear programming is used in the analysis of health services. The analysis of Uganda's stated objectives for curative health services undertaken in Chapter Four indicates that the government has placed a high priority on the provision of quality health care. The analysis further indicates that the government could, in pursuing this objective, maximize the number of successfully treated patients as well.

In the empirical analysis discussed in the section which follows, an objective function consistent with the Ugandan government's quality and quantity objectives for its curative health services was used. The objective function uses the rate of successful treatment as its set of weights.[13] (See Tables 5.4 and 5.5 for the values of these weights for each sector and treatment process.) In addition experimentation was conducted with a second objective function which differed from the first as follows: the second one possessed an additional constraint that at least one-half of all initial demanders in each disease category were provided with service. By adding this constraint to the objective function, all disease types from each treatment process were included in the linear programming solution. The results of this analysis are presented in Appendix C.

Presentation of Empirical Results of the Linear Programming Model

The Results

The linear programming solutions for each sector of Uganda's health service system are presented in Table 5.6. The table describes the number of successfully treated cases by disease category in each health sector,

Table 5.6. Summary of Linear Programming Solution for Uganda Government Hospitals, Mission Hospitals and Government Rural Units for 1968/69.

Objective Function: Rate of Successful Treatment

No Minimum Quantities Constraint Imposed on the Number of Each Type of Initial Demanders which Must be Treated.

I Optimum Number of Cases Treated

(A) OUTPATIENT

Outputs	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj
Goverment Hospitals (1)	0.73	0.40	0.00	0.86	0.00	0.95	0.94	0.89	0.00	-	0.96	0.73	0.90	0.18
Current Values of (3) Initial Demanders	1,856,893	4,969	57,181	316,427	5,422	1,080,744	760,258	141,520	30,838	-	763,935	11,448	245,761	533,597
Mission Hospitals (1)	0.57	0.40	0.00	0.85	0.39	0.89	0.85	0.75	0.57	-	0.95	0.55	0.00	0.12
Current Values of (3) Initial Demanders	357,826	1,245	32,459	46,811	3,157	125,270	93,821	26,308	10,720	-	105,501	3,320	23,867	21,382
Government Rural Units (1)	0.55	0.00	0.00	0.78	0.00	0.83	0.54	0.95	0.94	-	0.89	0.92	0.90	0.00
Current Values of (3) Initial Demanders	2,524,020	153	50,015	358,048	136	1,670,109	846,656	150,793	65,725	-	938,236	2,682	493,659	609,980

(B) INPATIENT

Outputs	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj	Objective Function Equals	Total No. Initial Demanders
Goverment Hospitals (1)	0.90	0.00	0.00	0.00	0.00	0.91	0.26	0.00	0.00	1.00	0.00	0.00	0.00	0.00	4,663,032	
Current Values of (3) Initial Demanders	37,464	4,085	10,467	6,107	3,845	23,642	22,505	8,830	25,017	44,911	10,379	1,976	4,371	24,103		6,033,695
Mission Hospitals (1)	0.06	0.00	0.00	0.00	0.00	0.95	0.00	0.97	0.98	1.00	0.00	0.00	0.95	0.00	614,749	
Current Values of (3) Initial Demanders	29,147	1,855	8,876	2,971	1,758	11,526	12,130	5,498	8,888	16,359	3,980	2,558	3,461	3,081		963,684
Government Rural Units (1)	0.86	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	5,192,066	
Current Values of (3) Initial Demanders	89,954	480	1,570	480	369	40,453	11,226	2,659	21,872	57,995	7,976	129	12,925	15,104		7,973,404

II Shadow Prices of Case Types Appearing in the Linear Programming Solution and the Cost of Forcing Non-Optimal Case Types into the Solution

(A) OUTPATIENT

Initial Demanders	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj
Government Hospitals														
(a) Shadow Prices (4)	0.00	0.05	0.00	0.71	0.00	0.84	0.80	0.79	0.00	-	0.71	0.64	0.58	0.00
(b) Cost of Non-Optimal (5)	-	-	5.93	-	3.84	-	-	-	0.07	-	-	-	-	-
Mission Hospitals														
(a) Shadow Prices (4)	0.00	0.06	0.00	0.44	0.08	0.34	0.32	0.30	0.25	-	0.54	0.24	0.00	0.00
(b) Cost of Non-Optimal (5)	-	-	7.63	-	-	-	-	-	-	-	-	-	0.14	-
Government Rural Units														
(a) Shadow Prices (4)	0.00	0.00	0.00	0.37	0.04	0.60	0.00	0.45	0.37	-	0.09	0.26	0.29	0.00
(b) Cost of Non-Optimal (5)	-	0.91	0.21	-	-	-	-	-	-	-	-	-	-	0.59

(B) INPATIENT

Initial Demanders	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj
Government Hospitals														
(a) Shadow Prices (4)	0.04	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal (5)	-	2.28	0.71	0.68	1.19	-	-	0.23	0.11	-	0.79	0.35	0.89	0.80
Mission Hospitals														
(a) Shadow Prices (4)	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.06	0.02	0.41	0.00	0.00	0.38	0.00
(b) Cost of Non-Optimal (5)	-	1.04	0.33	0.29	1.79	-	0.02	-	-	-	0.39	0.29	-	0.11
Government Rural Units														
(a) Shadow Prices (4)	0.18	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal (5)	-	2.69	1.43	0.14	0.11	-	1.33	0.23	0.41	-	1.12	0.27	0.58	2.70

III Shadow Prices and Slack Quantities of Service-Providing Inputs

Inputs (2)	(1) Drs.	(2) Med/N Assts.	(3) Prof. N/MW	(4) Enrolled N/MW	(5) Tr.Lab.	(6) Tr.XRay	(7) O. Tr. Med	(8) O. Tr. Non Med	(9) O. Non Tr. Med	(10) O.Non Tr. Non Med	(11) Students	(12) Beds	(13) Drugs etc.	(14) Food	(15) Vehicle Op.&Maint.	(16) Electr.	(17) O.Op.& Maint.
Government Hospitals																	
(a) Shadow Prices (6)	0.00	0.00	0.00	0.00	5.51	11.18	0.00	3.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	365,824	434,844	388,314	1,739,518	0	0	194,022	0	620,104	1,595,639	1,301,140	1,686,021	5,970,248	2,924,870	242,797	1,601,077	1,116,583
(c) Current Values (3)	550,800	575,400	529,920	2,395,995	126,000	50,400	396,900	244,650	2,691,255	4,178,160	1,854,000	1,956,035	10,438,134	4,167,795	747,723	2,880,252	1,945,927
Mission Hospitals																	
(a) Shadow Prices (6)	0.00	57.14	0.00	0.00	0.53	1.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	57,612	0	143,948	271,021	0	0	7,209	1,452	466,873	418,970	521,405	861,660	1,165,892	497,280	214,539	315,120	566,002
(c) Current Values (3)	126,921	6,300	292,608	404,130	105,000	23,100	13,965	7,875	895,755	845,502	770,000	1,111,060	1,977,712	734,373	393,242	656,442	978,549
Government Rural Units																	
(a) Shadow Prices (6)	-	0.00	-	0.00	88.37	-	0.00	23.26	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	-	141,557	-	71,943	0	-	7,516	0	96,585	54,108	-	724,625	23,430	106,779	8,322	35,301	213,373
(c) Current Values (3)	-	366,240	-	273,105	10,500	-	61,110	117,250	897,750	1,593,900	-	1,281,880	2,173,626	285,935	1,757,191	112,676	969,392

Notes: (1) The optimum number of successfully treated cases is expressed as a proportion of the current value figure which is the number of initial demanders.

(2) Inputs numbered 1-11 are measured in hours; input 12 is measured in bed days; and inputs 13-17 are measured in shs.

(3) The current value figures under the optimum number of cases treated and slack quantities of service-providing inputs represent the two parts of the input vector, the service-demanding and service-providing inputs respectively.

(4) The shadow prices of initial demanders show the amount by which the objective function could increase if an additional initial demander with the given disease characteristics were to demand service.

(5) The cost of adding a non-optimal case to the solution shows the amount by which the objective function would decline if one of those types of cases were treated as opposed to those cases which are treated.

(6) The shadow price of the service-providing inputs shows the amount by which the number of successfully treated persons would increase if one additional unit of that input were made available.

when (a) the objective function is specified in terms of the rate of successful treatment (RST) and (b) no constraint is placed on the minimum number for each type of initial demander included in the solution. This number is presented in the table as a proportion of the total number of initial demanders. For example, 94 percent of all persons treated at government hospitals in 1968/9 on an outpatient basis for alimentary diseases (760, 258) were successfully treated. Similarly, 85 percent (of 93,821) and 54 percent (of 846,656) persons so afflicted were successfully treated at mission hospitals and government rural units respectively. The total number of successfully treated in each sector is shown on the far right-hand side of the table, under the heading "objective function equals."

The proportion of total initial demanders successfully treated across sectors is presented in Table 5.7 below.

TABLE 5.7 Proportion of Total Initial Demanders Comprised by Successfully Treated Cases, By Sector

Sector	Total Number of Initial Demanders	Total Number of Successfully Treated	Percentage Successfully Treated
Government Hospitals	6,033,695	4,663,032	77.3
Mission Hospitals	963,684	614,749	63.8
Government Rural Units	7,973,404	5,192,066	65.1
All Sectors	14,970,404	10,469,847	69.9

(Note: Figures for this table were derived from Table 5.6)

The figures suggest that a larger proportion of initial demanders at government hospitals are included in the number of successfully treated in the optimal solution. Although the disease-specific RST's are generally higher in mission hospitals than in either government sector, the overall proportion of total initial demanders comprised by the successfully treated is lowest in the mission sector, 63.8 percent. This finding is due primarily to the fact that the proportion of initial demanders treated on an inpatient basis at mission hospitals is greater than is true for either government sector. Inpatient cases comprise 11.6 percent of total mission hospital cases, 3.7 percent of total government hospital cases, and 3.3 percent of rural unit inpatient cases. Since inpatient treatment requires a larger set of resources than does outpatient care, mission hospitals will necessarily treat a smaller proportion of initial demanders if they must be treated on an inpatient basis. The overall proportion of successfully treated cases in government rural units is lower than in government hospitals because the disease-specific RST is generally lower in rural units compared to hospitals.

In regard to the output case mix, a similar pattern emerges across all three sectors of the health service system. First, with the exception of infectious and parasitic diseases (I&P), respiratory conditions (Resp.), and uncomplicated deliveries (Del. w/o), virtually all output is treated on an outpatient basis. It is significant that these three disease categories, when treated on an inpatient basis, require little, if any surgical service and have the lowest average length of stay for all disease categories.[14]

Second, allergic, metabolic and blood (AMB), does not appear in any sector's outpatient disease distribution solution. In addition, accident and injury cases (Inj.) appear in two of the three sectors (mission and government hospitals), but are significantly below the potential rate of successful treatment, and circulatory diseases (Circ.) only appears in the mission hospitals solution.

The disease types mentioned above do not appear (or appear only marginally) in the solutions for at least two reasons. First, most of the excluded case types are relatively large users of scarce resources. This fact is seen in each sector's technological matrix (See Appendix C), comparing the disease-specific 'resource use' elements found in the tables. For example, the AMB disease category has a very high rate of use of scarce trained laboratory staff time, which is a binding constraint in all three sectors. (The constraint is measured by the input's shadow price in the third section of Table 5.6.) Second, most of the excluded case types have a lower rate of successful treatment than do those included in the solution. (See Table 5.4 for the disease-specific RST.) A lower RST tends to exclude a category from high priority in the optimal solution since the weight attached to the objective function is low.

Two sets of figures for each sector -- the shadow prices of case/disease types appearing in the LP solution and the cost of forcing non-optimal disease types into the solution[15] -- are presented in the second section of Table 5.6. The shadow prices of disease types suggest a demand constraint imposed upon the optimal solution for each sector, as each sector could increase its output of successfully treated cases of more initial demanders had illnesses falling within particular categories. For example, in the case of government rural units, if one more person with a respiratory illness, rather than an alimentary disease, had presented himself at a health center, the objective function for government rural units would have increased by 0.60, which would be the increase in the number of successfully treated persons.[16] The shadow price figures can be used to obtain a relative ranking of the disease category which is the most binding in the sense of increasing the value of the maximized objective function. Among disease groups which have the highest shadow prices and manifest the most binding demand constraints on the outpatient treatment process of all three sectors are respiratory (Resp.), nervous system and sense (NSS), genito-urinary (GU), skin and musculo-skeletal (S&MS), and new born (NB) cases. Only uncomplicated delivery (Del. w/o) and respiratory (Resp.) cases appear consistently on the inpatient side; uncomplicated deliveries have shadow price values of 0.62, 0.41, and 1.00, and respiratory cases have shadow price values of 0.02, 0.11, and 0.31, for government hospitals and government rural units respectively.

The second set of numbers presented in this section, the cost of forcing non-optimal case types into the solution, indicates the size of the trade-off which is imposed on each sector when it treats one more case of a disease which does not appear in the optimal solution. For example, the cost of treating an AMB case in a mission hospital on an outpatient basis means that the value of the objective function will decline by 7.63 successfully treated persons. The cost figures presented in Table 5.6 indicate that most of the non-optimal disease types are treated on an inpatient basis, although the highest cost disease category is AMB, particularly when treated on an outpatient basis in the two hospital sectors. If, over time, each sector of the health service system operates under an implicit policy of treating persons on a "first come, first served" basis, and the entire spectrum of diseases (as indicated by the current value figures for each sector's initial demanders, contained in the first section of Table 5.6) appears in the queue for treatment, the cost figures for non-optimal case types is high.

The third section of Table 5.6 presents the shadow prices and resulting slack quantities of service-providing inputs implied by the linear programming solution for each sector of the health service system. The shadow price figures first indicate that the most binding supply constraints in the delivery of health services are trained laboratory and radiographic staff and other trained, non-medical staff (primarily ambulance drivers), all of which are manpower inputs. The high shadow price for medical and nursing assistants in mission hospitals is explained by the fact that there were only three such employees in mission hospitals at the time of the research. The actual shadow price figures show that if, for example, one more hour of trained laboratory staff time becomes available in government hospital's objective function would rise by 5.51 successfully treated persons. These shadow price figures thus can be interpreted as a first approximation of the marginal value of an hour of overtime for those already employed or the marginal value of the first few hours worked by a new employee.

Second, the shadow price figures indicate that at a time when many countries are concerned about the "need" for more doctors, other high level professional medical manpower, and beds, all of these inputs are in a position of considerable slack in each sector of the health service system in which they are used. Table 5.8 (derived from figures presented in the third section of Table 5.6), for example, presents the results of an analysis of the proportion of slack contained in the total supply of any given input. The results suggest that at least 66 percent of the available supply of doctor's time in government hospitals is not required in that sector's solution. Similarly, between 73 and 86 percent of the available supply of other "important" inputs - medical and nursing assistants, professional and enrolled level nurses, midwives, and beds in government hospitals are not required in the solution.

Other important findings concerning slack supplies of inputs are contained in Table 5.8. First, the data suggest that both government and mission hospitals have the largest proportion of slack inputs, given the nature of the linear programming solution.[17] Second, the inputs least utilized in every sector (i.e., those which have the greatest proportion of slack) are the ones about which the government and the medical profession have been most concerned. Even in government rural units, the least utilized input is beds.

Third, although some of the government rural unit inputs manifest a certain proportion of slack (as mentioned above), many of them were used almost completely in the optimal solution. Vehicle operation and maintenance,

Table 5.8 Relative Proportion of Slack for Each Service-Providing Input By Sector of Uganda's Health Service System in 1968/69, Given the Linear Programming Solution.

Objective Function: Rate of Successful Treatment.

Inputs	Government Hospitals	Mission Hospitals	Government Rural Units
Doctors	0.66	0.45	----
Medical and Nursing Assts.	0.76	0	0.39
Professional Nurses/Midwives	0.73	0.49	----
Enrolled Nurses/Midwives	0.73	0.67	0.26
Trained Lab Staff	0	0	0
Trained X-Ray Staff	0	0	----
Other Trained Medical Staff	0.49	0.52	0.12
Other Trained Non-Medical Staff	0	0.18	0
Other Non-Trained Medical Staff	0.23	0.52	0.11
Other Non-Trained Non-Medical Staff	0.38	0.50	0.03
Students	0.70	0.68	----
Beds	0.86	0.78	0.56
Drugs, etc.	0.57	0.59	0.01
Food	0.70	0.68	0.37
Vehicle Operation and Maintenance	0.32	0.55	0.01
Electricity	0.56	0.48	0.31
Other Operation and Maintenance	0.57	0.58	0.22

Note: The figures found in this table were derived from data presented in the third section of table 5.6.

as well as drugs and medical supplies, are particularly noteworthy in this regard. This situation was not the case for any input in either hospital sector.

Policy Implications

Several health policy implications can be drawn from the findings of the linear programming solutions. First, the information suggests that over-emphasis has been and continues to be placed on the expansion of (a) hospitals vis-a-vis rural facilities and (b) high level manpower vis-a-vis technical personnel, whose specialties tend to facilitate improvement in accuracy of diagnosis. Results presented in Table 5.6 and 5.7 indicate that the rural health service system provides services to more initial demanders than do the two hospital sectors combined. It also provides inpatient care to a larger number of service-demanders than do government hospitals (263,192 compared to 224,702) and it performs approximately 50 percent of all normal deliveries (57,895 in rural units compared to 58,270 in hospitals). At the same time, its resource endowment is severely limited. Given these findings, in addition to the fact that beds represent the service-providing input with the greatest proportion of slack (Table 5.8), little economic justification is available for expanding the number of hospital facilities.

Similarly, although training facilities for doctors, medical assistants, and nurses and midwives have been expanded in recent years, the most binding service-providing input constraint on the provision of high quality health services appears to be the under-supply of technical personnel, such as laboratory and radiographic technicians and skilled ambulance drivers.

Uganda's Third Development Plan notes the importance of training more laboratory and radiographic technicians,[18] but the short supply of ambulance drivers, given present disease-specific transfer rates, has not been seriously addressed as yet.

The data also suggest that more attention should be given to ways of improving the utilization of potentially slack inputs in each sector. The following set of possibilities is by no means exhaustive, but indicates the type of alternatives available. First, work within the curative treatment processes could be reorganized in order to (a) expand the supply of service-providing inputs for use in outpatient work or (b) improve the diagnostic process for patients of either treatment process by retraining some employees to work as laboratory or radiographic technicians. Second, service-providing inputs having considerable slack in hospitals (e.g., doctors, professional nurses and midwives) could be transferred to rural health facilities where such highly trained manpower currently does not exist. This reallocation is but one possible means by which the differential in the disease-specific rates of successful treatment between government rural units and hospitals could be reduced. (Complementary inputs such as drugs could also be included in any reallocation effort.)

Finally, slack inputs could be used in the production of preventive health services to be consumed (a) at the health facility (e.g., young child clinics, to minimize AMB cases, which are not included in the solution), or (b) on a community basis (e.g., improved sanitation facilities or water supplies). It is heartening to note that the Third Development Plan significantly increases the budgetary allocation for water supplies, as opposed to curative health services *per se*.[19] Perhaps manpower retraining schemes are needed to shift slack manpower resources into health-improving activities other than curative care. In addition, given the apparent demand by consumers for some form of health service, government pharmacies perhaps could dispense drugs at cost or at subsidized prices, as an alternative to the use of health facilities for such purposes; released resources could well be more productively employed in other sectors of the economy.

If any of the above health policy implications are to be examined or explored, it is important that the Ministry of Health (a) continue to improve its statistics and statistical procedures and (b) expand its capacity to analyse the health service system by using techniques developed in this research, expanding on them over time in order to answer other questions. Of particular importance would be the use of parametric programming techniques as a basis for exploring the extent to which a reallocation of inputs will both relieve currently binding constraints as well as introduce new ones.

An Empirical Exploration into Factors Affecting the Output of the Health Service System and Resources Available for Delivering Health Services in the Future.

The discussion which follows presents results of linear regression analysis of the factors affecting the output and inputs of Uganda's health service delivery system. This analysis is based on ideas developed in Chapter Four. It is undertaken in order to project trends implied in present curative health service policies so that decision makers can better evaluate the longer run resource and output implications of present actions.

The analysis focuses on the factors affecting the total number of persons demanding service. It then turns to a discussion of changes that have occurred in the disease mix of initial demanders; these factors are of importance in understanding both the epidomiological transition which is under way in Uganda and the effects which that transition will have on health resources and outputs.[20] An analysis of the factors affecting the rate of successful treatment is subsequently conducted. Finally the results of an analysis of the factors affecting the supply of two important inputs used in the production of health services, drugs and the recurrent budget, are presented.

The results discussed in this section are incorporated into the final section of the chapter. Some of the estimated relationships found in this section are used in estimating the values of the elements of the input-vector for 1980/81. A further discussion of the important findings of that section is deferred until then.

Factors Affecting the Total Number of Persons Demanding Service

In Chapter Four, the functional relationship between the number of initial demanders and the variables affecting that number is specified. In a sense, the relationship specified is similar to a demand equation, where price, income and other factors peculiar to the market for curative health services are included. In Chapter Four, it was suggested that the relationship could be specified as follows:

(3) $S = S(O,Y,a,b,I,d)$, where

S = the total number of initial demanders,

O = population size,

Y = GDP per capita,

a = the rate of successful treatment,

b = price of curative health services,

I = the incidence of illness episodes, and

d = the average distance to health facilities.

In addition, it was indicated that price and distance could be specified as follows:

(4) $b = b\ (\frac{M}{H})$ and

(5) $d = d\ (H,\ (\frac{GR}{G}))$, where

H = total number of health facilities

$(\frac{M}{H})$ = ratio of mission health facilities to all health facilities, and

$(\frac{GR}{G})$ = the ratio of rural government facilities(non-hospital) to all government facilities.

Empirical analysis, however, requires several changes in these equations. First, although there are time series data available for most variables, there are no data available for the incidence of illness episodes and only limited cross-sectional data are available on the rate of successful treatment; as a result, the statistical analysis is likely to include misspecification error. Such specification error may result in biased and inconsistent estimates of the parameters of the variables included, however, only if the variables excluded are correlated, positively or negatively, with those that are included.[21]

In this explanatory analysis, it is difficult to determine whether correlation does exist between the two sets of variables. It may be argued that the incidence of illness episodes per person per year is negatively related to income, however, little evidence is available to support the hypothesis. For purposes of this analysis, it is assumed that correlation between the variables does not exist and, thus, that the parameter estimates do not contain any systematic bias.

Another problem arises in estimating the effects of the price paid for the curative services consumed in mission health facilities, and the distance variable, d, which was used as a proxy for the opportunity cost of obtaining a "free" set of services provided by the government. Since each of the two variables are only partial indicators of the total price paid by the demander of a set of curative health services, the econometric analysis used several alternative specifications utilizing different combinations of these variables. As a first approximation, the analysis assumes that a linear functional form can be used and that the basic assumptions for using ordinary least squares (O. L. S.) techniques hold.

The basic econometric equation estimated is presented below with the statistical results:[22]

$$(6) \quad S = \underset{}{22345.86} + \underset{(0.68)^{***}}{2.48(O)} - \underset{(226.32)}{339.85(Y)} - \underset{(57.82)}{80.88\left(\frac{M}{H}\right)} + \underset{(17.05)^{***}}{43.49(H)} - \underset{(174.66)^{**}}{397.97\left(\frac{GR}{G}\right)}$$

(Linear Functional Form)

$n = 20$

$R^2 = .989$, $\bar{R}^2 = .984$, d.w. = 2.01;

$$\begin{array}{llllllll} (7) & S = 2.05 & + 1.61(O) & - 0.69(Y) & + 0.19(\frac{M}{H}) & + 1.53(H) & - 3.83(\frac{GR}{G}) \\ & & (0.42)^{***} & (0.31)^{**} & (0.11)^{*} & (0.44)^{***} & (1.38) \end{array}$$

(Linear in Logarithms Functional Form)

$n = 20$

$\overline{R}^2 = .991$, $\overline{R}^2 = .988$, d.w. = 2.17; and

* = significant at < 0.10, ** = significant at < 0.05, and *** = significant at < 0.01.

The results suggest several important findings. Most important is the negative relationship between per capita income and the number of initial demanders. Results of the log equation indicate that the income elasticity of demand is negative and inelastic (-0.69). Reasons for this finding are difficult to discern but the following tentative solution is corraborated by other results.

First, the data used to estimate the number of initial demanders were taken from the government sector of the health service system only. As a consequence, the sign of the income coefficient may reflect the fact that as incomes rise in Uganda, people demand a higher quality package of health services, i.e., a higher rate of successful treatment, which may be available either in mission hospitals or from urban-based private physicians. The data in Table 5.5 indicate that there is a generally higher rate of successful treatment for inpatient care in mission hospitals.

The suggestion that people demand a higher quality package of health services as incomes rise also helps to explain the positive relationship found between the number of initial demanders and the ratio of mission hospitals to total health facilities, (see for example, the results of the linear in logarithms equation (26) in Table D.8, Appendix D. Of interest is the fact that this positive relationship occurs even though it might be expected that the existence of a positive money price in mission hospitals would retard the number of persons seeking such service. Since the rate of successful treatment is generally higher in mission hospitals, a person who requires care and has enough money will rationally seek service at mission hospitals rather than government hospitals.

Another result of the analysis indicates, as expected, the positive effect of population growth on the number of initial demanders. The more interesting findings, however, lie in the relationships between the total number of initial demanders and (a) the total number of health facilities (H), and (b) the ratio of rural to total government facilities $(\frac{GR}{G})$. Total number of health facilities was positively related to the number of initial demanders, and the ratio of rural units to total government facilities was negatively related. These findings are not inconsistent with expectations concerning the opportunity cost of time and the way in which perceptions of quality would affect the consumption of health services.[23] It is particularly interesting to note, however, that the number of demanders is highly responsive to changes in the number of facilities with the log equation, suggesting an estimate of the elasticity of initial demanders with respect to facilities greater than 2.

In the case of the negative relationship between the ratio, $\frac{GR}{G}$, and initial demanders, the findings suggest that although rural unit facilities may be closer (thereby reducing the opportunity cost of time in consuming the service) the perceived difference in quality between rural units and hospitals is sufficiently great to offset the reduced opportunity cost of consuming. The data in Table 5.4 and 5.5 suggest that consumers are rational in their discrimination between the services and outcomes obtained in rural health units as opposed to either hospital sector. Since the signs of estimated coefficients for the variables 'total health facilities' and 'ratio of rural units to total government units' are different, an interaction occurs between quality and price when the total number of health facilities increases due to an increase in the number of rural units. The net impact depends on the actual values of each variable, H and $\frac{GR}{G}$, but they do tend to offset one another.

Changes in Disease Mix of the Initial Demanders

Although a complete analysis of the reasons for changes in the disease mix of initial demanders would encompass a study in itself, relating a number of socio-economic as well as medical and cultural factors, the results of an initial analysis of disease mix changes in hospital inpatient and outpatient categories are presented in this section.

Annual data were used on the number of persons treated in government and mission hospitals on an inpatient and outpatient basis by 14 major disease classifications. The data for government hospitals extends from 1952 to 1968/69 (18 observations), and the series for missions extends from 1958 to 1968/69 (12 observations).[24]

The analysis estimated the average annual rate of change for each disease group as a proportion of the total number of cases treated in a government or mission facility by inpatient or outpatient treatment process. Formally, the estimation equation was specified as follows:

(8) $Y_j = a_j + b_j X + \varepsilon$ where

Y_j = proportion of total disease treated in disease category j,

$j = (1,\ldots,14)$,

X = year,

ε = disturbance term, and

a_j and b_j = are the estimated parameters.

The results of this analysis are presented in Table 5.9.

The most important finding, which corraborates information on disease mix change presented in Chapter Two (see Tables 2.13 - 2.16), is the significant decline in the proportion of infectious and parasitic diseases treated in hospitals on either an inpatient or outpatient basis. In government hospitals, for example, the annual rate of decline in the proportion of infectious and parasitic diseases was about 0.4% per year for outpatients and 0.8% per year for inpatients. This finding is coupled with a significant rise in the proportion of pregnancy and normal delivery cases treated on an inpatient basis in government hospitals. Also worthy of note are the positive coefficients for allergic, metabolic and blood diseases and alimentary diseases; within those categories many specific cases are related either to poor nutrition or to gastro-enteritis affecting mothers and children. Given that these four

Table 5.9 , Estimates of the Annual Rate of Change in the Distribution of Diseases Treated on an Outpatient and Inpatient Basis in Government and Mission Hospitals.

Disease Category	Government Hospitals Outpatient	Government Hospitals Inpatient	Mission Hospitals Outpatient	Mission Hospitals Inpatient
	18 observations		12 observations	
Infectious & Parasitic	-0.409** (0.151)	-0.822*** (0.147)	-0.295** (0.121)	-0.822*** (0.183)
New Growths	0.003 (0.002)	0.049*** (0.015)	-0.030*** (0.006)	-0.035 (0.033)
Allergic Metabolic & Blood	0.048*** (0.010)	0.197*** (0.026)	0.095** (0.033)	0.424*** (0.059)
Nervous System and Sense	0.273*** (0.055)	-0.019 (0.019)	0.183** (0.075)	0.032 (0.023)
Circulatory	0.008** (0.004)	0.043* (0.023)	0.003 (0.004)	0.021 (0.012)
Respiratory	0.253*** (0.059)	0.050 (0.058)	0.083 (0.113)	-0.070 (0.085)
Alimentary	0.093** (0.040)	0.252*** (0.023)	0.233* (0.113)	0.247*** (0.069)
Genito-Urinary	0.121*** (0.016)	0.029 (0.035)	0.004 (0.034)	-0.093* (0.050)
Pregnancy & Puerprium	0.047*** (0.009)	0.310*** (0.063)	-0.126 (0.079)	-0.026 (0.110)
Delivery w/o Complication	-- --	0.531*** (0.060)	-- --	0.382 (0.393)
Skin & Muscule-Skeletal	-0.011 (0.042)	-0.181*** (0.046)	0.090* (0.042)	-0.036 (0.034)
New Born	-0.003 (0.006)	-0.018* (0.010)	0.024* (0.011)	0.009 (0.046)
Ill Defined	0.017 (0.063)	-0.400*** (0.051)	-0.304 (0.192)	-0.032 (0.050)
Injuries	-0.197*** (0.040)	-0.027 (0.037)	-0.102* (0.055)	-0.012 (0.027)

NOTE: Significant at < 0.10 *
Significant at < 0.05 **
Significant at < 0.01 ***

The Figures presented in this table are the estimated bj's.

disease categories comprise 17.6% of the total outpatients treated and 44.4% of the inpatients treated in government hospitals in 1968/69,[25] and given that the three latter disease categories are increasing as a proportion of all cases, it can be said that maternal and child health is rapidly becoming the most significant health problem facing Uganda today.

Factors Affecting the Rate of Successful Treatment

It was hypothesized in Chapter Four that the rate of successful treatment is a function of (a) differences in the composition of diagnostic service inputs $(\frac{v_r}{v_r},)$[26], medical technology, (c) the disease mix of initial demanders $\overset{*}{S}$, and (d) the ratio of service-providing inputs to initial demanders, $(\frac{\overset{*}{V}}{\overset{*}{S}})$. The medical technology variable could not be included in the empirical analysis, as there were no data available to estimate its magnitude. In addition, insufficient data were available on components of the rate of successful treatment for each health facility included in the sample. As a result, the dependent variable used in the analysis is a hybrid, $\overset{*}{a}$. For the outpatient treatment process, it is the proportion of the total number initially demanding service, S, which is comprised of the number transferred to other health facilities or treated on an inpatient basis. For the inpatient treatment process, it is the proportion of those treated who are either transferred to another facility or who die. Basically, $\overset{*}{a}$ can be interpreted as a rate of unsuccessful treatment. Use of this dependent variable, $\overset{*}{a}$, rather than a, makes more difficult the interpretation of the estimated coefficients; it is clear however, that the signs of the estimated relationships between the dependent and independent variables would change if a were to be substituted for $\overset{*}{a}$ in the equation.[27]

Three dummy variables were incorporated in the analysis in order to determine whether any institutional factors affect the rate of successful treatment. The first such variable was 'hospitals or non-hospital facilities'. The second was 'rural units with or without inpatient care', and the third distinguished between government and mission hospitals.

The empirical analysis used cross-sectional data, as there was no time series information available on the rate of successful treatment.[28] The econometric relationship estimated used ordinary least squares statistical techniques and it was assumed that a linear functional form was appropriate. The most interesting findings were obtained when the data for hospitals and rural units were combined to analyze the factors affecting the outpatient rate of successful treatment. The results are summarized below in a presentation of the estimated parameters obtained for one equation.[29]

$$
\begin{array}{llllll}
(9)\quad \overset{*}{a} = 299.46 + 3.98\left(\frac{v_r}{v_r'}\right) & - 2.37(I\&P) & - 3.37(AMB) & - 2.20(NS) & - 2.36(Resp) \\
\qquad\qquad\qquad\quad (2.27)^{*} & (0.67)^{***} & (0.99)^{***} & (0.74)^{***} & (0.66)^{***}
\end{array}
$$

$$
\begin{array}{lllll}
-2.33\,(Alim) & - 1.42(GU) & - 3.00(Preg\ \&\ Puer) & - 2.58(S\&MS) & - 2.42(Ill\ Def) \\
(0.69)^{***} & (0.76)^{*} & (0.97)^{***} & (0.66)^{***} & (0.76)^{***}
\end{array}
$$

$$
\begin{array}{lllll}
-2.75\,(Inj) & + 0.08\left(\frac{\overset{*}{v}}{\overset{*}{s}}\right) & + 4.38(Hosp) & + 5.96(GRB) & + 9.33(GOVMI), \\
(0.75)^{***} & (0.07) & (2.60)^{***} & (1.68)^{***} & (3.00)^{***}
\end{array}
$$

$n = 20$

$R^2 = .81,\ \bar{R}^2 = .75,$

where $\overset{*}{a}$, $\left(\frac{v_r}{v_r'}\right)$, and $\left(\frac{\overset{*}{V}}{\overset{*}{S}}\right)$ are defined as above,

I&P through Inj = the proportion of the total number of initial demanders comprised by that particular disease type, Hosp = 'hospital, non-hospital' dummy variable, where 1 represents a hospital facility,

GRB = 'rural unit with or without inpatient care' dummy variable, where 1 represents a rural unit with inpatient care, and

GOVMI = 'government or mission health facility' dummy variable, where 1 represents mission units.

Several important results emerge from the data. First, the positive relationship between the rate of unsuccessful treatment and the index of diagnosticians, b_1, tends to suggest, given the construction of the index, that the more the training held by the primary diagnosticians in a given facility, the lower the rate of unsuccessful treatment. Second, the findings for the relationship between (a) the rate of unsuccessful treatment and (b) the ratio of total expenditures to initial demanders, b_{16} (a resource availability variable), are inconclusive because the estimated parameter is not significant. The results suggest additional research, to disaggregate the resources variable, $\overset{*}{v}$, in order to determine if there are particular factors, other than the diagnostician, which affect the rate of successful treatment.

The three institutional dummy variables were very significant. The (Hosp) dummy variable suggests that there is a significantly higher rate of unsuccessful treatment in hospitals than in non-hospital facilities. This finding is primarily reflective of the fact that a higher proportion of outpatients treated at hospitals subsequently become inpatients. The same phenomenon manifests itself in the case of rural units (see the coefficient for the dummy variable GRB), where units with beds have a higher rate of unsuccessful treatment than do those without beds.[30] The coefficient for the third dummy variable (GOVMI) indicates that the rate of unsuccessful treatment in mission hospitals is significantly higher than in government hospitals, again reflecting a higher rate of inpatient treatment on the part of mission hospitals.

The negative signs of the coefficients for case mix variables all suggest that the higher the proportion of a particular disease type in the total disease mix, the lower is the rate of unsuccessful treatment for that disease. The results are somewhat puzzling in that all disease types introduced into the analysis have a positive effect on the rate of successful treatment. It may be that the case types not included in the analysis[31] create a negative impact on the rate of successful treatment for outpatients. Even though the signs for all disease-type coefficients are negative, however, their relative magnitude suggests that certain disease types have a greater impact on the rate of successful treatment than do others. For example, persons with diseases in the categories of AMB, Preg and Puer, and Inj tend to have a greater positive impact on the rate of successful treatment than do others.

Factors Affecting Selected Service-Providing Inputs

In Chapter Four, the service-providing input vector was disaggregated into four sub-sets: manpower, capital, other material inputs, and budget or financial inputs. The data were insufficient for econometric analysis of factors affecting the supply of manpower. Estimates of this input for 1980/81 projection, however, were based on projected training school output, adjusted for retirements and turnover; for untrained personnel, it was assumed that the labor supply function is perfectly elastic at the existing minimum wage.

An expected result was confirmed in an analysis of the capital input: the government's developmental priorities constitute the most important factor affecting the supply of capital available to the health service system. The present government's building and construction plans in the field of health were used as a first approximation of the future supply of capital to health, and these plans were utilized in the 1980/81 projections.

More extensive analyses of two inputs -- imported drugs and recurrent budget -- were undertaken in order to better determine the factors affecting their supply. The results of these analyses were then used to estimate the value of several inputs in the service-providing input vector for the linear programming solution of the health service system in 1980/81.

Drugs

The availability of drugs is assumed to be related to the general economic well-being of the country as measured in three ways: (a) total monetary GDP (b) capacity to expand imports easily, as measured by the difference between total exports and total imports, and (c) the total level of imports. In addition, it is also expected that the number of initial demanders for health services may have an impact on the authorities' decision to purchase more drugs abroad. As a consequence, the statistical analysis included, in addition to the other factors mentioned, the number of initial demanders (the variable) and the variable lagged by one year, to reflect the lag in obtaining information.

Two examples of the statistical results of the analysis are presented below, along with the equations used in the estimation:[32]

(10) $$v_{n1} = -4.26 + \underset{(0.29)^{***}}{2.00Y} \ \underset{(0.21)}{-0.10IM}$$ (Functional Form, Linear in Logarithms)

$n = 16,$

$R^2 = .96,\ \bar{R}^2 = .95,\ d.w. = 1.64,$ and

(11) $$v_{n1} = -4.16 + \underset{(0.42)^{***}}{1.80} + \underset{(0.22)}{0.05S_{(t-1)}}$$ (Functional Form, Linear in Logarithms)

$n = 16,$

$R^2 = .96,\ \bar{R}^2 = .95,\ d.w. = 1.49,$ where

v_{n1} = total drug imports from outside East Africa,

Y = total monetary GDP,

IM = total imports, and

$S_{(t-1)}$ = total number of initial demanders lagged by one year.

The results show clearly that total monetary GDP is the most important factor affecting the importation of drugs. The income elasticity to import (and demand) drugs appears to be highly elastic (1.8-2.0); this finding is consistent with other estimates of the income elasticity of demand for health services.[33] Neither total imports nor the capacity to import (total exports minus total imports) were found to be statistically significant factors. The initial demander variable (an indicator of a demand-induced supply response) is also statistically insignificant.

Recurrent Budget

The budget, although not a direct service-providing input, provides money necessary for the acquisition of all other inputs. It is comprised of several important factors: (a) the government health budget (central and local) (b) mission grants, (c) fees, and (d) gifts. Although grants and fees are generally increasing, the most important single item in the financial support of the entire health service system is the government's annual appropriation. The empirical analysis, therefore, focuses on the factors which affect the government's recurrent health budget: (a) total monetary GDP (Y), (b) the proportion of recurrent expenditures comprised by recurrent health expenditures $(\frac{GRHE}{GRE})$, (c) the proportion of total government health facilities comprised by government rural units $(\frac{GR}{G})$, and (d) the government's capital budget for health. The two variables, $(\frac{GRHE}{GRE})$ and $(\frac{GR}{G})$, are incorporated to record the effect of shifting governmental priorities (a) between health and other sectors and (b) within the health sector. The capital budget for health is included to determine the effect of present capital priorities on recurrent expenditures; in addition, it is lagged by one and two years in order that the effect of past capital decisions on present recurrent costs may be analyzed. When either lagged form of the variable appears in the equation the non-lagged form is not included.

It is assumed that the econometric analysis can be performed by specifying the functional relationship in a linear form and the OLS techniques apply.

The results of two estimated equations are presented below as examples of the statistical results.[34]

$$\text{(12)} \quad VGB(t) = \underset{}{-18.23} + \underset{(0.14)^{***}}{1.70(Y)} + \underset{(0.20)_{***}}{1.17(\frac{GRHE}{GRE})} + \underset{(2.42)_{**}}{6.18(\frac{GR}{G})} \quad \text{(Linear in Logarithms Functional Form)}$$

$n = 20,$

$R^2 = .98,\ \bar{R}^2 = .98,\ \text{d.w.} = 1.58;$

(13) $VGB(t) = -5.77 + 1.96(Y) + 0.76(\frac{GRHE}{GRE}) + 0.09(GBC(t-1)),$ (Linear in Logarithms Functional Form)

$\qquad\qquad (0.15)^{***} \quad (0.16)^{***} \quad (0.03)^{**}$

$n = 20,$

$R^2 = .98,\ \bar{R}^2 = .98,\ d.w. = 2.02,$ where,

$VGB(t)$ = the recurrent government budget for health at time t,

Y = total monetary GDP,

$(\frac{GRHE}{GRE})$ = the proportion of government recurrent expenditures spent on health,

$(\frac{GR}{G})$ = the proportion of total health facilities comprised by government rural health facilities, and

$GBC(t-1)$ = the government's capital budget for health lagged by one year.

All results are significant. The coefficients for the monetary GDP variable are highly significant and the log equation values suggest a highly elastic income elasticity of demand for health services (around 2.0). Results for other variables suggest that they also significantly affect the size of the recurrent health budget. The fact that the capital budget variable is significant tends to indicate that capital expenditures have a lagged effect on recurrent health expenditures.[35]

Projected Solution of the Linear Programming Model for the Year 1980/81

In order to obtain a better idea of the potential response of the health service system to future demands placed upon it by the growing population of the country, the input vector - both service-demanding and service-providing -- was projected to 1980/81 (the end of the fourth five-year planning period). The projections were subjected to the same linear programming exercise and the results of the projections are compared to the results for the year 1968/69.

Methods and Procedures Used to Project the Input Vector to 1980/81

In order to conduct the linear programming exercise for 1980/81, it was necessary to project the input vector from 1968/69 to that date. It was assumed that no significant changes in medical technology would occur during that period and thus, that the values of the technological matrix would remain constant. It was also assumed that the basic methods of organizing resources and delivering health services within each sector would not change.[36]

The projection effort was conducted in five parts. First the disease mix from 1968/69 to 1980/81 was projected on the basis of information contained in Table 5.9. Where negative values occurred, a minimum value was assumed to exist. This was the situation, for example, in the case of the inpatient, ill defined disease category in government hospitals, where a minimum figure of 0.5% was used.[37] It was assumed that the distribution of diseases for rural units would change at one half the average rate estimated for government and mission hospitals.[38]

The second projection concerned the total number of initial demanders for each sector. These estimates were developed in two ways. For mission hospitals, it was assumed that the total number of initial demanders would increase at the projected rate of population growth (3.6% per year), since no information exists on past trends. This estimate might have been adjusted by taking into consideration the rather high income elasticities of demand for health services from mission hospitals inferred from the analysis in the previous section. It was felt, however, that two factors mitigated against this adjustment: (a) the number of mission hospitals in Uganda will likely decline during the period, and (b) fees are charged for mission services.

An estimate of total initial demanders for government hospitals and rural units, was obtained by equations 4 and 8, Table D.8 , Appendix D. The estimates derived from these two equations were 36,915,000 and 38,016,000 persons respectively; for reasons of conservatism, the figure used was the lower of the two estimates. This figure was then disaggregated between hospitals and rural units on the basis of past trends in the percentage of initial demanders in each sector.

The remaining three parts of the projection required estimates of each service-providing input for the three sectors of the health service system. For mission hospitals, a number of assumptions were made on the basis of available evidence. First, it was assumed that although no new facilities would be built, some additions might be made to existing facilities, such that available beds would rise to about 4,000 by 1980/81.[39] It was assumed that the supply of doctor time would not increase over the period for two reasons: (a) the number of hospitals is not likely to increase, and (b) doctors tend to be in short supply throughout the world and the opportunity cost of being a missionary doctor is rising rapidly. The supply of trained nursing and midwifery staff is expected to expand over the period, primarily as expatriates are replaced and Ugandans trained in mission nurse/midwifery schools are retained. The remaining trained manpower categories are expected to expand to an average of one or two persons in each category of trained staff throughout the entire group of mission hospitals. The supply of student input was estimated on the basis of present levels of training and future plans for expansion described in the Third Five Year Plan.[40] Finally, the remaining inputs were projected on the basis of population growth, adjusting that growth upwards to reflect the high income elasticity of drug imports and recurrent health budgets reported in the last section.

Turning to the two government sectors, the projections of the trained manpower staff input categories were based on information presented in Third Five Year Development Plan.[41] The total supply was then disaggregated between the hospitals and rural units on the basis of each sector's proportion of total available supply in 1968/69, and adjusted to reflect the relatively greater emphasis which has been given to rural health facilities since the beginning of the Third Plan. Other manpower input categories were projected on the basis of personnel-to-bed ratios existing in 1968/69. The supply of students was estimated from information as to present and future trends in training programs.

The supply of beds for each government sector was estimated on the basis of the short and long-run building plans described in the Third Plan, (i.e., an increase in the supply of beds to 2.0 per thousand in the early 1980's).[42] Finally, estimates for other inputs used in hospitals were obtained by combining estimated income elasticities for imported drugs and recurrent expenditures with income trends as described above. These figures were used, in turn, to estimate total recurrent expenditures for the hospital sector, and then, on the basis of 1968/69 figures for the proportion of total recurrent expenditures comprised by each input category, an estimate for 1980/81 was obtained. Estimates of other inputs used in the rural health facility sector, were based on the following: (a) a factor to reflect the increase in the average size of each rural unit, (b) a factor to reflect the increasing number of units, and

(c) a factor to reflect the changing distribution of types of rural units (an increasing proportion are health centers rather than dispensaries).[43]

Linear Programming Results for 1980/81

The linear programming results for 1980/81 are presented in Table 5.10. The results suggest the evolution of the health service system during the period 1968/69 to 1980/81, given the projected input vector for that date. These results are also indicative not only of future trends in health services but also of the scope of potential problems which may not be presently visible.

First, the disease mix for the two government sectors in the 1980/81 solutions contains virtually no inpatient cases. This result differs considerably from the 1968/69 solution, where infectious and parasitic (I&P), nervous system and sense (NS), respiratory (Resp), and alimentary (Alim) cases appeared in at least one of the two government sector's solutions. (See Table 5.6). With respect to the mission hospitals, the most significant changes between the two solutions are the following: (a) outpatient injury cases are included to a much greater extent in the 1980/81 solution than they were in 1968/69 and (b) a larger proportion of inpatient disease types are represented in the 1980/81 solutions. (This increase is manifested in the fact that NS, Alim and NB disease categories are included in 1980/81 but not in 1968/69. At the same time, the GU category drops out of the solution in 1980/81.)

The primary reason for this change in case mix -- and the resulting cost figures attached to the non-optimal case types -- is that the number of outpatient cases will likely increase significantly from 1968/69 to 1980/81,

Table 5.10. Summary of Linear Programming Solution for Uganda Government Hospitals, Mission Hospitals and Government Rural Units for 1980/81.

Objective Function: Rate of Successful Treatment

No Minimum Quantities Constraint Imposed on the Number of Each Type of Initial Demanders which Must be Treated

I Optimum Number of Cases Treated

(A) OUTPATIENT

Outputs	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	B & MS	NB	Ill Def	Inj
Government Hospitals(1)	0.92	0.00	0.00	0.86	0.22	0.95	0.94	0.89	0.58	-	0.96	0.73	0.03	0.91
Current Values of(3) Initial Demanders	3,313,587	15,131	190,392	1,069,224	22,696	2,650,365	1,740,011	477,873	133,653	-	1,595,010	20,174	543,438	837,224
Mission Hospitals(1)	0.54	0.40	0.00	0.85	0.39	0.89	0.86	0.75	0.57	-	0.95	0.55	0.00	0.83
Current Values of(3) Initial Demanders	511,167	1,962	35,447	102,286	4,447	208,757	183,774	41,725	6,670	-	178,934	9,025	6,670	17,135
Government Rural Units(1)	0.87	0.00	0.41	0.78	0.26	0.83	0.67	0.95	0.94	-	0.98	0.92	0.90	0.00
Current Values of(3) Initial Demanders	6,937,740	5,000	365,015	1,795,679	5,000	5,761,852	3,147,951	658,987	93,091	-	3,074,458	36,746	1,139,142	1,487,009

(B) INPATIENT

Outputs	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	B & MS	NG	Ill Def	Inj	Objective Function Equals	Total No. Initial Demanders
Government Hospitals(1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,968,762	
Current Values of(3) Initial Demanders	33,263	11,736	34,360	12,186	5,843	54,287	63,676	20,876	72,516	122,159	11,936	3,246	2,497	50,841		13,108,200
Mission Hospitals(1)	0.94	0.00	0.00	0.21	0.00	0.95	0.96	0.00	0.60	1.00	0.00	0.82	0.95	0.00	1,045,231	
Current Values of(3) Initial Demanders	27,830	2,133	22,429	5,212	3,130	16,271	23,616	6,553	13,141	33,058	5,366	4,111	4,661	4,489		1,480,000
Government Rural Units(1)	0.86	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	19,300,561	
Current Values of(3) Initial Demanders	117,000	1,042	9,863	1,002	1,323	61,987	23,175	3,287	36,607	99,156	9,542	120	14,434	22,492		24,908,700

II Shadow Prices of Case Types Appearing in the Linear Programming Solution and the Cost of Forcing Non-Optimal Case Types into the Solution

(A) OUTPATIENT

Initial Demanders	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	B & MS	NB	Ill Def	Inj
Government Hospitals														
(a) Shadow Prices(4)	0.24	0.00	0.00	0.55	0.14	0.70	0.71	0.65	0.07	-	0.63	0.48	0.00	0.48
(b) Cost of Non-Optimal(5)	-	0.07	3.98	-	-	-	-	-	-	-	-	-	-	-
Mission Hospitals														
(a) Shadow Prices(4)	0.00	0.07	0.00	0.72	0.32	0.72	0.69	0.61	0.47	-	0.77	0.45	0.00	0.74
(b) Cost of Non-Optimal(5)	-	-	0.09	-	-	-	-	-	-	-	-	-	0.42	-
Government Rural Units														
(a) Shadow Prices(4)	0.58	0.00	0.00	0.38	0.04	0.61	0.01	0.46	0.38	-	0.10	0.27	0.30	0.00
(b) Cost of Non-Optimal(5)	-	0.87	-	-	-	-	-	-	-	-	-	-	-	0.56

(B) INPATIENT

Initial Demanders	I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	B & MS	NB	Ill Def	Inj
Government Hospitals														
(a) Shadow Prices(4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal(5)	1.64	8.07	3.74	3.67	5.06	1.72	1.77	2.41	2.08	0.05	3.96	2.74	4.23	3.97
Mission Hospitals														
(a) Shadow Prices(4)	0.23	0.00	0.00	0.00	0.00	0.31	0.08	0.00	0.00	0.55	0.00	0.02	0.51	0.00
(b) Cost of Non-Optimal(5)	-	0.80	0.01	-	1.11	-	-	0.06	-	-	0.27	-	-	0.92
Government Rural Units														
(a) Shadow Prices(4)	0.20	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal(5)	-	2.62	1.38	0.11	0.09	-	1.28	0.21	0.30	-	1.08	0.24	0.55	2.62

III Shadow Prices and Slack Quantities of Service-Providing Inputs

Inputs(2)	(1) Drs.	(2) Med/N Assts.	(3) Prof. N/MW	(4) Enrolled N/MW	(5) Tr.Lab.	(6) Tr.XRay	(7) O. Tr. Med	(8) O. Tr. Non Med	(9) O. Non Tr. Med	(10) O.Non Tr. Non Med	(11) Students	(12) Beds	(13) Drugs etc.	(14) Food	(15) Vehicle Op.&Maint.	(16) Electr.	(17) O.Op.& Maint.
Government Hospitals																	
(a) Shadow Prices(6)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	775,479	1,278,977	1,384,556	6,987,630	1,581,480	97,866	1,972,186	0	1,889,734	4,747,228	3,240,000	4,015,000	22,082,142	11,375,200	937,692	5,856,697	4,602,714
(c) Current Values(3)	931,127	1,596,420	1,415,260	6,987,630	1,875,740	254,190	2,222,410	502,390	5,524,340	8,576,510	3,240,000	4,015,000	28,490,975	11,375,200	2,035,900	7,868,900	5,316,000
Mission Hospitals																	
(a) Shadow Prices(6)	0.25	0.00	0.00	0.00	1.63	0.00	0.00	18.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	0	45,845	127,265	1,110,786	0	17,790	24,953	0	223,930	229,358	208,568	790,185	4,007,772	1,617,793	832,179	1,367,669	2,033,673
(c) Current Values(3)	126,921	56,700	449,420	1,445,490	142,800	56,700	39,900	11,725	1,177,020	1,110,990	876,180	1,460,000	5,467,580	2,254,520	1,207,250	2,015,280	3,004,145
Government Rural Units																	
(a) Shadow Prices(6)	-	0.00	-	0.00	0.00	-	0.00	22.78	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	-	380,241	-	881,381	285,301	-	401,670	0	975,190	1,001,857	-	3,935,351	1,781,230	883,500	980,591	312,256	2,048,503
(c) Current Values(3)	-	1,064,280	-	1,233,110	331,010	-	555,600	434,010	3,323,110	5,899,980	-	4,745,000	8,694,500	1,143,740	7,028,760	490,700	3,877,570

Notes: (1) The optimum number of successfully treated cases is expressed as a proportion of the current value figure which is the number of initial demanders.

(2) Inputs numbered 1-11 are measured in hours; input 12 is measured in bed days; and inputs 13-17 are measured in shs.

(3) The current value figures under the optimum number of cases treated and slack quantities of service-providing inputs represent the two parts of the input vector, the service-demanding and service-providing inputs respectively.

(4) The shadow prices of initial demanders show the amount by which the objective function could increase if an additional initial demander with the given disease characteristics were to demand service.

(5) The cost of adding a non-optimal case to the solution shows the amount by which the objective function would decline if one of those types of cases were treated as opposed to those cases which are treated.

(6) The shadow price of the service-providing inputs shows the amount by which the number of successfully treated persons would increase if one additional unit of that input were made available.

such that each sector in the health service system, particularly government hospitals and rural facilities, will be able to maximize the total number of successfully treated cases by treating a greater number of the less costly outpatient cases, rather than by treating any cases on an inpatient basis. The change in the disease mix of initial demanders will also lead to a significant increase in the proportion of successfully treated cases from the total number of initial demanders. In 1968/69, the proportion of successfully treated cases in all sectors combined was approximately 69.9%. In 1980/81, the projected rate will be approximately 79.3%.

Comparative analysis of the cost of forcing non-optimal case types into the linear programming solution between 1968/69 and 1980/81 suggests that a relatively constant pattern exists over the entire period (compare Tables 5.6 and 5.10). The only significant changes between 1968/69 and 1980/81 appear in the relative magnitudes of the costs. Inpatient costs will increase significantly over the period, particularly in government hospitals.

Perhaps more important from a policy point of view, however, are the changes in the shadow prices of the constraints imposed by the service-providing input variables. The analysis presented in Table 5.11 concerning the relative proportion of slack for each service-providing input provides additional information as to the nature of these constraints, assuming that the estimated service-providing input vector for 1980/81 reasonably reflects the situation at that point in time. Assuming that the government's health manpower training programs are implemented, the constraints which existed throughout the health service system in 1968/69 in trained laboratory staff

Table 5.11 Relative Proportion of Slack for Each Service-Providing Input by Sector of Uganda's Health Service System in 1980/81, Given the Linear Programming Solution.

Objective Function: Rate of Successful Treatment

Inputs	Government Hospitals	Mission Hospitals	Government Rural Units
Doctors	0.83	0	----
Medical and Nursing Assts.	0.80	0.81	0.36
Professional Nurses/Midwives	0.98	0.28	----
Enrolled Nurses/Midwives	1.00	0.77	0.72
Trained Lab Staff	0.84	0	0.86
Trained X-Ray Staff	0.38	0.31	----
Other Trained Medical Staff	0.89	0.62	0.72
Other Trained Non-Medical Staff	0	0	0
Other Non-Trained Medical Staff	0.34	0.19	0.29
Other Non-Trained Non-Medical Staff	0.55	0.21	0.17
Students	1.00	0.24	----
Beds	1.00	0.54	0.83
Drugs, Etc.	0.78	0.73	0.20
Food	1.00	0.72	0.77
Vehicle Operation and Maintenance	0.46	0.69	0.14
Electricity	0.74	0.68	0.64
Other Operation and Maintenance	0.87	0.68	0.53

Note: The figures found in this table were derived from data presented in the third section of Table 5.10.

will have been largely erased by 1980/81 except in mission hospitals. The input variable which will remain the most binding constraint in 1980/81 (a variable which was not addressed in the third development plan) is the manpower category of other trained, non-medical staff, whose major component is ambulance drivers. (See the shadow prices for this category, Table 5.10.) When the small average annual rate of 3.4 transfers per thousand (the average rate in 1968/69 for a sample of 19 rural health facilities, Table 2.12), is applied to a base of approximately 25 million attendees at rural units, 13 million at government hospitals and 1.5 million at mission hospitals, the total number of persons transferred becomes quite large. Even if the average transfer rate were to decline significantly, there would still be an absolutely large number of transfers. Further, given that the government is increasing the number of ambulances in rural areas[44] and is spending large sums of money to improve roads throughout the country, it is difficult to conceive that the transfer rate will decline.

It is also interesting to note that while the input complementary to drivers -- vehicle operation and maintenance -- is slack in the linear programming model, its proportion of slack is relatively small in all three sectors in both 1968/69 and 1980/81 (see Tables 5.8 and 5.11). In terms of training programs, the government should implement a program, not just to train ambulance drivers, but also to render basic first aid and emergency medical procedures. Perhaps some of the less intensively used manpower cadres, indicated as slack inputs in the linear programming solutions, could be trained as ambulance drivers.

Turning to an analysis of the relative degree of input slack, the information presented in Table 5.11 suggests that, given the linear programming solutions for each sector in 1980/81, the proportion of slack throughout the system will have generally increased from 1968/69 to 1980/81. This situation is particularly true in the case of trained manpower and in the government hospitals. Government hospitals have such a high proportion of inputs as slack due to the large proportion of all inputs used in the inpatient treatment process, whereas the linear programming solution suggests that little if any inpatient care is warranted. At the same time, while not containing as much slack, inputs in rural units also will experience an increase in slack over the period.

What are the policy implications of the above analysis? First, assuming that (a) the objective function used conforms to the priorities of Uganda, and (b) the estimated 1980/81 input vector conforms to reality in an approximate way, a considerable expenditure will have been made by the government for the training and provision of staff for very costly health maintenance activities, i.e., curative inpatient care. Perhaps spillover benefits will accrue to the entire population as a result of having many medically trained persons living throughout the country, but those benefits would have to be quite large in order to compensate for the income disparities which will likely result from increased opportunity for trained persons to engage in private practice.[45]

Secondly, it would appear that although rural health units will receive a larger proportion of available inputs through 1980/81, additional resource reallocation between government hospitals and rural health units is warranted.

A particularly important area for the beginning of such resource reallocation is in drugs. Although the drug input is never a binding constraint in any of the linear programming solutions, its proportion of slack in the rural units is very low. If the rural units were disaggregated, it is highly likely that many would experience a binding drug and medical supply constraint. The personal stories of medical assistants recounting how they often run out of monthly allotments in two weeks, if not before, provide graphic illustrations of the general point. Third, no more units with beds appear to be needed since the slack proportions for government hospitals and rural units increases during the period. The only exception to this statement lies in maternity beds for normal deliveries and minor complications.

Finally, given the large and increasing degree of slack in each sector, the input intensity in the health services provided each person demanding service might be increased. There appears to be slack diagnostic time generally available, both among doctors and medical and nursing assistants, as well as among the nursing staff generally. The nursing staff could be used to a greater extent in the outpatient department or, as was earlier suggested, in the provision of preventive health care. Such reallocations could well yield a higher quality of care and the rate of successful treatment presumably would manifest that fact.

Summary

In this chapter, the linear programming model for analyzing Uganda's health service system was empirically specified. The procedures, methods, and assumptions used for estimation of the input vector, the technological matrix, and the objective function -- when specified in terms of the rate of successful treatment -- were described. The model was empirically tested using 1968/69 data from the three main sectors of Uganda's health service system (government hospitals, mission hospitals, and government rural health units with beds for inpatient care). The implications of the results were discussed. An exploratory empirical analysis of the factors affecting the vector of initial demanders, the rate of successful treatment, and several components of the service-providing inputs was conducted. Finally, projections and analyses of the health service system in 1980/81 were made, utilizing the linear programming model developed for and tested on 1968/69 data. This analysis was conducted by projecting both subsets of the input vector from 1968/69 values to 1980/81. The health policy implications of the analysis were presented.

Footnotes

1. The linear programming model could have been constructed to conform more realistically to the production process discussed in the first section of Chapter 4 by incorporating into one vector the inpatient and outpatient initial demanders and then having two lower submatrices, each 14 x 14, containing a principal diagonal whose elements have the same significance described above. The scope of the s technological matrix would have been $i=(1,\ldots,31)$, $j=(1,\ldots,28)$. This procedure has not been followed for reasons of convenience, and the substance of the analysis is not affected.

2. Output data for government and mission hospitals are summarized in monthly reports according to sex and disease. Government rural units, however, summarize data on a monthly basis according to a disease classification different than that used by hospitals, and data on age and sex are included only in summarized form, without disaggregation on a disease-specific basis. The disease classification scheme employed by rural units has been adjusted to conform to that employed in government and mission hospital units through detailed analysis of the daily medical record books for several rural units. See copies of MF 74, 75, and 77 in Appendix F.

3. Martin Feldstein, in his example of the use of linear programming in health services planning, used the budget as a variable. His use of the budget, however, was due to his desire to keep the analysis suggestive of the applicability of the methodology. He further implied that it would be desirable to disaggregate the input vector, particularly to include drugs and medical supplies, in order to provide a greater degree of realism in the planning problem. See Martin Feldstein, _Economic Analysis for Health Service Efficiency_ (Amsterdam: North-Holland Publishing Company, 1967), Chapter 6.

4. A copy of the survey instrument used is contained in Appendix F.

5. The data on initial demanders were randomly audited by going back to original sources in rural facilities.

6. See J. Galea, "Inventory, Appraisal, and Assessment of the Basic Health Services of Uganda, Developments for a Malaria Eradication Programme," (Jinja, Uganda: Malaria Pre-Eradication Programme, World Health Organization, 1967). See also Hallway, Jane, _A Survey of Church Related Hospitals in the Anglican Province of Uganda, Rwanda and Burundi_, (Kampala: Provincial Medical Board, 1972) and _Survey of all our Catholic Medical Units_, (Kampala: Catholic Medical Bureau, 1969).

7. See Martin Feldstein, Economic Analysis for Health Service Efficiency, pp. 171-175, for a discussion of the methodology he employed.

8. The Ministry of Health was beginning to develop a complete hospital-specific budgeting system in 1969.

9. See Tables 2.13, 2.14, 2.15, and 2.16 for an analysis of the differences in the disease distribution between government and mission hospitals.

10. In Table C.9, Appendix C, the calculations made to obtain an estimate of the average quantity of drugs and medical supplies used by disease category on an outpatient and inpatient basis are shown. A better method of estimating the cost of drugs and medical supplies on an inpatient basis would be to examine a sample of inpatient case records. At one point, the researcher began such an analysis but ran into great difficulty deciphering handwriting and could not obtain necessary assistance from medical staff. At some point this research should be conducted.

    One additional complicating factor, not taken into consideration in the calculations but of which the researcher is aware, is the problem of theft. It was well known in certain markets that individuals could obtain drugs for a fee, particularly antibiotics such as penicillin. Exactly how to take this problem into consideration is unclear, but one must be aware of its existence when interpreting the results.

11. Basically, the data used to estimate the disease-specific rates of successful treatment for each of the three sectors were obtained from the following sources: (a) published statistics of the Ministry of Health, (b) unpublished records of a sample of health facilities from all three sectors of the health service system, and (c) a patient follow-up survey used to estimate the number of unsuccessfully treated initial demanders.

12. Martin Feldstein, Economic Analysis for Health Service Efficiency, pp. 175-178.

13. See Chapter 4 for a discussion of the rationale for using the rate of successful treatment as the appropriate set of weights.

14. It is possible to discern the differential resources requirements among disease groups by looking at the inpatient portion of the technological matrix for each sector. For example, differences in the average length of stay may be discerned by looking at the twelfth row, beds, in Tables D.5, D.6, D.7, Appendix D.

15. The shadow price and cost figures are to be interpreted as estimates of marginal prices or costs rather than average price or cost since an extra marginal change in any one or more or the inputs would yield a solution different than that indicated.

16. Since each initial demander is weighted by his rate of successful treatment, (less than one, except for inpatient uncomplicated deliveries), the values of the shadow prices for each disease type is constrained to values between zero and one.

17. In Table C.13, Appendix C, an alternative linear programming solution is presented. The principal difference between the alternative and the one presented in the text is as follows: the alternative requires that a minimum proportion of each case type, on an inpatient and outpatient basis be treated before the optimizing process occurs for the remaining service demanders and service-providing inputs. Although the nature of the solution in terms of the optimal disease mix and the values of particular shadow prices, costs of forcing non-optimal case types into the solution and the quantity of slack of each input are different, a similar pattern is observed with respect to the proportionality of slack in the "important" service-providing inputs such as doctors, nurses and beds. For example, in government hospitals the proportion of doctor's slack time is 36.8 percent, for professional nurses and midwives 52.0 percent, and for beds 73.9 percent.

18. Republic of Uganda, Uganda's Plan III, para. 17.74, p. 322.

19. Republic of Uganda, Uganda's Plan III, p. 120.

20. See Abdel R. Omran, "The Epidemiologic Transition: A Theory of the Epidemiology of Population Change," Milbank Memorial Fund Quarterly, 49, 4, Part 1, (October 1972), pp. 508-538.

21. See Jan Kmenta, Elements of Econometrics, (New York: The Macmillan Co., 1971), pp. 392-394.

22. See Table D.8, Appendix D, for the statistical results of other estimated equations.

23. As the total number of health facilities increases (assuming that there is some reasonable concern for equitable spatial and population distribution), the average distance required for travel to obtain health services is reduced, and the amount of time spent in the consumption process falls; the cost of consuming such services and is thereby reduced, leading an expansion of demanders.

24. It was assumed that the one-half year observation for January to June 1960 was a valid observation, when the reporting period for the Ministry of Health changed from a calendar to a fiscal year in June 1960.

25. Data to calculate these figures are found in Tables 2.13 and 2.15. The corresponding mission hospital figures are 20.3% and 41.7%, respectively.

26. The index of diagnostic service inputs, $\left(\frac{v_r}{v_r'}\right)$, is described more fully in section 4, Appendix C. Briefly, however, it is constructed such that it can vary between one and five, with a value of one indicating that all diagnostic services are provided by doctors and a value of five meaning that all diagnostic services are provided by untrained dressers.

Footnotes

1. The linear programming model could have been constructed to conform more realistically to the production process discussed in the first section of Chapter 4 by incorporating into one vector the inpatient and outpatient initial demanders and then having two lower submatrices, each 14 x 14, containing a principal diagonal whose elements have the same significance described above. The scope of the s technological matrix would have been $i=(1,\ldots,31)$, $j=(1,\ldots,28)$. This procedure has not been followed for reasons of convenience, and the substance of the analysis is not affected.

2. Output data for government and mission hospitals are summarized in monthly reports according to sex and disease. Government rural units, however, summarize data on a monthly basis according to a disease classification different than that used by hospitals, and data on age and sex are included only in summarized form, without disaggregation on a disease-specific basis. The disease classification scheme employed by rural units has been adjusted to conform to that employed in government and mission hospital units through detailed analysis of the daily medical record books for several rural units. See copies of MF 74, 75, and 77 in Appendix F.

3. Martin Feldstein, in his example of the use of linear programming in health services planning, used the budget as a variable. His use of the budget, however, was due to his desire to keep the analysis suggestive of the applicability of the methodology. He further implied that it would be desirable to disaggregate the input vector, particularly to include drugs and medical supplies, in order to provide a greater degree of realism in the planning problem. See Martin Feldstein, *Economic Analysis for Health Service Efficiency* (Amsterdam: North-Holland Publishing Company, 1967), Chapter 6.

4. A copy of the survey instrument used is contained in Appendix F.

5. The data on initial demanders were randomly audited by going back to original sources in rural facilities.

6. See J. Galea, "Inventory, Appraisal, and Assessment of the Basic Health Services of Uganda, Developments for a Malaria Eradication Programme," (Jinja, Uganda: Malaria Pre-Eradication Programme, World Health Organization, 1967). See also Hallway, Jane, *A Survey of Church Related Hospitals in the Anglican Province of Uganda, Rwanda and Burundi*, (Kampala: Provincial Medical Board, 1972) and *Survey of all our Catholic Medical Units*, (Kampala: Catholic Medical Bureau, 1969).

31. The exclusion is due either to lack of information -- i.e., the disease comprises a very small proportion of total outpatient cases seen - or to the fact that normal deliveries are not conducted on an outpatient basis.

32. Other statistical results are presented in Table D.10, Appendix D.

33. See Benton Massell and Judith Heyer, "Household Expenditure Analysis in Nairobi: A Statistical Analysis of Consumer Behavior," Economic Development and Cultural Change, (January 1969), pp. 212-234. Their estimates of the income elasticity of demand for health services varied between 1.07 to 1.42.

34. Other statistical results are presented in Table D.11, Appendix D.

35. The government appears to be cognizant of this important relationship. See Republic of Uganda, Uganda's Plan III, pp. 121-124.

36. It is unfortunate that economic methods of analysis cannot adequately handle major changes in the socio - politico - economic system, such as have occurred in Uganda since 1971. A recent issue of Africa Reports indicates that one-third to one-half of all the doctors in Uganda prior to 1971 have left the country -- including nationals. In addition, many other health workers have left. I suspect the situation is particularly acute in mission hospitals. The lack of trained health manpower has manifested itself in at least two ways: Africa Report mentions that the government is attempting to recruit health workers from North African countries, and Mr. Roy Innis of the Congress of Racial Equality has been recruiting Black Americans with health skills to work in Uganda. In addition there is evidence that the medical manpower training programs, (including both the medical school at Makerere and other training programs) have been seriously curtailed. Exactly how these shocks will work themselves out over a ten to fifteen year period is difficult to predict; the analysis conducted in this last section, however, is suggestive of the situation as it might have existed if the health service system had developed according to the plans and priorities developed in the 1970/71 period and spelled out in Uganda's Third Five Year Development Plan, 1971/72 - 1975/76, Chapter 1, and 17.

37. Figures were used which indicated a rather precipitious rate of decline in the proportion of total cases comprised by infectious and parasitic diseases -- 0.4% per year for outpatient and 0.8% per year for inpatient. More research attention should be given to these figures in future projections, since it is unlikely that the etiology in Uganda will change to the extent that such a rate of decline will continue.

38. This assumption is based primarily on pragmatism, as little alternative information is available.

39. See Republic of Uganda, Uganda's Plan III, para. 17.50, p. 315.

40. See Republic of Uganda, Uganda's Plan III, para. 17.62, p. 319.

41. See Republic of Uganda, Uganda's Plan III, Table 17-1, and pp. 315-324.

42. See Republic of Uganda, Uganda's Plan III, para. 17.26, 36, 39, 40 and 43, pp. 308-313.

43. The resulting figure used to project 1968/69 figures to 1980/81 was 4.0. This figure was derived in the following way:

    (1) The average size health facility, in terms of beds, would increase from 15.8 beds in 1968/69 to 25.0 beds in 1980/81, an increase of 58.2%.

    (2) The total number of units would increase by 97% over the period, from 169 in 1968/69 to 352 in 1980/81.

    (3) The average increase in cost due to the general improvement of the rural units from dispensaries to health centers is 30%. This figure is based on 1968/69 average cost data from a sample of rural health facilities in Busoga, East Mengo and Ankole Districts.

    The final figure was determined by multiplying these three figures together: 1.58 x 1.97 x 1.30 = 4.0.

44. See Republic of Uganda, Uganda's Plan III, para. 17.32, p. 310.

45. See W. Lee Hansen and Burton A. Weisbrod, "The Distribution of Costs and Direct Benefits of Public Higher Education: The Case of California," Journal of Human Resources, 4,2 (Spring 1969), pp. 176-191.

CHAPTER SIX

In this chapter, the analysis focuses on the macro-economic effects of Uganda's health service system. To the extent that data are available, the relationships between Uganda's development objectives and the provision and development of the health service system are examined. The analysis focuses on the relationships between health services and (a) population growth and demographic change, (b) the balance of payments, (c) employment, (d) other industries, and (e) developmental equity.[1]

Health and Demographic Change

The literature on health and demographic change has emphasized two relationships. Some analyses have examined the effects of availability of health services on the rate of population growth and demographic change. Others have discussed the effect of population growth on both the general level of health in the population and on a country's health services. Most of the literature, however, is speculative in nature, offering very little empirical information. This problem is particularly acute when long run effects are discussed, for virtually all of the studies make inferences related to the impact of improved health standards on demographic variables. Approximate quantitative estimates of these relationships, and the relative importance of these relationships vis-a-vis other socioeconomic changes in the population, have not been developed.

Health Effects on Population Growth

The literature suggests that disease eradication tends to increase the rate of population growth by causing a decline in the death rate and/or an increase in fertility.[2] Several studies have also indicated that the reduction in morbidity rates brought about by the eradication of disease lends to an increase in human capital.[3] It is also maintained that the improvement of health services, particularly the addition of both maternal and child health services and family planning services, leads to demographic change. It is assumed in this regard that the rate of population growth over time will decline as families perceive an increase in the probability that their children will live to adulthood.[4]

Health services are also said to affect demographic change when the availability of the services is improved, but family planning services are not provided concomitantly. Improvement of the health of females and reduction of high infant mortality rates are both assumed to result in an increase in population growth.[5] It is also maintained, however, that an increase in nutritional standards will result in a decline in infant mortality as malnutrition is often complicated with other severe illnesses. This decline in infant mortality, it is suggested, will lead in the long run to a decline in desired family size, and thereby a reduction in fertility and decline in the rate of population growth.[6]

Effects of Population Growth on Health

There has been some discussion in the literature of the effects of population growth both on health standards and on the demand for health services. First, it has been suggested that rapid population growth leads to a reduction in health standards. Standards such as hospital-bed-to-population ratios and doctor-to-population ratios are said to decline as a result of population increase and the assumption is made that the health of the population will also decline. As indicated in Chapter 3, however, the use of medical resource-to-population ratios as a measure of health output and health standards is spurious.

Second, it is maintained that rapid population growth will have an impact on government decisions with respect to budget allocations. It is suggested that although health services are likely to receive increased budgetary allocations, standards of health will not increase because rapid population growth itself retards the service system's ability to keep up with the increasing service demand.[7] After suggesting that the relationship between population growth and health standards is negative, most authors explore alternative cost-minimizing policies, such as increasing paramedical staff,[8] or expanding the training of both professional and paraprofessional staff.

Population is also said to affect health in another way. As the age structure of the population changes, the composition of demand for health services shifts. There is a change in the incidence of certain diseases, which affects the disease mix within a population.[9] When the rate of population growth increases, a larger proportion of the population is found in younger age brackets; an increasing proportion of the demand for health services thus results from maladies afflicting young children. As the rate of population growth falls and the age structure of the population becomes older, an increasing proportion of the disease mix is composed of circulatory and heart related problems and cancer.[10]

Demographic changes also affect health and the health service system through the process of rural to urban migration. Health services in urban areas tend to be delivered in hospitals, while health centers or other less sophisticated facilities predominate in rural areas. As people migrate to urban areas, the cost of providing health services increases because hospitals are based on more expensive organizational structures.[11]

Finally, the impact of a shorter birth interval on health has been analyzed in the literature.[12] A shorter birth interval increases both the illness rate per family, and the rate of illness per family member per unit of time. It also tends to decrease the nutritional status of the entire family which may have the further effect of changing the distribution of diseases contracted.

Health and Population: The Ugandan Case

The purpose of this section is to present information which highlights some of the implications discussed above relating health and population change. Two studies were undertaken in this regard: the first examined the availability of health services in relation to the rate of population growth in Uganda's sub-counties from 1959 to 1969, and the second examined the extent to which the age structure has become younger over that period in relation to health service availability.

Population Growth and Health Service Availability

In order to test the relationship between the availability of health services and the rate of population growth, two types of data were required: (a) population census data for at least two periods, and (b) the type and location of every health facility in both census years.[13] Once gathered, the data were used to conduct three different tests on two relationships between health services and population growth.

The first test was made to determine whether there was a significant difference in the mean annual rate of population growth over the decade in those subcounties (called divisions or gombololas) with no health facilities as compared to those gombololas in which there was a health facility. Health facilities were further classified into two groups: (a) those with maternity services (including antenatal and young child clinics) and (b) those without such services. The specific taxonomy used is as follows:

(1) No health facility in 1959 or 1969;

(2) No health facility in 1959, but a health facility in 1969 without maternity services;

(3) No health facility in 1959, but a health facility in 1969 with maternity services;

(4) A health facility in 1959 without maternity services, and a health facility in 1969 without maternity services;

(5) A health facility in 1959 without maternity services, and a health facility in 1969 with maternity services;

(6) A health facility in 1959 with maternity services, but no facility in 1969; and

(7) A health facility in 1959 with maternity services, and a health facility in 1969 with maternity services.

The test was conducted to determine the effect of the availability of health services on two demographic variables, births and deaths, which, in interacting, constitute the basic mechanism of population growth. In order to focus solely on the effect of changes in birth and death rates, the 599 gombololas in the country [14] were divided into a rural and urban groups. The urban gombololas were dropped from the analysis due to the likelihood of high levels of net immigration, which would bias the test results.[15] The resulting sample of 467 "rural" gombololas were analyzed and the results are summarized in Table 6.1 and Figure 6.1.

As seen in Table 6.1, few of the mean population growth rates are statistically different from one another, primarily because the standard devations are quite large. Where there are significantly different means, no consistent pattern emerges. However, Figure 6.1 reveals several interesting trends which, although not statistically significant, do point to the possibility of a linkage between population growth and the availability of health services.[16]

Figure 6.1 illustrates the data found in Table 6.1, eliminating health facility categories 3 and 6 due to a lack of observations. The subcounties, grouped according to health facility classification, represent a continuum of services: (a) no services, (b) recently introduced curative health services, (c) curative health services available for at least 10 years, and (d) both curative and maternal and child health services available for at least 10 years. In Figure 6.1, part (A), we see that in all cases - in the country as a whole as well as in each region - the rate of population growth tends to be greater in gombololas with no health facilities, than it is in those where both

TABLE 6.1

Test of Differences Between Mean Population Growth Rates for Groups of Subcounties in Uganda, Grouped According to the Type of Health Services Available

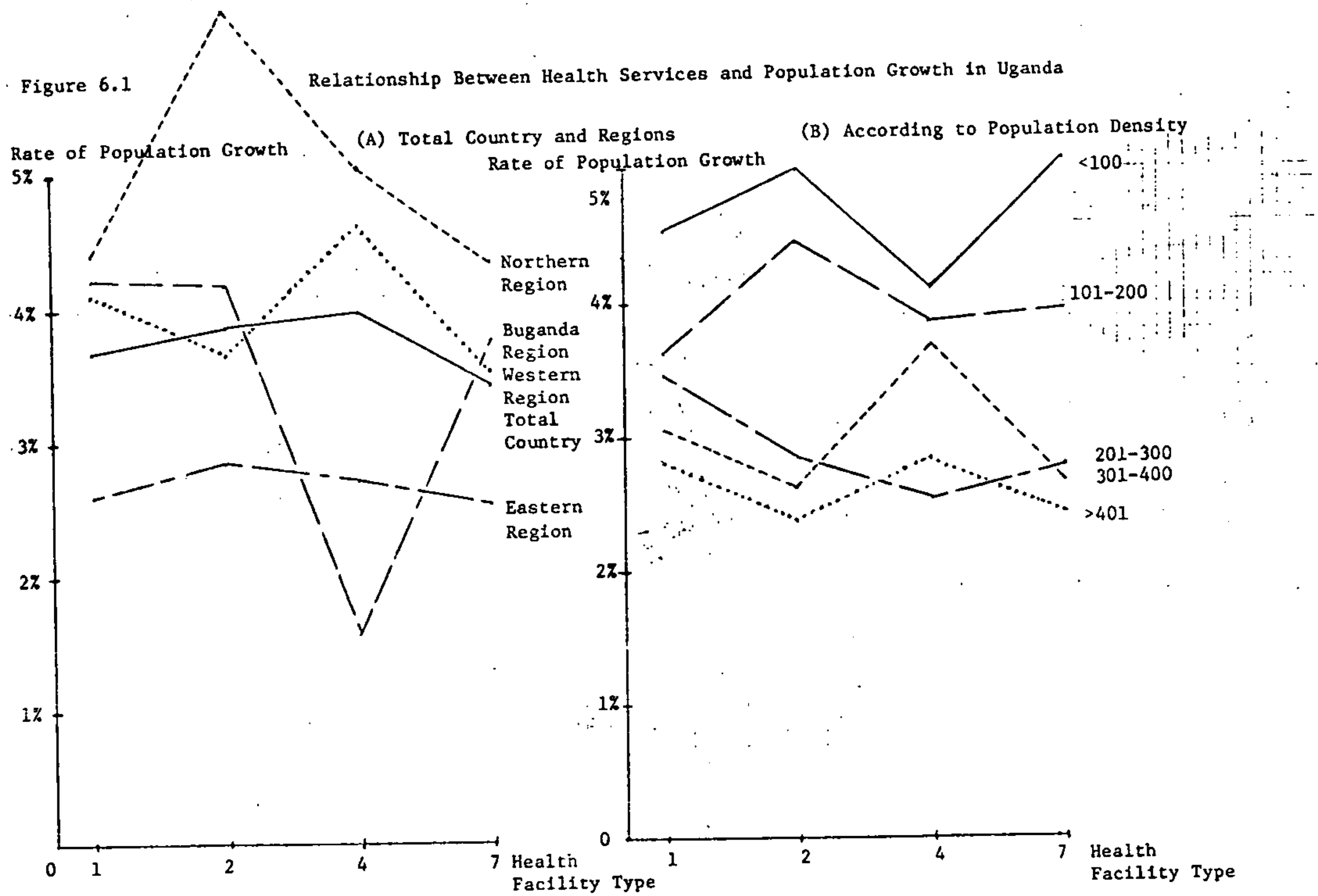
Health Facility Type	Total Test	Total Population Density 1969 ≤100	101-200	201-300	301-400	≥401	Region Buganda	East	North	West	Explanation of Categories of Health Facility Types
1	160 3.621 (2.351)	31 4.468 (2.201)	35 3.520 (2.269)	30 3.393 (2.886)	19 2.984 (1.230)	13 2.738 (1.211)	19 4.137 (3.040)	56 2.548 (0.822)	48 4.354 (2.396)	37 4.030 (2.818)	No Health Facility in 59 or 69
2	144 3.802 (2.698)	34 4.909 (2.263)	20 4.380 (3.123)	26 2.796 (1.335)	22 2.573 (1.651)	13 2.308 (1.037)	51 4.116 (2.634)	41 2.805 (1.540)	14 6.150 (2.540)	38 3.592 (3.169)	No Health Facility in 59--Health Facility in 69 w/o Mat. Services
3	16 4.212 (2.109)	3 4.367 (3.137)	3 5.033 (1.144)	2 2.250 (0.150)	2 2.050 (0.650)	---- ----	1 8.600 (2.000)	6 3.150 (2.108)	4 5.100 (1.212)	5 3.900 (1.339)	No Health Facility in 59--Health Facility in 69 with Mat. Services
4	65 3.918 (2.300)	19 4.026 (2.089)	14 3.800 (2.350)	8 2.500 (2.108)	6 3.617 (1.406)	5 2.760 (0.445)	7 1.643 (1.078)	18 2.672 (0.996)	31 4.974 (2.067)	9 4.544 (3.041)	Health Facility in 59 w/o Mat. Services H.F. in 69 w/o Mat. Services
5	----	----	----	----	----	----	----	----	----	----	Health Facility in 59 w/o Mat. Service--H.F. in 69 with Mat. Service
6	2 2.400 (2.000)	----	----	----	1 0.400 (0.000)	1 4.400 (0.000)	1 0.400 (0.000)	1 4.400 (0.000)	----	----	Health Facility in 59 with Mat. Services--No H.F. in 69
7	80 3.330 (2.030)	14 5.000 (2.626)	15 3.880 (1.906)	10 2.730 (0.949)	12 2.375 (1.292)	16 2.625 (1.272)	19 3.689 (2.113)	24 2.492 (1.144)	11 4.273 (1.714)	26 3.442 (2.416)	Health Facility with Mat. Services--H.F. in 69 with Mat. Services
Note (1)	467	101	87	76	62	48	98	146	108	115	
Note (2)	4>7 3>7	2>4 ----	3>1 ----	1>3 2>3	4>7 ----	---- ----	1>4 2>4 7>4	---- ---- ----	2>1 2>4 2>7	---- ----	

Notes: The first number in each cell indicates the number of observations. The second number is the mean annual rate of population growth, and the third indicates the standard deviation.

Note (1) = Total Observations

Note (2) = Statistically Significant Diff. means at 0.10 level using t test

Figure 6.1 Relationship Between Health Services and Population Growth in Uganda



Notes: (1) Population Density in persons per square mile
(2) Data from Table 6.1

curative and maternal health services have been available for some time. In three of the five cases - Country Total, Northern Region, and Eastern Region - an interesting possibility presents itself: when health facilities provide curative services only, the rate of population growth may be affected as a result of a reduction in the death rate without a concomitant reduction in fertility.[17] Since the data from the other two regions, do not conform to this pattern, however, the possibility is tentative, at best. If future data bear out the "trend", however the policy implication - provision of maternal and child health services in all health facilities - is obvious.

The data in Figure 6.1 (B), organized on the basis of population density, suggest a potentially significant negative relationship between population growth rate and population density. Health services appears to have a negative impact on the rate of population growth in more heavily populated areas of the country, but a positive effect in the lightly populated areas. Without the pressure of population on the land, therefore, it may be that the short or medium term effect of all types of health services will be to increase the rate of population growth through reducing the death rate, without affecting fertility.

A second test was conducted to analyze the relationship between the population growth and health services availability. This test was conducted in the same manner and utilized the same data as described above. One additional adjustment was made, however, to correct for the possible biases of (a) rural to rural migration, (b) international net in-migration to refugee settlement areas in rural parts of the country and (c) under-counting in the 1959 census.[18] The adjustment eliminated from the sample of gombololas those in which the average rate of population growth over the decade was greater than five percent. Although this figure is somewhat arbitrary, evidence from around the world [19] suggests that few areas have ever experienced crude birth rates over a sustained period in excess of approximately 56 per thousand. Similarly, crude death rates have not fallen below approximately nine per thousand, even where a population is predominately young. Since the natural rate of increase is defined as the difference between the crude birth rate and crude death rate and is the rate of population growth in a closed population which does not experience migration effects, the highest possible natural rate of increase which could be expected in Uganda would approximate five percent. The total number of gombolola observations was thus reduced from 467 to 374.

The results of the second test are summarized in Table 6.2 and Figure 6.2. The results suggest no clear relationship between the availability of health services and population growth. The data summarized in Figure 6.2, however continue to tentatively suggest the possibility of a slower rate of population growth in gombololas where both curative and maternal health services have been provided, as contrasted to those gombololas where no health services have been available. The trend in Buganda region is most puzzling and evokes no plausible explanation.

It is interesting, however, to contrast the trend in the Eastern Region with that of the North. The region classification serves as a

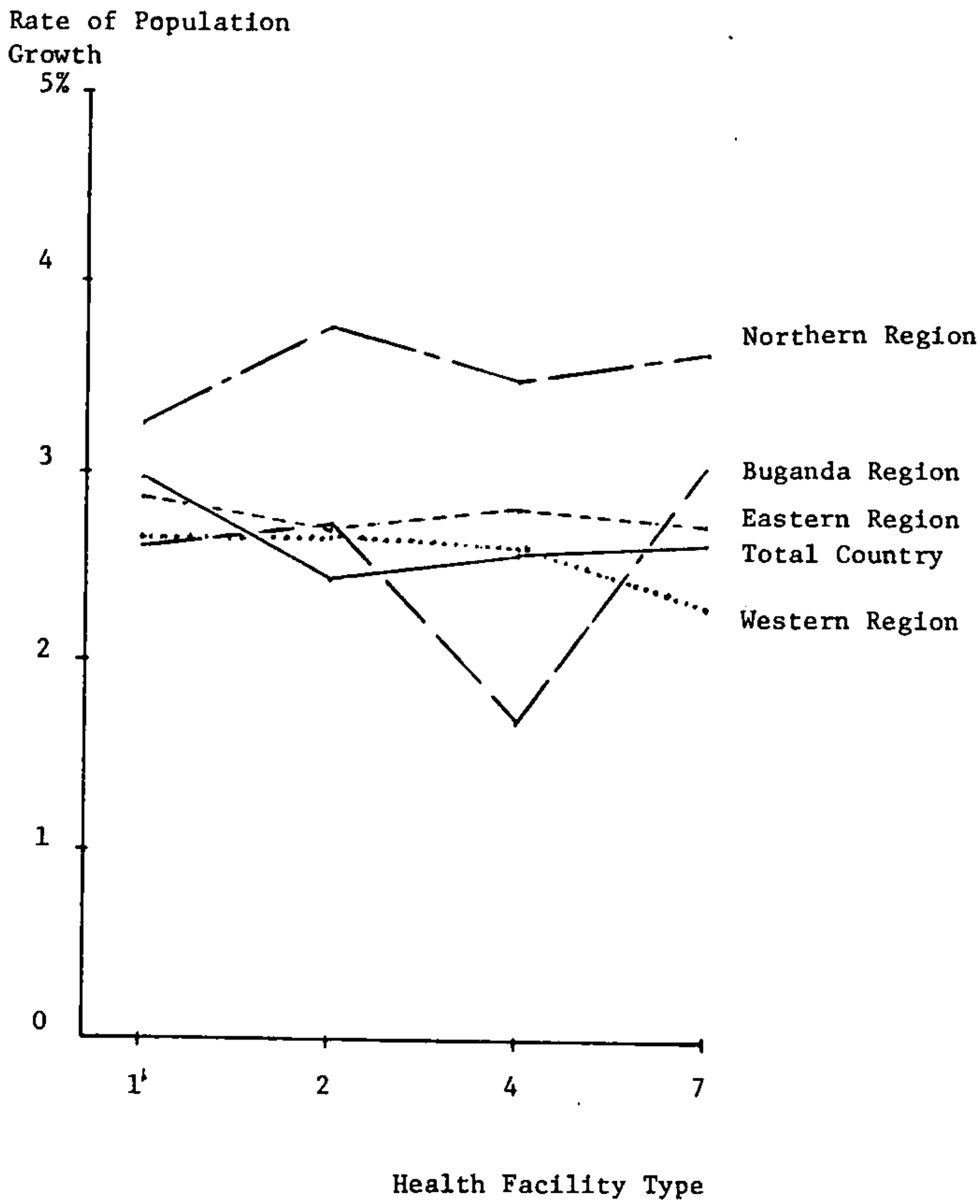
TABLE 6.2

Test of Differences Between Mean Population Growth Rates For Groups of Subcounties in Uganda, Grouped According to The Type of Health Services Available and Adjusted for Migration and Undercounting.

Health Facility Type	Total Country	Buganda Region	Eastern Region	Northern Region	Western Region
1	N=133 2.779 (1.054)	14 2.536 (0.926)	56 2.548 (0.822)	34 3.165 (0.983)	29 2.890 (1.387)
2	N=111 2.608 (1.126)	34 2.644 (1.106)	40 2.605 (0.890)	6 3.667 (0.761)	31 2.368 (1.336)
3	N=11 3.000 (1.135)	--- --- ---	5 2.300 (0.998)	2 4.000 (0.600)	4 3.375 (0.928)
4	N=48 2.719 (0.958)	7 1.643 (1.078)	17 2.512 (0.766)	18 3.406 (0.643)	6 2.500 (0.392)
5	N=0 --- ---	--- --- ---	--- --- ---	--- --- ---	--- --- ---
6	N=2 2.400 (2.000)	1 0.400 (0.000)	1 4.400 (0.000)	--- --- ---	--- --- ---
7	N=69 2.680 (1.168)	16 2.975 (1.379)	22 2.236 (0.801)	9 3.544 (0.813)	22 2.555 (1.184)
Total N	374	72	141	69	92
	---	1>4 xx 2>4 xxx 7>4 xxx	2>7 x 1>7 x	---	7>4 x 1>2 x

Notes:
x = significant at 0.15 level
xx = significant at 0.10 level
xxx = significant at 0.05 level

Figure 6.2 Relationship Between Health Services and Population Growth in Uganda Adjusted for Migration and Undercounting

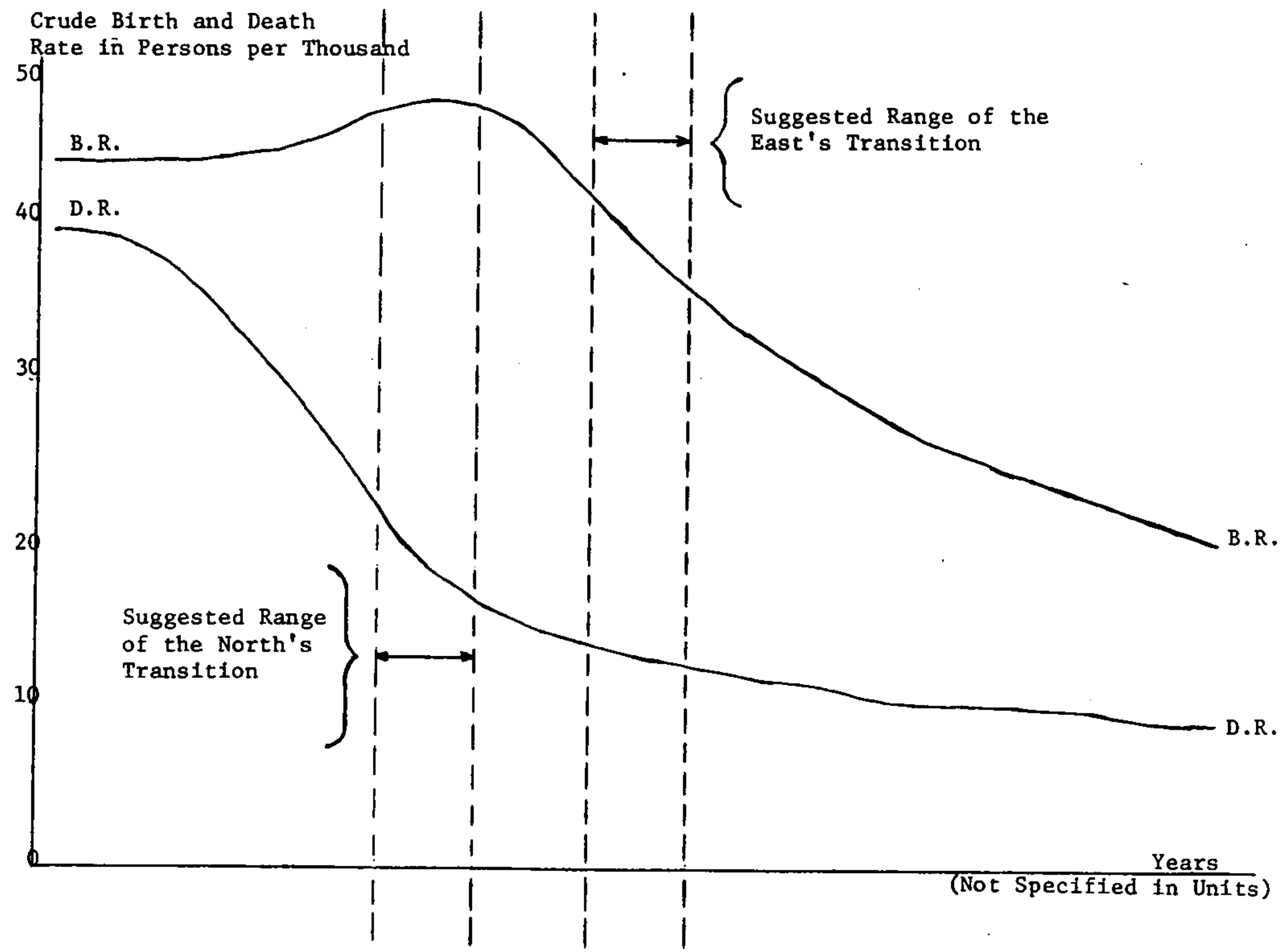


(1) Data from Table 6.2

good proxy for two variables which certainly affect population growth: (a) population density and (b) the extent and duration of other socio-economic forces which, over time, affect desired family size. There are at least two socio-economic forces which are important in the case of Uganda: (1) education, particularly of females,[20] and (2) participation in the monetary economy, through cash crop agriculture as well as non-agricultural activities. In the Eastern Region both education and economic participation have been prevalent over a longer period of time in the Northern region.[21] In addition, the Eastern region has a much higher population density than does the North.[22] For these reasons it is possible that the relationship between population growth and health services shown in Figure 6.2 is a manifestation of different periods of the demographic transition within the country. The North, having more recently been drawn into socio-economic development and experiencing little population pressure, has increased in rate of population growth. In the East, however, both socio-economic development and population pressure have been at work for some time and it appears that health services may now be contributing not only to a declining death rate but also to a declining trend in fertility, as indicated by crude birth rates.[23] These suggestions are presented in schematic form in Figure 6.3, which presents a "classical" demographic transition and the points at which the Northern and Eastern Regions are now to be found.

A final test was conducted on the available data in a determination of the relationship between health service availability and the rate of population growth. Gombolola observations were grouped into

Figure 6.3 Demographic Transition and the Approximate Location of the Northern and Eastern Regions of Uganda in That Transition in 1969



counties; again the urban counties were excluded from the analysis. A category of partially urbanized counties was created and this category was analyzed separately.[24]

There were two primary reasons for conducting the analysis on a county basis. First, the problem of migration bias (short rural-rural movements) is minimized, since many moves do not cross county boundaries. Second, it was possible to develop two additional crude measures of health service availability: (a) health facility beds per thousand population as of 1969, and (b) maternity service beds per thousand population as of 1969. These two measures are continuous in nature, making it possible to focus on the functional relationship between population growth and health service.

The hypothesis tested assumes that the rate of population growth is affected by the availability of both curative and maternal health services (represented by measures (a) and (b) above). It was assumed that the functional relationships were linear and could be estimated according to O.L.S. assumptions. Econometrically, the relationships estimated were:

$X_{18} = a + b_{19}X_{19} + \varepsilon$,

$X_{18} = a + b_{20}X_{20} + \varepsilon$, and

$X_{18} = a + b_{21}X_{19} + b_{22}X_{20} + \varepsilon$,

where

X_{18} = average annual rate of population growth from 1959-1969,

X_{19} = total health service beds per thousand persons in 1969,

X_{20} = total maternal health service beds per thousand persons in 1969,

a, b_{19}, b_{20}, b_{21}, and b_{22} = estimated parameters, and

ε = the disturbance term.

These relationships were estimated for the sub-sample of partially urbanized counties as well as for all rural counties and the rural counties in each of the four regions. The results are summarized in Table 6.3.

The most significant finding of this analysis is that even though (a) not all the estimated parameters are statistically significant and (b) the proportion of variation between the variables explained by the model is generally low (due largely to an incomplete model specification of the factors affecting population growth), 21 of the 24 health service parameters estimated had a negative sign. This tends to suggest that the relationship between the availability of health services and the rate of population growth may likely be negative. This finding tends to corroborate the tentative findings of the two tests discussed above.

Changes in the Age Structure Related to Health Service Availability

Two tests were conducted to determine the effect of health service availability on the age structure of the population of Uganda. The first test analyzed differences between mean changes in the ratio of "old" persons to "young" persons over the decade 1959 to 1969 in rural gombololas. The results are presented in Table 6.4. The second test analyzed the average annual rate of change in the ratio of old persons to young persons over the decade 1959 to 1969 in rural counties of the country.[25] The results are presented in Table 6.5.

TABLE 6.3

Results of O.L.S. Regression Analysis of the Relationship Between Population Growth and the Availability of Curative and Maternal Health Services in Uganda

	N	$\hat{a}$	Std. Error of $\hat{a}$	Significance of $\hat{a}$	b19	Std. Error of b19	Significance of b19	b20	Std. Error of b20	Significance of b20	R^2	$\bar{R}^2$	d.w.	$r_{19,20}$
Mixed Counties	14	4.544	(1.335)	0.005	-0.514	(0.839)	0.552				0.030	-0.051	2.19	
Rural Total	86	4.996	(0.418)	<0.0005	-0.703	(0.323)	0.032				0.054	0.042	1.73	
Buganda Region	14	4.403	(0.855)	<0.0005	-0.197	(0.805)	0.811				0.005	-0.078	1.34	
Eastern Region	22	2.782	(0.299)	<0.0005	-0.146	(0.193)	0.459				0.028	-0.021	1.68	
Western Region	22	8.420	(1.237)	<0.0005	-3.180	(1.138)	0.011				0.281	0.245	2.47	
Northern Region	28	4.609	(0.471)	<0.0005	0.012	(0.353)	0.973				0.000	-0.038	2.08	
Mixed Counties	14	4.547	(1.154)	0.002				-2.540	(3.343)	0.462	0.046	-0.034	2.10	
Rural Total	86	4.887	(0.376)	<0.0005				-2.012	(0.904)	0.029	0.056	0.044	1.70	
Buganda Region	14	4.296	(0.751)	<0.0005				-0.207	(1.873)	0.914	0.001	-0.082	1.39	
Eastern Region	22	2.797	(0.307)	<0.0005				-0.481	(0.615)	0.443	0.030	-0.019	1.71	
Western Region	22	8.339	(1.217)	<0.0005				-10.162	(3.650)	0.011	0.279	0.243	2.31	
Northern Region	28	4.661	(0.375)	<0.0005				-0.161	(0.912)	0.861	0.001	-0.037	2.06	
Mixed Counties	14	4.708	(1.423)	0.007	-0.225	(1.060)	0.836	-2.021	(4.257)	0.644	0.050	-0.123	2.13	0.574
Rural Total	86	5.034	(0.421)	<0.0005	-0.381	(0.482)	0.432	-1.220	(1.352)	0.369	0.063	0.040	1.72	0.742
Buganda Region	14	4.395	(0.908)	0.001	-0.229	(1.067)	0.834	0.119	(2.475)	0.962	0.005	-0.176	1.35	0.615
Eastern Region	22	2.810	(0.321)	<0.0005	-0.069	(0.333)	0.838	-0.304	(1.063)	0.778	0.032	-0.070	1.70	0.805
Western Region	22	8.526	(1.269)	<0.0005	-1.716	(2.676)	0.529	-5.201	(8.577)	0.551	0.295	0.220	2.41	0.902
Northern Region	28	4.599	(0.482)	<0.0005	0.107	(0.499)	0.833	-0.352	(1.292)	0.787	0.003	-0.077	2.06	0.695

Note: (a) X_{19} = total health services beds per thousand persons in 1969

(b) X_{20} = total maternal health service beds per thousand persons in 1969.

TABLE 6.4

Test of Differences in Mean Changes in Age Structures Between Subcounties in Uganda Grouped According to Health Service Availability

Type of Health Facility	Total Test	Population Density Persons/mile^2 <100	101-200	201-300	301-400	$\geq$401	Region Buganda	Eastern	Northern	Western
1	160 1.114 (0.194)	31 1.079 (0.251)	35 1.119 (0.145)	30 1.181 (0.184)	19 1.182 (0.153)	13 1.074 (0.140)	19 1.235 (0.247)	56 1.192 (0.130)	48 0.971 (0.120)	37 1.117 (0.208)
2	144 1.190 (0.195)	34 1.163 (0.207)	20 1.267 (0.123)	26 1.207 (0.128)	22 1.232 (0.197)	13 1.060 (0.159)	51 1.276 (0.105)	41 1.218 (0.136)	14 0.898 (0.142)	38 1.150 (0.240)
3	16 1.068 (0.222)	3 1.108 (0.121)	3 1.123 (0.218)	2 1.041 (0.102)	2 1.151 (0.126)	----	1 1.166 (0.000)	6 1.193 (0.111)	4 0.841 (0.230)	5 1.082 (0.196)
4	65 1.100 (0.165)	19 1.040 (0.142)	14 1.157 (0.189)	8 1.264 (0.122)	6 0.992 (0.060)	5 1.152 (0.217)	7 1.313 (0.092)	18 1.188 (0.159)	31 0.998 (0.088)	9 1.107 (0.163)
5	----	----	----	----	----	----	----	----	----	----
6	2 1.235 (0.023)	----	----	----	1 1.211 (0.000)	1 1.256 (0.000)	1 1.211 (0.000)	1 1.258 (0.000)	----	----
7	80 1.115 (0.169)	14 1.020 (0.232)	15 1.132 (0.159)	10 1.144 (0.153)	12 1.216 (0.121)	16 1.090 (0.131)	19 1.222 (0.118)	24 1.148 (0.127)	11 0.918 (0.142)	26 1.091 (0.167)
Statistically Significantly Different Means Based on t test	2>1 2>7 2>4 2>3	2>4 2>7 2>1 (almost)	2>1 2>7 2>4 2>3	2>3 4>3 4>7	2>4 7>4 1>4 3>4	----	2>7 4>7	2>7 1>7 (almost)	4>2 4>3 4>7 1>2 1>3	----

Note: if mean is (a) <0.920, the population age structure has gotten older
(b) >0.920, the population age structure has gotten younger
(c) = 0.920, the population age structure has not changed

TABLE 6.5

Results of O.L.S. Regression Analysis of the Relationship Between Changes in the Age Structure and the Availability of Curative and Maternal Health Services in Uganda

	N	$\hat{a}$	std. error a	sign. of a	b19	std. error b19	sign. of b19	b20	std. error b20	sign. of b20	R^2	$\bar{R}^2$	d.w.	$r_{19,20}$
Mixed Counties	14	0.0258	(0.0099)	0.023	-0.0105	(0.0062)	0.117				0.193	0.125	1.67	
Rural Total	86	0.0101	(0.0029)	0.001	-0.0011	(0.0022)	0.621				0.003	-0.009	0.89	
Buganda Region	14	0.0275	(0.0032)	<0.0005	-0.0076	(0.0030)	0.025				0.335	0.301	2.12	
Eastern Region	22	0.0174	(0.0042)	<0.0005	-0.0002	(0.0027)	0.930				0.000	-0.050	1.83	
Western Region	22	0.0163	(0.0061)	0.014	-0.0049	(0.0056)	0.392				0.037	-0.011	1.75	
Northern Region	28	0.0074	(0.0037)	0.053	0.0012	(0.0027)	0.656				0.006	-0.030	0.83	
Mixed Counties	14	0.0057	(0.0093)	0.553				0.0217	(0.0271)	0.439	0.051	-0.028	2.19	
Rural Total	86	0.0076	(0.0003)	0.004				0.0047	(0.0062)	0.455	0.007	-0.005	0.93	
Buganda Region	14	0.0238	(0.0033)	<0.0005				-0.0095	(0.0081)	0.266	0.102	0.027	1.98	
Eastern Region	22	0.0148	(0.0042)	0.002				0.0073	(0.0085)	0.397	0.036	-0.012	1.90	
Western Region	22	0.0130	(0.0061)	0.045				-0.0040	(0.0183)	0.829	0.002	-0.048	1.63	
Northern Region	28	-0.0057	(0.0029)	0.061				-0.0017	(0.0071)	0.815	0.002	-0.036	0.80	
Mixed Counties	14	0.0203	(0.0081)	0.029	-0.0203	(0.0060)	0.006	0.0685	(0.0242)	0.016	0.532	0.447	2.17	0.574
Rural Total	86	0.0096	(0.0029)	0.001	-0.0052	(0.0033)	0.116	0.0155	(0.0092)	0.096	0.036	0.013	0.98	0.742
Buganda Region	14	0.0274	(0.0033)	<0.0005	-0.0082	(0.0039)	0.060	0.0023	(0.0091)	0.809	0.359	0.242	2.11	0.615
Eastern Region	22	0.0157	(0.0043)	0.002	-0.0046	(0.0045)	0.319	0.0191	(0.0143)	0.197	0.086	-0.010	2.00	0.805
Western Region	22	0.0152	(0.0060)	0.020	-0.0203	(0.0127)	0.127	0.0546	(0.0407)	0.196	0.120	0.027	2.17	0.902
Northern Region	28	-0.0077	(0.0037)	0.050	0.0033	(0.0038)	0.404	-0.0075	(0.0099)	0.455	0.030	-0.048	0.93	0.695

Note: (a) X_{19} = total health services beds per thousand persons in 1969.
(b) X_{20} = total maternal health service beds per thousand persons in 1969.

It can be seen in Table 6.4 that the mean percentage change among category 2 gombololas, those with no curative health services in 1959 and only curative health services in 1969, tended to be greater than the percentage change in every other category, with the exception of the Northern region. In category 2 gombololas, the age structure became younger at a more rapid rate than in either the gombololas with no health services or those which have had health services -- both curative and maternal -- for some period. This result tends to corroborate the earlier finding of a slightly higher population growth rate in gombololas with only curative health services.

The only unusual finding in the data summarized in Table 6.4 is to be found in the Northern region, where, in some cases, the population age structure tended to become older. Either the finding is spurious as a result of misreporting of ages in the 1959 census, or it may infer that the effect of health services as indicated by the figures for gombololas in categories 2, 3, and 7, was particularly focused on diseases which previously caused death among the older age groups. This effect on the death rates among the older age group would tend to corroborate evidence presented above, which suggested that the North is still in the very early stages of a demographic transition (Figure 6.3).

In Table 6.5, the results of the test analyzing the impact of curative and maternal health services on the average annual rate of change in the age structure are presented. This test was conducted with the same econometric methods and variables discussed above with respect to the rate of population growth. Although the results, by and large, were not statistically significant -- both from the perspective of the estimated parameters of the curative and maternal health service variables (beds per thousand persons) and from the perspective of the proportion of the total variation explained by the specified relationships -- it is again interesting to analyze the consistency of the estimated parameter signs. For the curative health service variable, X_{19}, the sign is negative in 9 out of 12 cases, whereas for the maternal health service variable, the sign is positive in 8 out of 12 cases; the sign is consistently positive only in the Northern Region. This admittedly weak evidence, however, tends to suggest that curative health services may retard the rate at which the population's age structure becomes younger, whereas the opposite may be true in the case of maternal health services, whose principle short term impact would be the reduction infant mortality.

To summarize briefly, several tests have been conducted on the relationships between the availability of health services and (a) the rate of population growth and (b) changes in the age structure of the population. Although the test results were generally statistically insignificant, limited evidence tends to suggest that these relationships may not be insignificant, given improved data. In addition, when the results are interpreted in light of the theory of demographic transition, they suggest that Uganda should not be analyzed from a monolithic perspective, but rather that the country should be disaggregated, at least according to region, in order to discern the location of each part of the country in the demographic transition process. This finding, in and of itself, is crucial for the development of an implementable set of family planning strategies in subsequent planning periods.

Balance of Payments and Foreign Exchange Considerations

The health service industry in Uganda has several links with other countries, through the importation of drugs and other medical materials, construction and other capital goods, and skilled manpower. In addition, some methods of securing external financing for development plan expenditures have a significant effect on the maintenance of a equilibrium in the area of foreign exchange. In this section, these areas are examined: (a) the extent to which the operation of Uganda's health service system is linked to the foreign trade sector, and (b) the effect of contractor finance methods for new capital projects on public indebtedness and international liquidity.

Imports of Drugs and Related Items

Of the approximately 160 million shs. spent on health services by all branches of government and missions in 1968/69, approximately 12.5 percent (20 million shs.) was used to purchase drugs, medical supplies and equipment. Virtually all of these goods were imported. The magnitude and trend of this importation is shown in Table 6.6. Three points are of particular interest. First, although the health service industry spent approximately 20 million shs. on imported items, up to 40 percent of the items were consumed within the private sector or used to build up inventories among importing pharmacies.[26] Second, although total imports have nearly doubled over the 1960's, imports of drugs and related medical supplies and equipment have

TABLE 6.6

Trends in Uganda's Importation of Drugs and Related Medical Supplies and Equipment

Selected Year	Total Imports Million Shs.	Imports of Drugs and Related Items From Outside East Africa Million Shs.	Imports of Drugs and Related Items from East African Countries Million Shs.	Proportion Drugs and Related Imports are of Total Imports	Proportion East African Drug and Related Items are of total Drug and Related Item Imports
1946	118.6	1.68	NA (1)	1.51	
1956	665.0	10.24	NA (1)	1.53	
1960	652.8	12.00	0.61	1.93	4.8
1964	928.2	18.76	1.25	2.15	6.2
1966	1188.2	24.32	4.15	2.40	14.6
1968	1176.0	26.81	5.52	2.75	17.1
1969	1247.0	29.80	6.00	2.87	16.8

Notes: (1) Virtually all of the items imported were from Kenya. Data are unavailable as to the extent of drug and pharmaceutical imports from Kenya prior to 1960, although the trend would suggest that the amounts prior to that time were very small. Industrial production data from Kenya provides a corraborating evidence.

(2) Sources: Uganda Government, Statistical Abstract, various years; East Africa Annual Trade Reports, various years.

nearly tripled.[27] Other items comprise larger proportions of total imports, but health service imports comprise a rapidly growing proportion of the total. Finally, from the perspective of the long run economic integration of East Africa, the increase in the proportion of drugs and related imports from Kenya is welcome; over the 1960's, this proportion has grown from 5.1 percent to 20.2 percent.

Imports of Building Materials and Other Capital Goods for Health Facilities

Not only does the health service system require the importation of a large proportion of drugs, medical supplies and equipment, but it also imports a substantial proportion of the items for transportation and for the construction of health facilities (Table 6.7).

As may be recalled (Chapter One, Figure 1.1), expenditures by the central government on health have varied over the decade, primarily as a result of capital expenditure lumpiness. Since 1964, however, health facilities construction activity has increased more than five-fold and the proportion of total imports comprised by health facility construction materials has increased from 0.2 percent to 1.0 percent.

The proportion of health facility construction imports within total construction material imports is illustrated in Table 6.8. Even during periods of relatively minor health facility construction as in 1966, a minimum of 6 percent of all imported construction materials went into health facilities; during periods of major health facility construction (1969/1970), as much as 15 percent of imported construction materials were so used.

Aside from construction materials, the other most important imported capital items in health services are vehicles (ambulances, etc.).

TABLE 6.7

Estimated Quantity of Imported Items for Health Facility Construction[4]

Year	Total Imports[1] Million Shs.	Estimated Expenditure of Government and Missions on Health Facility Construction Million Shs.	Estimated Proportion of Health Facility Construction Expenditures Used for Imported Materials[2] (a) 10% assump.	(b) 50% assump.	Estimated Expenditure on Health Facility Construction Spent on Materials[3] Million Shs. (a)	(b)	Proportion Health Facility Construction Imports is of Total Imports % (a)	% (b)
1960	652.8	19.1	16.8	27.1	3.2	5.2	0.49	0.80
1962	679.0	12.6	16.8	27.1	2.1	3.4	0.31	0.50
1964	928.2	10.2	16.8	27.1	1.7	2.8	0.18	0.30
1966	1188.2	20.3	16.8	27.1	3.4	5.5	0.29	0.46
1968	1176.0	28.3	16.8	27.1	4.8	7.7	0.44	0.65
1969	1247.0	54.5	16.8	27.1	9.2	14.8	0.74	1.19

Notes:

(1) Includes total retained merchandise imports and re-exports.

(2) In 1964 the Ugandan government made a survey of the building and construction industry. In Appendix Table II (a) and II (b) of the report, (Survey of Industrial Production: Building and Construction, 1964, Statistics Division, Ministry of Planning and Community Development, Entebbe, January 1964) the proportion that imported materials represents of total sales (turnover) is calculated. The figure was 14.2% for the Building and Construction sector and 40.0% for the Plumbing, Electrical and Painting sector. It is unclear what proportion of total health facility expenditures accrues to each sector of the construction industry. However, for illustrative purposes we examine 2 situations, each based on a different assumption: Case (a) - 10% of total health facility expenditures accrues to the Electrical, *et al.*, sector - and case (b) 50% of total health facility expenditures accrues to the Electrical *et al.* sector.

Notes to Table 6.7 (Contd.)

Two additional assumptions are implied in the above calculations: (a) there has been a substantial change in the availability of materials used in the construction of health facilities over the decade 1960-1969 and (b) health facilities construction does not require a substantially different mix of materials than are used in construction generally. As a first approximation, I am willing to live with both assumptions.

(3) The figures are calculated by multiplying the figures in Column (2), estimated expenditure of government and missions on health facility construction, with the figure in either Column (3a) or (3b), the estimated proportion of health facility construction expenditures used for imported materials.

(4) Additional sources: Uganda Government, Statistical Abstract, various years; Audited Financial Statements of District Administration Governments for years 1965-1969 on file with Auditor General, Uganda Government, Kampala.

TABLE 6.8

Estimated Proportion of Imported Construction Materials
Used in the Construction of Health Facilities.

Year	Imports of Construction Materials[1] Million Shs.	Estimated Imports of Health Facility Construction Materials, Million Shs. Assumption (a)[2]	Assumption (b)[2]	Proportion Health Facility Construction Imports is of Total Construction Material Imports (a)	(b)
1966	66.6	3.4	5.5	5.1	8.3
1967	73.4	3.8	6.2	5.2	8.4
1968	79.9	4.8	7.7	6.0	9.6
1969	96.9	9.2	14.8	9.5	15.3
1970	92.5	9.7[3]	15.7[3]	10.5	17.0

Notes:

(1) Data is taken from The Republic of Uganda, Uganda's Plan III, Third Five-Year Development Plan, 1971/72-1975/76, Government Printer, Entebbe, 1972, Table II-4, p. 33.

(2) See note 2, Table 6.7, for a discussion of assumptions (a) and (b).

(3) 1970 figures were estimated from estimated government expenditures during 1970.

Financial accounts of both government and missions indicate that less than 500,000 shillings are being spent each year on new vehicles. In recent years, this may be true; however, figures on new vehicle registrations and data found in Galea's survey of Uganda's health facilities in 1966 and 1967 indicate that the health service industry spent, at a minimum, 700,000 shillings in 1965 and as much as 1,700,000 shillings in 1964 and 1967 on transport costs.[28] If these estimates of imported capital goods are added to construction materials imports, the average annual proportion of total imports comprised by capital inputs for health services during the 1960's was approximately 0.7 percent.

Non-Trade and Capital Account Considerations

Although it is difficult to quantify the size of all public and private non-trade and capital balance payment flows attributable to health services, it is useful to review the sources of such flows, especially because Uganda's balance of payments position has deteriorated markedly in the last several years.[29] Important flows attributable to the health sector are (a) private remittances of earnings by non-Ugandans;[30] (b) public transfers, (e.g., membership payments and other fees to international health organizations); and (c) net capital flows from abroad, public and private, for health facility construction. Table 6.9 presents data showing the approximate effect on these factors on the balance of payments position of the country.

The overall effect of health-related financial transactions on the balance of payments position in 1969 was positive, amounting to a net inflow of approximately 9 million shs. Closer analysis however,

TABLE 6.9

Health-Related Financial Transactions Affecting Uganda's Balance of Payments Position in 1969.

Transfers		mill. shs.	mill. shs.
(1)	Private Income Transfers		
	(a) Non-African[2]	-0.32	
	(b) Non-Ugandan African[3]	-1.59	-1.91[1]
(2)	Public Transfers		
	(a) to international health related organizations[4]		-0.35
(3)	Capital Account, Long Term		
	(a) Private-Mission Related[5]	+2.70	
	(b) Public-Health Service Construction[6]		
	(i) inflow of loans and grants	+9.81	
	(ii) outflow of interest and repayment of loans	-1.34	+11.17
(4)	Net Effect on Balance of Payments		+8.91
(5)	Total Balance of Payments of Uganda 1969[7]		+70.00

Notes

(1) a (-) sign indicates a financial outflow from the country, whereas a (+) sign indicates an inflow.

(2) It is estimated that 5% of total wages paid to non-African personnel in 1969 were remitted abroad.

(3) It is estimated that 50% of total wages paid to Non-Ugandan Africans were remitted abroad. Total wages paid to Non-Ugandan Africans were estimated on the basis of information found in The Republic of Uganda, Enumeration of Employees, (1968 and 1969), Statistics Division, Ministry of Planning and Economic Development on employment in health services.

(a) Estimated Total Employment in Health Services 1969 — 17,700

Notes to Table 6.9 (contd.)

(b)	Estimated proportion of Non-Ugandan Africans employed in Health Services 1969. Based on Health and Education or Place of Birth	5.6%
(c)	Estimated number of Non-Ugandan Africans employed in Health Services 1969	1,000
(d)	Estimated proportion of Non-Ugandan Africans employed in Government Health Services. Based on employment data between Private and Public employment in Health Services	80%
(e) (i)	Average annual wage for Africans in Government Health Services in 1969:	3505 shs.
(ii)	Average annual wage for Africans in Private Health Services in 1969:	1867 shs.
(f)	Estimated total wages paid to Non-Ugandan African employees.	
(i)	Government Health Services	2,804,000 shs.
(ii)	Private Health Services	373,400 shs.
	Total Wages	3,177,400 shs.

(4) The Republic of Uganda, Medical Services Statistical Records 1968/1969, Ministry of Health, Entebbe, Appendix IV, pp. 55-56.

(5) Financial records of Catholic and Protestant Mission Health Facilities, provided by the respective Medical Bureaus for 1968/1969.

(6) The Republic of Uganda, The Public Accounts of the Republic of Uganda for the Year Ended 30th June, 1969, Government Printer, Entebbe, 1970, pp. 32-33, 81-82.

(7) The Republic of Uganda, Background to the Budget, 1970-71, Statistics Division, Ministry of Planning and Economic Development, June 1970, Table 8.1, p. 50.

reveals that the position is not as positive as it appears. Estimations of the net remittance abroad of employees' earnings place the figure at a minimum of 2 million shs. Available evidence, however, indicates that the amount remitted abroad is declining for at least 2 reasons: (a) the rapid decline in the number of European expatriates, who are being replaced by trained Ugandans or less expensive non-European expatriates, and (b) the reduction in the number of non-Ugandan Africans working in the country. In addition, the period of large capital inflows from abroad for mission health facility construction appears to be at an end, as a result of governmental decisions (a) to expand the government health service system and (b) to discourage further expansion of mission health services. Although recurrent external support is thus likely to decline, support from abroad to assist in the operations of present facilities will undoubtedly continue; this support of operating costs amounts to approximately 1.2 million shs. at the present time. The net effect, from a balance of payments perspective, is that the positive inflow related to health services should decline in the future to a level of approximately 0.75 million shs.

In the public capital account, a positive inflow of approximately 8.5 million shs. was recorded in 1969. This trend is unlikely to continue however, due to (a) decline in health facility construction activities; [31] (b) a decline in the use of foreign financing methods, particularly contractor finance, in future health services expansion activities; [32] and (c) an increase in the level of interest and loan repayment commitments, particularly as a result of the large rural hospital project of the second development plan.[33] Interest and loan repayment commitments have risen, due to the increase in outstanding contractor-financed projects, to a minimum outflow of 7.0 million shs. in 1970 through 1972, and 6.6 million through 1975. This substantial repayment commitment will tend to exacerbate Uganda's balance of payments position during the early and middle 1970's.

Health Services Effect on Employment

In 1969, approximately 18,000 persons were employed in the health services industry -- approximately six percent of the total number employed in the wage sector of the economy.[34] Since employment in this sector nearly doubled over the decade 1959-1969, while total employment in the country has been relatively stagnant, and since health service facilities have been expanded in recent times, it is useful to analyze the present and future impact of the health service system on employment and the related equity objectives of the process of economic development.[35] The analysis will focus on three issues: (a) a comparison of the health service industry with other industries, in terms of output and employment relationships; (b) the important secondary employment effects of the health services industry, particularly in the case of the construction industry; and (c) the distribution of employment in health services throughout the country.

An Interindustry Analysis of the Relationship Between Output and Employment

The analysis here focuses on the position of the health service industry relative to other sectors of the Ugandan economy, in terms of the relationship between output and employment. Two methodologies have been employed in determining the relationship for each industry:

(a) the incremental output employment ratio (IOER) and (b) estimation of the elasticity of employment with respect to output. In the IOER method, the percentage change in value added for each industry over the period 1963-1969 is divided by the percentage change in the number employed. The results of these calculations are presented in Table 6.10.[36] In addition to the IOER calculations, a simple labor demand model has been developed in order to derive estimates of the elasticity of employment with respect to output.[37] These elasticity estimates are also presented in Table 6.10.

Results of the first analysis indicate that the health service industry has a lower IOER than the economy as a whole, which implies a larger than average [38] employment impact during the 1960's as a result of increases in value added. Services in general, in fact, have values below the economy average, indicating a larger employment impact in those industries due to increases in value added. Employment elasticity estimates tend to corroborate the finding, for the service industries' employment elasticities tend to be larger than most other industries'. [39]

Secondary Employment Effects of the Health Services Industry

Although an input-output transaction matrix does not exist for the Ugandan economy as yet,[40] it is clear that health services demand goods and services from a number of other industries in the country. In doing so, the health service sector expands the derived demand for labor in those other sectors. Some of the most important linkages between the health services industry and other industries are summarized for 1968/69 in Table 6.11; included are estimates of the secondary employment

TABLE 6.10

Incremental Output Employment Ratio (IOER) and Elasticity of Employment With Respect to Output for Uganda, According to Industrial Sector

Industry	IOER 1963-1969 VA60	IOER 1963-1969 VA66	Estimated Elasticity of Employment with Respect to Output Linear VA60[2]	Double Log VA60	Linear VA66[2]	Double Log VA66
Agriculture	2.50	2.89	0.30**	0.29**	0.13	0.13
Forestry, Fishing, Hunting	----	----	0.30	0.33	0.25	0.19
Mining and Quarrying	0.38	0.54	-1.01***	-1.25***	-0.68	-0.84
Manufacture of Food Prod.	1.11	0.51	0.65**	0.63*	0.19	0.16
Misc. Manufacturing	1.33	0.88	0.46***	0.36**	1.64***	1.62***
Construction	1.15	1.07	0.71***	0.76***	1.29***	1.24***
Commerce	1.71	2.10	1.08*	1.93**	-0.56	-0.18
Transport and Communication	3.10	3.34	0.66**	0.65**	0.60*	0.60*
Local Government	0.33	---	1.05***	1.28***	----	----
Misc. Services	0.96	0.91	1.10***	1.10***	1.11***	1.19**
Education Service	---	0.85	----	----	0.87***	0.84***
Health Service	---	0.92	----	----	1.00***	0.99***
Entire Economy	1.15	1.21	1.16***	1.16***	0.99	1.11*

Notes on Table 6.10

(1) * significant at the 0.10 level
** significant at the 0.05 level
*** significant at the 0.01 level

The significant notation appearing beside the elasticity estimates calculated from the linear equation, indicate the significance of the estimated parameter relationship between output and employment.

(2) Estimated elasticities using the 1960 constant price value added series, VA60, used data over period 1954-1969. The 1966 constant price value added series, VA66, started in 1961; therefore, the series contains data for the period 1961-1969.

(3) The estimated elasticity of employment with respect to output was calculated at the mean values of employment and value added for the linear equations.

(4) Sources: Republic of Uganda, Statistical Abstracts, selected years; Republic of Uganda, Background to the Budget, 1970-71, Statistics Division, Ministry of Planning and Economic Development, June 1970; Uganda Government, The Real Growth of the Economy of Uganda, 1954-1962, Statistics Division, Ministry of Planning and Community Development, April 1964.

(5) The IOER shown for Uganda is quite low compared with estimated IOER's for other less developed countries. A sample of IOER's for other countries is presented below.

Country	Years	IOER	Remarks
Uganda	1963-69	1.1	All Sectors
Japan	1953-63	2.6	All non-agricultural sectors
Puerto Rico	1953-63	4.0	All non-agricultural sectors
Israel	1955-63	3.0	All non-agricultural sectors
Philippines	1953-63	2.9	All non-agricultural sectors
Yugoslavia	1953-63	2.5	All non-agricultural sectors
Poland	1955-63	3.1	All non-agricultural sectors
Hungary	1953-63	3.7	All non-agricultural sectors
United States	1950-61	6.3	Mining, Mfg. constructional public utilities sectors

(From Zschock, Dieter, Manpower Perspective of Colombia, New Jersey, Princeton University Press, 1967, P. 136.)

effects of the health service industry.

In 1968/69, approximately 3,800 persons were employed in other industries as a secondary effect of the demands for goods and services by the health services industry. This constituted approximately 1.3 percent of the average total employment in the country. The most important secondary employment impact was in the construction industry, where at least 3,100 additional jobs existed as a result of health facility construction activities. That number comprised approximately 7.5 percent of the total number of persons employed in construction in June 1969. In addition, estimates based on Table 6.11 indicate that for every additional 19,200 shs. spent by the health service system for goods and services in other industries, the demand for labor in those industries is increased by one employee.[41]

The Geographical Distribution of Health Service Employment in Rural Areas

Table 6.12 presents information, by district, concerning the proportion of total wage employment comprised by health services employment. Of immediate importance is the fact that people are employed in the health services industry in every district and town with one exception.[42] Thus, while a completely equitable distribution of health services has by no means been accomplished,[43] there are at least some services available in every district and major town.

Although employment in the health services industry does exist in all areas of the country, it comprises a significantly larger proportion of total employment in the towns than in the districts - 9.0 percent as opposed to 4.3 percent. Even adjusting the figures to

TABLE 6.11

Inter-Industry Linkages of the Health Service Industry and Estimates of the Secondary Employment Impact in 1968/69

Industry	Industry Receipts from Health Service Industry (2) million shs.	Receipts per Employee Ratio million shs. Per Employer	Estimated Secondary Employment Impact of Health Service Industry (3)
Agriculture (4)	6.04	0.0396	150
Electricity (5)	4.43	0.0525	80
Construction (6)	39.62	0.0128	3100
Commerce (7)	21.63	0.1380	150
Transport	NA	NA	NA
Communications	1.28	NA	NA
Misc. Services (8)	3.04	0.0120	250
Total (excluding NA)	71.55		3730
Estimated Total Wage Employment			288,400
Proportion Estimated Secondary Employment is of Total Wage Employment			1.3%

Notes to Table 6.11

(1) Not all industries are included in the list. It is assumed that those not included do not have significant purchases made from them by the health service industry. This assumption is based on an analysis of financial statements of the respective governmental and mission sectors of the health services industry.

(2) Source: an analysis of the 1968/1969 financial statements from the appropriate jurisdictions responsible for health services in the central, districts and municipal governments and the Protestant and Catholic mission organizations.

(3) Estimates are rounded to the nearest ten employees.

(4) The estimated secondary employment impact in Agriculture was made as follows. I took the monetary sectors estimated value, added in agriculture (for 1968 and 1969) per Table 1.2 in the Republic of Uganda, Background to the Budget 1970-71, Statistics Division, Ministry of Planning and Economic Development, Entebbe, 1970, and made an assumption that it represented 80% of total receipts by that sector. I divided each year's figure by two to get an estimate of receipts for each half of the 1968/69 fiscal year. These estimates were added together and were divided by the estimated number of total employees in agriculture for the fiscal year 1968/69 (by averaging the 1968 and 1969 figures in the same manner as described above), per the Republic of Uganda's Enumeration of Employees, June 1963 and 1969.

Est. Receipts in Agriculture (mill. shs.)	Estimated Total Employees (thousands)	Est. Receipts per Employee Ratio (mill. shs.)
2092.9	52.85	0.0396

(5) The receipts-per-employee ratio was estimated from data in Republic of Uganda, Survey of Industrial Production, 1967, Statistics Division, Ministry of Planning and Economic Development, Entebbe, 1969. Table 3.118, p. 83.

(6) Receipts-per-employee ratio was estimated from data in Uganda Government, Survey of Industrial Production: Building and Construction, 1964, Statistics Division, Ministry of Planning and Community Development, 1964. Appendix Table 1. Labor productivity data in construction was analyzed to determine the extent to which the figures should be adjusted to reflect the 1968/69 situation. The annual rate of increase in productivity over that period was about 0.5%.

Notes to Table 6.11 (Contd.)

(7) The industry receipts from health services is estimated as follows:

		mill. shs.	mill. shs.
(a)	Drugs and Equipment	19.10	
	Less Direct Imports	2.47	16.63
(b)	Misc. Commerce Purchases		0.28
(c)	Transport, Petroleum and Related Purchases		4.72
	TOTAL		21.63

The receipts-per-employee ratio was estimated from data in The Republic of Uganda, Census of Distribution 1966, Statistics Division, Ministry of Planning and Economic Development, 1967, Table A, IV, p. 35, and Table BIII, p. 45.

(8) The receipts-per-employee ratio was estimated as follows. It was assumed that the average labor cost per employee in miscellaneous services in 1968/69 was 6,000 shs. It was then assumed that labor cost constituted 50% of total receipts in miscellaneous services. On the basis of these two assumptions the receipts-per-employee ratio was estimated. Data on average cash wages in Misc. Services in 1968 and 1969 was approximately 4100 and 4500 shs., respectively. It is assumed that labor costs such as pensions, workman's compensation, social security and non-wage benefits comprise the difference. See Republic of Uganda, Enumeration of Employees, 1968 and 1969, Appendix Table XX.

Table 6.12

Proportion Health Service Employment is of Total Employment in Uganda by Districts, Towns, and Regions in 1968

	Districts, Towns, or Regions	% of Total African Employees Comprised by African Health Services Employees in 1968	% of Total African Employees, excluding Employees in Agricultural Sector, Comprised by African Health Services Employees in 1968
(1)	Districts		
	East Mengo	1.53	2.09
	West Mengo	2.51	6.05
	Masaka	2.65	3.74
	Mubende	3.69	7.44
	Busoga	1.60	2.68
	Bugisu	4.64	6.15
	Bukedi	4.84	4.90
	Sebei	9.97	10.36
	Teso	7.31	8.13
	Karamoja	11.97	12.33
	Madi	9.19	9.74
	Acholi	10.46	10.94
	Lango	9.58	10.21
	West Nile	6.75	7.27
	Bunyoro	8.15	10.73
	Toro	1.64	2.73
	Kigezi	7.36	7.99
	Ankole	8.45	9.32
(2)	Towns		
	Kampala (W. Mengo)	8.72	8.80
	Entebbe (W. Mengo)	14.41	14.56
	Masaka (Masaka)	23.45	23.45
	Jinja (Busoga)	5.27	5.35
	Mbale (Bugisu)	11.36	11.47
	Tororo (Bukedi)	14.11	14.37
	Njeru (E. Mengo)	---	---
(3)	Regions Total	4.34	6.01
	Buganda	2.49	4.58
	Eastern	4.68	6.02
	Northern	9.12	9.68
	Western	5.56	7.33
	Towns Total	9.02	9.11
	Total Country	6.18	7.67

Notes to Table 6.12

(1) Source of information: (1) Republic of Uganda, Enumeration of Employees, June 1968, Statistics Division, Ministry of Planning and Economic Development, Entebbe, 1969; (2) Unpublished data on Health Services Employment from the Statistics Division, Ministry of Planning and Economic Development.

(2) Employment in towns appearing on the list above is excluded from district data. As a result, district and Regional data can be used as a crude first approximation of rural employment.

(3) Buganda Region is comprised of East and West Mengo, Masaka and Mubande districts. Eastern Region is comprised of Busoga, Bugisu, Bukedi, Sebei, Teso, and Karamoja districts. Northern Region is comprised of Madi, Acholi, Lango, and West Nile districts. Western Region is comprised of Bunyoro, Toro, Kiegezi, and Ankole districts.

account for the difference in employment structure between rural and urban areas (by subtracting employment in the agricultural sector from total employment), the proportion of health services employment is approximately 50% larger in the towns than in the districts - 9.1 percent in the towns and 6.0 percent in the districts. The reason for this difference is somewhat unclear, although it may be due in part to the fact that most towns in Uganda serve as mechanisms through which services of all types - social, political and administrative - are dispensed throughout the country.

An interesting relationship appears between health services employment and district economic development, as measured by per capita income. Although the data on per capita income by districts are not completely accurate, two independent estimates were obtained from different points in time, and the rank order of districts remained constant.[44] A rank order correlation test was performed and a significant negative relation between the level of income and the proportion of total employment in health services was found.[45]

This finding may be due to both of the following factors: (1) health services have been used by government and missions, to improve the welfare of the least developed areas of the country, and their presence has provided employment opportunities; (2) social services development throughout Uganda has generally preceeded the economic development of all areas. It may be that one of the most significant effects of the expansion of hospitals and rural health facilities during the second development plan has been the initial employment effect in rural areas and the stimulation of demand for food and other local consumption items. The primary employment implication of a new 100-

bed hospital is at least 150 new jobs; every new health facility center creates about 20 new jobs. It may be somewhat facetious to suggest that health services lead economic growth, but the development of health facilities does have a substantial economic impact on the surrounding community.

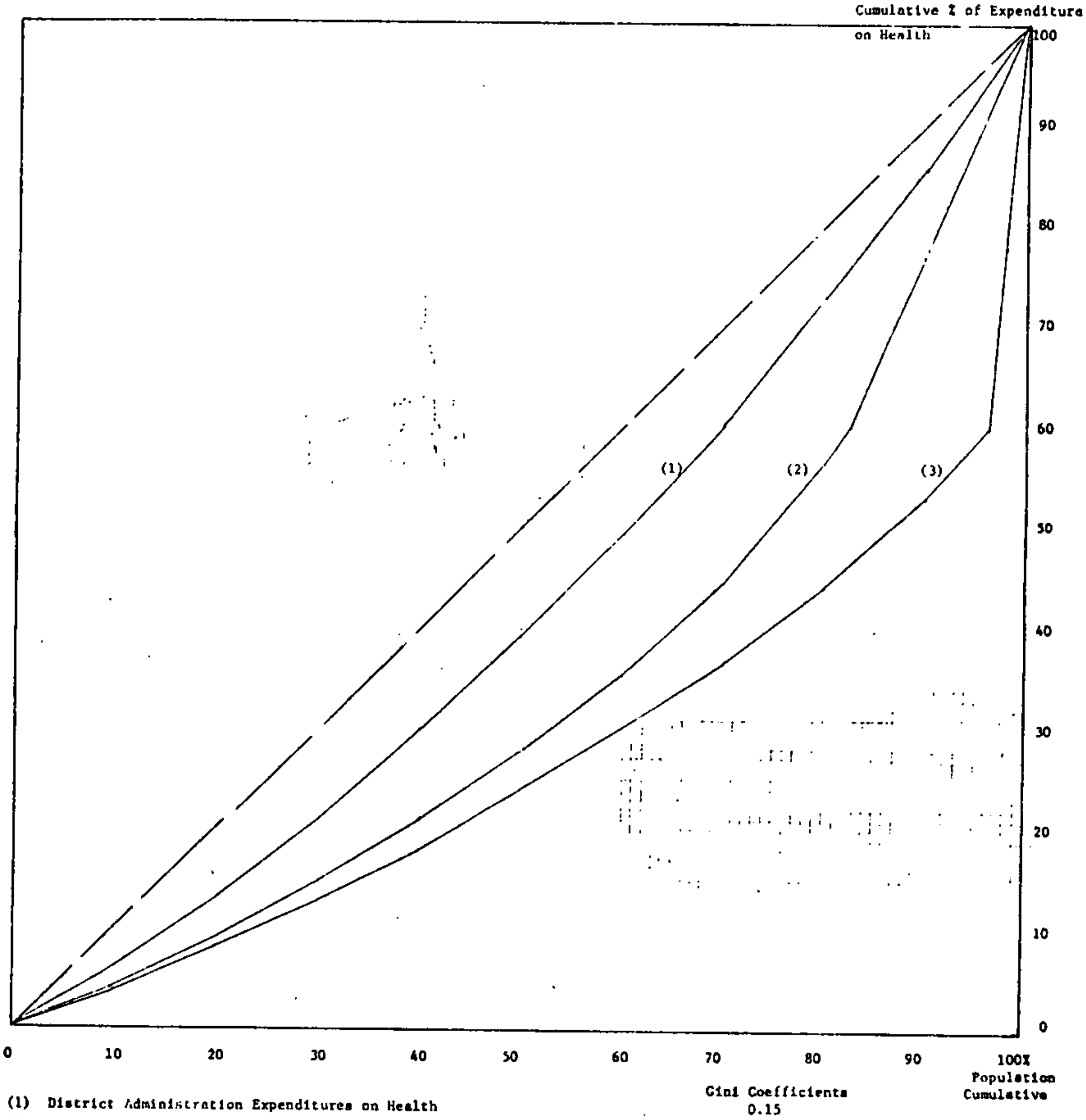
Equity Considerations in the Distribution of Health Services

One of the objectives of Uganda's third five-year development plan is the promotion of more equitable distribution of income and wealth, through implementation of a rural development strategy.[46] In this section, the distribution of three resources used in the delivery of health services will be examined: financial expenditures, manpower, and facilities. (The number of beds was used as an indicator of health facilities.) Although many analyses of income distribution focus on the household as the principle unit of measure, the analysis here utilizes the individual as the unit of measure. This procedure is used for two reasons: (1) data on the number of households in Uganda are not available and (2) most health services are consumed by individuals.

The Distribution of Expenditures on Health Services[47]

Data on the distribution of health expenditures are summarized in Lorenz curves in Figure 6.4. The most equitable distribution of health service expenditure (i.e., that most closely approaching a 45° line) is found in district administrations (Curve (1)). Curve (2) illustrates the distribution of total governmental expenditures on health services; this measure includes the expenditures of districts, central government, and municipalities and towns.[48] Curve (3) depicts the distribution of

Figure 6.4 The Distribution of Expenditures on Health Services: A Lorenz Curve Analysis



		Gini Coefficients
(1)	District Administration Expenditures on Health	0.15
(2)	Total Government Expenditures on Health, Kampala included with East and West Mengo and Jinja with Busaga	0.32
(3)	Total expenditures on Health; Government and Voluntary; Kampala and Jinja included separately	0.46

Notes to Figure 6.4

(1) Data sources: (a) Central Government Health Expenditures: The Republic of Uganda, Medical Services Statistical Records as from 1st July 1968 to 30th June 1969, Ministry of Health, Entebbe, 1971; and unpublished financial analyses of the Ministry of Health 1968/69; (b) District, Municipality and Towns Health Expenditures: Audited financial statements prepared by the respective jurisdictions 1968/69 and in the files of the Auditor General, Kampala; (c) Catholic Health Facility Expenditures: Uganda Catholic Medical Bureau, Survey of All Our Catholic Medical Units, 1968/69, Kampala, 1970; (d) Protestant Health Facility Expenditures: Hollway, Jane, A Survey of the Church Related Hospitals in the Anglican Province of Uganda, Rwanda and Burundi, Provincial Medical Board, Church of Uganda, Rwanda and Burundi, Kampala, 1972; and unpublished Audited Financial Statements of three other protestant hospitals.

(2) The health expenditure data from which the Lorenz curves in figure 6.4 are derived are included in the appendices as Table 2.9, Appendix D.

total health service expenditure of government, as well as all mission health facilities.

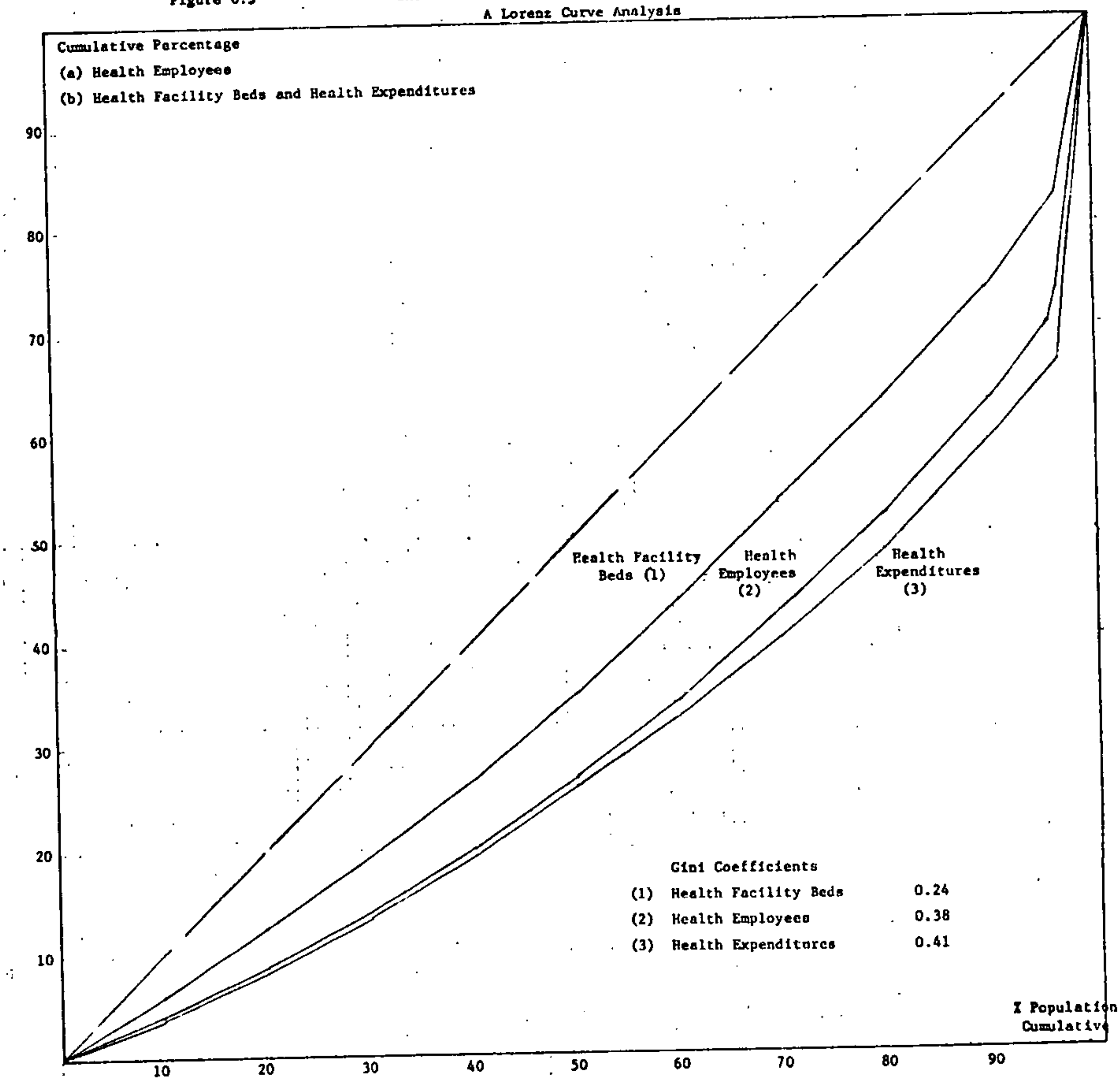
Consolidation of central government expenditures with district health expenditures thus causes the distribution to become more skewed (the difference between Curves (1) and (2)).[49] The increased skewness is principally due to the fact that the size and sophistication of hospitals maintained by the government differ from district to district.[50] Although mission health expenditures are added to Curve (3), they are not materially responsible for the increased skewness of that curve over Curve (2). The difference in those two distributions is explained primarily by the fact that in Curve (2), the expenditures on health in Kampala and Jinja were incorporated into the surrounding districts, rather than standing separately as they do in Curve (3). The incorporation the expenditures of those two cities into the adjacent districts (Curve (2)) is somewhat more realistic as a large number of visits to government hospitals in both cities are by persons residing outside the cities.

A Comparative Analysis of the Distribution of Health Resources

The distribution of three health service resources - manpower, facility beds, and expenditures - are illustrated in Figure 6.5 in the form of Lorenz curves. The three curves are taxonomically comparable in that (a) the data refer to total health service resources of that type, government and private and (b) there is consistent treatment of the city data (all are incorporated into the relevant district, with the exception of Kampala, which is included as a separate entity).[51]

The Lorenz curves presented in Figure 6.5 suggest that expenditures on health services have a more skewed distribution than either manpower

Figure 6.5 The Distribution of Health Service Resources: A Lorenz Curve Analysis



Notes to Figure 6.5

(1) Data Sources: (a) Health expenditure data: (See note (1), Figure 6.4); (b) Health facility bed data: The Republic of Uganda, Uganda's Plan III, Third Five-Year Development Plan, 1971/72-1975/76, Government Printer, Entebbe, 1972, Table vii - 3, p. 98; (c) Health Employment data: Unpublished data from the Statistics Division, Ministry of Planning and Economic Development, Entebbe, 1970. This unpublished employment data is summarized with other data in the annual government publication, Enumeration of Employees.

or bed resources. This difference between the distribution of expenditures on the one hand, and the other two resources on the other hand, is significant in terms of the delivery of health services throughout the country. The implications of the difference include the following: (a) even though a health facility may exist in a particular location, other resources may not, resulting in no provision of service, and (b) even if both health facilities and health workers are available, the amount of drugs and the range of services provided may be inequitably distributed. The equity of health service availability in Uganda therefore, cannot be determined simply by analyzing the distribution of one resource required in the production of health services; the distribution of all required resources must be considered. In Uganda, distributional equity of health service availability is reduced to "the lowest common denominator" and the most unequally distributed resource - funding.

Footnotes

1. At this time, it is not feasible to develop a fully specific model detailing the interaction of the health service system and macro-economic variables. Theoretical understanding of the role of health in the processes of demographic change and economic development is still rudimentary; in addition, the empirical base for exploring these relationships is also poorly developed as yet. The analysis in this chapter, therefore presents empirical information concerning past and present interactions between the health service system in Uganda and other sectors of the Ugandan economy.

2. See Eduardo E. Arriaga, Mortality Decline and Its Demographic Effects in Latin America, Population Monograph Series (Berkeley, California: Institute of International Studies, University of California, 1970); Robin Barlow, Economic Effects of Malaria Eradication; John Bryant, Health and the Developing World; Leslie Corsa Jr., and Deborah Oakley, "Consequences of Population Growth for Health Services in Less Developed Countries: An Initial Appraisal," in Rapid Population Growth: Consequences and Policy Implications, National Academy of Sciences Study Committee, Roger Revelle, chairman (Baltimore: John Hopkins Press, 1971); E. C. Cummings, "The Development of Health Services in Sierra Leone," in The Demographic Transition in Tropical Africa, Proceedings of an Expert Group Meeting, Paris, 17-19 November 1970 (Paris: Development Center, Organization for Economic Cooperation and Development, 1971); Roudshi A. Henin, "The Applicability of the Theory of Demographic Transition in African Countries," in Demographic Transition in Tropical Africa; Dudley Kirk, "A New Demographic Transition," in Rapid Population Growth, by the National Academy of Sciences Study Committee; Michael Lipton, rapporteur, Population Growth: The Impact of Advances in Agriculture and Medicine, Report of a Conference at Ditchley Park, January 1969 (Enstone, England: The Ditchley Foundation, 1969); National Academy of Sciences Study Committee, Roger Revelle, chairman, Rapid Population Growth: Consequences and Policy Implications, Vol. 1, "Summary and Recommendations" (Baltimore: Johns Hopkins Press, 1971); Peter Newman, Malaria Eradication and Population Growth, with Special Reference to Ceylon and British Guiana, Research Series No. 10 (Ann Arbor, Michigan: Bureau of Public Health Economics, School of Public Health, University of Michigan, 1965).

3. See Barlow, Economics Effects of Malaria Eradication; and Carl E. Taylor, "Health and Population," Foreign Affairs, 43, 3 (April 1965), 475-486.

4. The following studies discuss this set of demographic effects: Barlow, Economic Effects of Malaria Eradication; Cummings, "Health Services in Sierra Leone"; E. O. Idusogie, "Relation of Population

and Nutritional Health Problems in African Communities," paper presented at the African Regional Population Conference, Accra, Ghana, December 9-18, 1971 (unpublished paper, Accra, Ghana, 1971). Kirk, "Demographic Transition"; Francis O. Okediji, "Socio-economic and Demographic Aspects of Nigeria's Second National Development Plan, 1970-74," paper presented at the African Regional Population Conference, Accra, Ghana, December 9-18, 1971 (unpublished paper, Accra, Ghana, 1971); Republic of Zambia, Development Division, Office of the Vice-President, Zambian Manpower (Lusaka: Government Printer, 1969); Taylor, "Health and Population."

5. See Arriaga, Mortality Decline; Barlow, Economic Effects of Malaria Eradication; Henin, "Theory of Demographic Transition"; and J. A. Mahoney, "The Demographic Effects of Improvements in the Health Services in Gambia," in The Demographic Transition in Tropical Africa, Proceedings of an Expert Group Meeting, Paris, 17-19 November 1970 (Paris: Development Center, Organization for Economic Cooperation and Development, 1971).

6. Studies which suggest this demographic reaction pattern include: Amor Benyouseff, "Health, Population Dynamics and Development", paper presented at the African Regional Population Conference, Accra, Ghana, December 9-18, 1971 (unpublished paper, Accra, Ghana, 1971); Idusogie, "Population and Nutritional Health Problems"; and Thianar N'Doye, "Infant Mortality and Nutritional Problems," in The Demographic Transition in Tropical Africa, Proceedings of an Expert Group Meeting, Paris, 17-19 November, 1970 (Paris: Development Center, Organization for Economic Cooperation and Development, 1971); and President's Science Advisory Committee, The World Food Problem, Vol. I, The White House, U. S. Government Printing Office, Washington, D. C., May 1967.

7. See Barlow, Economic Effects of Malaria Eradication; Corsa and Oakley, "Consequences of Population Growth"; Economic Commission for Africa, "Population Growth and Social and Economic Development in Africa; A Review and Discussion of Country-Case Studies," paper presented at the African Regional Population Conference, Accra, Ghana, December 9-18, 1971 (unpublished paper, Accra, Ghana, 1971); Roudshi A. Henin, "Population Growth and Economic Development: the Sudan - A Case Study," paper presented at the African Regional Population Conference, Accra, Ghana, December 9-18, 1971 (unpublished paper, Accra, Ghana, 1971); National Academy of Sciences Study Committee; Rapid Population Growth; Republic of Zambia, Zambian Manpower; Theodore Ruprecht and Carl Wahren, Population Programs and Economic and Social Development (Paris: Development Center, Organization for Economic Cooperation and Development, 1970); United Nations, Department of Economic and Social Affairs, Measures, Policies and Programmes Affecting Fertility, with Particular Reference to National Family Planning Programmes, Population Studies No. 51 (New York: United Nations, 1972); M. D. Veitch, "The Implications of Population Growth on the Health Services: An Economist's View, Zambia," paper presented at

the Seminar on Population Growth and Economic Development, Nairobi, Kenya, December 14-22, 1969 (unpublished paper, Nairobi, Kenya, 1969); Ronald E. Watts, "The Impact of Demographic Trends on Rural Development and Welfare," Rural Africana, No. 14, (Spring 1971), 11-18.

8. See Economic Commission for Africa, "Population Growth", for a discussion of this proposal.

9. See Veitch, "Implications of Population Growth", and National Academy of Sciences Study Committee, Rapid Population Growth.

10. Abdel R. Omran discusses these points and the theory of epidemiologic transition in "The Epidemiologic Transition: a Theory of the Epidemiology of Population Change," Milbank Memorial Fund Quarterly, 49, 4, Part 1 (October 1972), 509-538.

11. See Veitch, "Implications of Population Growth."

12. See Joe D. Wray, "Population Pressures on Families; Family Size and Child Spacing," in Rapid Population Growth: Consequences and Policy Implications, National Academy of Sciences Study Committee, Roger Revelle, Chairman (Baltimore: Johns Hopkins Press, 1971).

13. The data used in all tests discussed in this section were obtained from the following sources: J. Galea, An Inventory of Government Medical Units in Uganda (Entebbe: Ministry of Health, 1968); Republic of Uganda, Ministry of Planning and Economic Development, Report on the 1969 Population Census, Vol. 1, The Population of Administrative Areas (Entebbe: Government Printer, 1971); Uganda Protectorate, Uganda General African Census, 1959, Age Sex Analysis, Vol. 1, Population by Sex and Age Group for Protectorate Provinces, Districts, Counties, Divisions and Parishes (Entebbe: Government Printer, 1960); Uganda Protectorate, Ministry of Economic Affairs, Uganda Census, 1959, African Population (Entebbe: Government Printer, 1962); Uganda Protectorate, Ministry of Health, Statistical Report, 1st January to 30th June, 1960 (Entebbe: Government Printer, 1960); J. VanderHooven, "An Inventory of Government Medical Units in Uganda, 1969," (Jinja, Uganda: Basic Health Services Project, World Health Organization, 1970).

14. There were 599 gombololas in Uganda at the time of the 1969 census. In addition, there were four census areas in Mbale, 17 in Jinja/Njeru Municipality, and 99 in Kampala Municipality. The boundaries of some changed after the 1959 census, and a number of name changes occured. Where consistency could be maintained from one census to another, the gombololas were retained in the sample; where comparability of information was lacking, however, (this occurred most often in Karamoja and West Nile Districts), they were dropped.

15. High rates of rural to urban migration have assisted in doubling the average annual rates of population growth for a number of major

urban areas in the world. This migration pattern is undoubtedly true for a number of smaller urban areas as well. See Michael Todaro, "Education and Rural-Urban Migration: Theoretical Constructs and Empirical Evidence from Kenya," a paper presented at the Conference on Urban Unemployment in Africa, University of Sussex, September 1971 (unpublished paper, Sussex, England, 1971).

A restricted definition of "urban" was used in the analysis of Uganda's gombololas in order to reduce, as much as possible, the bias due to migration. Urban gombololas were defined as follows: a gombolola which had a town or trading center with more than 500 Africans in residence or which was immediately adjacent to a gombolola with such a town or trading center.

16. See Organization for Economic Cooperation and Development, The Demographic Transition in Tropical Africa, Proceedings of an Expert Group Meeting, Paris, 17-19 November 1970 (Paris: Development Center, Organization for Economic Cooperation and Development, 1971) and Kirk, "Demographic Transition," for a description of the theory of demographic change.

17. This situation would conform to the initial period of a classical demographic transition where the death rate is the first to decline.

18. The problem of under-counting was not widespread in Uganda, but did exist in border areas in some parts of the North. Sources: personal discussion with Dr. Steven Tabor, Demographer at Makerere University, Kampala, and Mr. Ken Hill, Demographer, 1969 Uganda Census, Ministry of Planning and Economic Development, Kampala.

19. The United Nations provides information on demographic trends throughout the world in its annual publication, The Demographic Yearbook (New York: United Nations, annually).

20. The following studies have examined the impact of education, particularly of females, on population growth and desired family size: J. C. Caldwell, "Fertility Differentials as Evidence of Incipient Fertility Decline in a Developing Country: The Case of Ghana," Population Studies, 21, 1 (July 1967), 5-21; Thomas E. Down, Jr., "Fertility and Family Planning in Sierra Leone," Studies in Family Planning, II 8 (August 1971), 153-166; Donald Heisel, "Attitudes and Practice of Contraception in Kenya," Demography, V, 2 (1968) 632-641; D. I. Pool, "Ghana: A Survey on Fertility Attitudes towards Family Limitation," Studies in Family Planning, No. 25, (December 1967) 10-15.

21. Large proportions of the two main cash crops, coffee and cotton, as well as a large proportion of the industrial activities of the country are located in the Eastern Region. Cotton has been grown in the north, but it has not participated in the economic development of the country to the same extent as the East. The planners

in Uganda recognize this long-standing difference in regional development and have addressed that problem in the 1971/72 - 1975/76 Plan. See Republic of Uganda, Uganda's Plan III, pp. 93-115.

22. 1959 figures indicate that the average population density in the North was 41 persons per square mile and 171 persons per square mile in the East. See Republic of Uganda, Department of Lands and Surveys, Atlas of Uganda, 2nd ed. (Entebbe: Government Printer, 1969), pp. 6 and 38.

23. The author is aware that the crude birth rate is but one of several measures of fertility. It is, however, the most frequently available measure and, like GNP, is most often used, despite its limitations.

24. This category was established because there were some counties in which small towns and trading centers existed, but which were predominatly rural. To exclude the possible bias of rural-urban migration, these counties were analyzed separately.

25. The old-young ratio was constructed as follows. In the 1959 census, the age categories used for gombolola and county data were (a) 0-15 years and (b) 16 years and older. Unfortunately, the age classification used in the 1969 census included a number of groupings, but did not provide the 0-15 and 16+ categories. The closest matching to the 1959 classification was 0-14 years and 15 years and older. Obviously, a bias is thus interjected into any comparison. The extent of the bias entering each observation could be analyzed if age structure data on a year-by-year basis were available for each gombolola and county, but such data is unavailable. A rough calculation of the bias can be made, however, for the country as a whole. In 1959, the ratio of 15+-year-olds to 0-14 year olds was 1.41. That same ratio in 1969 was 1.17. Given that the 15-year-olds comprised approximately two percent of the population in 1959, however, the 1.41 ratio cited can be adjusted to 1.30. The percentage change between the 1959 and 1969 ratios is thus 11.4 percent rather than 21.0 percent, a difference of about 8.5 percent, or approximately 0.8 percent per year too low.

The two percent figure for 15 year olds cited above was obtained from data in Uganda Protectorate, Ministry of Economic Affairs, Uganda Census, 1959. Table 4-10, p. 22, and Republic of Uganda, Ministry of Planning and Economic Development, 1969 Population Census, Table "Population of Uganda by Region." A similar estimate was obtained after consultation of the model life tables in Ansley J. Coale and Paul Demeny, Regional Model Life Tables and Stable Populations (Princeton, New Jersey: Princeton University Press, 1966) and United Nations, Department of Economic and Social Affairs, Methods of Estimating Basic Demographic Measures from Incomplete Data, Population Studies No.42 (New York: United Nations, 1967).

26. It may be that the SITC classification system used in trade reports does not completely correspond to the classification system used in the health service bookkeeping system. The extent or direction of this potential bias is unknown.

27. The proportion of total imports attributable to drugs and related medical supplies has increased by 48.5 percent, from 1.93 percent to 2.87 percent.

28. Republic of Uganda, Ministry of Planning and Economic Development, Statistical Abstract, for the years 1962 and 1969 (Entebbe: Government Printer, 1962 and 1969), Table UE.8; and Galea, "Basic Health Services of Uganda", Appendix VI A.

29. See International Financial News Survey, 24, 21 (May 31, 1972), p. 165.

30. Non-African expatriates in the governmental sector of the health service system earned approximately 6.45 million shs. in 1969/70. Figure estimated from detailed salary payments of the Ministry of Health.

31. See Republic of Uganda, Uganda's Plan III, Chapter 17, for a discussion of future health-related development projects.

32. See Republic of Uganda, Uganda's Plan III, Paragraph 8.46, for a statement of policy change pursuant to the use of contractor finance.

33. As of June 30, 1969, the contractor financed public debt of the country for health facilities had risen from zero in 1965, to 31.6 million shs. This amount comprised 38.5 percent of Uganda's outstanding contractor financed long-term debt in 1969, and about 3.4 percent of the country's total outstanding long-term public debt. See Republic of Uganda, Ministry of Planning and Economic Development, Background to the Budget, 1970-71, Table 9.8, p. 72, and Republic of Uganda, The Public Accounts of the Republic of Uganda for the Year Ended 30th June 1969, (Entebbe: Government Printer, 1970), p. 47.

34. Employment data in Uganda attempt to "cover every known firm employing one or more persons for a cash wage or an agreed salary. Domestic servants and employees of peasant farmers are not included. . .However, for all years the undercoverage within small firms might be quite considerable." Republic of Uganda, Ministry of Planning and Economic Development, Enumeration of Employees, June 1969 (Entebbe: Government Printer, 1970), p. 1.

35. Republic of Uganda, Uganda's Plan III, Chapter 1, indicates the country's commitment to these objectives.

36. Uganda's Ministry of Planning and Economic Development recently revised its GDP series to include previously unmeasured items. The new series (revised from 1961 to 1969, with estimates for 1970), was first published in Republic of Uganda, Ministry of Planning and Economic Development, Background to the Budget, 1970-71 (Entebbe: Government Printer, 1970), but a detailed methodological report describing the adjustment made to the old series data has not been issued as yet. As a result, two calculations of the IOER for each industry have been made, using the old and new output series; this is also true of the elasticity calculations. The IOER has been calculated over the period 1963-1969, because it is the longest period since the attainment of independence for which data from both series are available.

37. The labor demand model is the following:

$$E_i = F(Q_i, W_i)$$

where
E = wage employment, measured in thousands of employees,
Q = value added in constant 1960 or 1966 prices, depending on the series used, and measured in millions of shs. for the 1960 and 1966 constant price series;
W = average wage, measured in shillings;
i = industry where i = (1,. . . . . , 13).

Two functional forms of the model were estimated, a linear and a double-log form, written as follows:

(a) $E = a + b_1 VA + b_2 w + \varepsilon$

(b) $\log E = a + b_1 \log VA + b_2 \log w + \varepsilon$

where
VA = Q above, but specified specifically as value added,
a, b, and b_2 = estimated parameters, and
ε = stochastic disturbance term.

The empirical results of the regressions are reported in Appendix D, Tables D.12, D.13. In general, the results conform with theoretical expectations, with most equations suggesting a negative relationship between average wage and employment and a positive relationship between output and employment. In most equations, there was little auto-correlation between the independent variables; however, in most equations, there was serious multicollinearity between wages and output, which was a major reason for the large estimated standard errors of the wage variable. The multicolinearity problem, however, does not bias the estimated value of the parameters b_1 and b_2. Although cross-section data have been incorporated with time series data in other well-known studies in order to reduce the problem of multicollinearity, (e.g., Richard Stone, et. al.

Measurement of Consumers Expenditure and Behaviour in the United Kingdom, 1920-1938 (Cambridge: Cambridge University Press, 1954) and S. J. Prais and H. S. Houthakker, The Analysis of Family Budgets (Cambridge: Cambridge University Press, 1955)), that methodology could not be employed in this analysis due to data constraints.

Where the results for a particular industry are poor, in terms of low R^2 and poorly estimated parameters (as in the case of Forestry, Fishing and Hunting), variable measurement error can be a primary reason. There are undoubtedly other measurement errors, but the results, viewed in broad perspective, are reasonably good as a first approximation.

38. The economy as a whole is taken to mean the average.

39. A particularly significant finding presented in Table 6.10 is that the modern agricultural sector consistently has one of the lowest estimated employment elasticities, as well as one of the highest IOER's. These results would seem to warrant a close look at the industry to determine the reasons therefore, if the results are confirmed, the modern agricultural sector may not be as useful as some economist have claimed for the attainment of the country's output and employment objectives. Since the small scale agricultural sector is so important in Uganda, the results of the analysis also suggest that if an agricultural strategy is to be vigorously implemented, it is very important to have more information about the employment implications of output among small scale agricultural producers.

40. A study to analyze the inter-industry linkages and to develop and inter-industry matrix is proposed for the third five-year plan; see Republic of Uganda, Uganda's Plan III, Paragraph 11.19, p. 209.

41. In order to use such a figure for projection purposes, it is necessary to make a careful analysis of aggregate productivity trends within the Ugandan economy. See Azarias Baryaruha, "Factors Affecting Industrial Employment: A Study of the Ugandan Experience, 1954-1964", East African Institute of Social Research, Occasional Paper No. 1, (Kampala: East African Institute of Social Research, Makerere University College, 1967). Charles R. Frank, Jr., "Urban Employment and Economic Growth in Africa", Oxford Economic Papers, 20, 2, (July 1968), 250-274; and John R. Harris and Michael P. Todaro, "Wages, Industrial Employment and Labour Productivity: The Kenyan Experience," Eastern African Economic Review, I, 1 (June 1969), 250-274.

42. The sole exception is Njeru, which is adjacent to Jinja, separated by the Nile River at the mouth of Lake Nyanza (Victoria).

43. See the discussion of regional development equity in Republic of Uganda, Uganda's Plan III, pp. 93-99; and Irving Gershenberg and

Mark Haskell, "The Distribution of Medical Services in Uganda," Social Science and Medicine, 6, 3 (June 1972), 353-372.

44. The first estimate appeared in International Bank for Reconstruction and Development, Economic Development of Uganda (Baltimore: Johns Hoskins Press, 1962), Table S.5, p. 443; the second is contained in George A. Saxton, "General Fertility and Infant Mortality," in Uganda Atlas of Disease Distribution, edited by S. A. Hall and B. W. Langlands (Kampala, Uganda: Department of Preventive Medicine and Department of Geography, Makerere University College, 1968), pp. 162-163.

45. The test utilized the ranking of districts by income levels as estimated from cash earnings derived from crop sales and wage employment found in Saxton, "General Fertility", and the district data in Table 12. The rank order correlation coefficient calculated, $r_s = -0.7473$, is significant at $p<0.005$.

46. See Republic of Uganda, Uganda's Plan III, Paragraph 1.1, p. 1.

47. District administration expenditures on health are clear cut. In the case of central government and mission health services, however, it was necessary to determine the magnitude of expenditures. It was assumed that the health services provided in any given facility are consumed by persons from that district. (It is true that inter-district migration for health services provided in the national or regional hospitals does occur; the numbers, however, are relatively small, except for Kampala. Even in the case of Mulago Hospital in Kampala, however, well over 80 percent of all cases come from the city or from within 25 miles of the city.) Using that assumption, health expenditures were allocated to the district in which the health facility was located. (Health employees and beds were also allocated to districts on the basis of health facility location.)

48. Central government expenditures on health services during 1968/69 were approximately 84 million shs. 65 million shs. of this amount were allocated to specific health facilities and programs identifiable with particular geographic areas. The other 19 million shs. were not allocated to any particular location and were spent primarily on administration and other items. This amount was not included in the analysis.

49. The expenditures of municipalities and towns do not materially effect the results because they comprise less than 15 percent of total government expenditures and generally conform to the distribution pattern established by the other two sets of expenditures. For details of the expenditures by districts in 1968/69, see Appendix D, Table D.14.

50. By 1968/69, a few of the rural hospitals being constructed during the second development plan had been opened in some districts, which affected the distribution of expenditures. It will be useful to conduct the same analysis subsequent to the completion of the hospital expansion program.

51. The separate inclusion of Kampala undoubtedly skews the distributions more than would otherwise be the case. It should be noted further that the data on health facility beds refers to 1971, whereas the expenditure and employment data refers to 1968/69. This difference probably has the effect of improving the distributional equity of health facility beds over the figures for 1968/69.

CHAPTER SEVEN

This dissertation has described and analysed Uganda's health service system which, in 1969/70, was similar to many in other African countries. As expressed in the country's Third Plan, 1971/72-1975/76, Uganda had given health a relatively high national priority. This priority was reflected in (a) the relative proportion of national development plan expenditures allocated to health, and (b) the relatively high proportion of total recurrent budget expenditures spent on health, averaging eight percent on the part of the central government, and higher percentages from local governmental units. In addition, the Plan expressed concern for the health of the country's population in several other ways.

First, attention was devoted to an equitable distribution of health facilities, and emphasis was placed upon the delivery of rural health services which would lead to a further reduction of inequities in the distribution of health services. Second, the Plan outlined a relative shift away from strictly curative service toward a greater emphasis on preventive health services; this was manifested in the plans for expansion of rural water supplies and an increasing the supply of such health manpower cadres as assistant health visitors and midwives. Third, Uganda responded to a number of socio-political and economic factors as the Third Plan supported and expanded the availability of family planning services; this public statement of a population policy was a major step in introducing a generally expanded health policy. Finally, the country's concern for health has been manifested by the support given to Makerere Medical School. Although the country is paying a relatively high price for medical services provided by doctors and professional nurses, given existing wage scales and the actual number of services directly provided by such personnel, the quality of health services tends to be greater when provided by professionally trained personnel. Evidence in Chapter Five suggests that the quality differential, as measured by differences in the rate of successful treatment, is approximately six percent across all outpatient disease categories and eleven percent for inpatient treatment between hospitals, where doctors are available, and rural units, where they are not.

Conceptual Developments

In order to evaluate Uganda's health service system, several conceptual and theoretical innovations were required. First, the concept of the output of a health service system was developed (Chapter Three) and incorporated into a theoretical framework (Chapter Four). The output concept contains two basic ideas: (a) the output of a health service system is not homogeneous and must incorporate, at the very least, distribution of diseases, and (b) a measure of the quality of the services is required. The quality measure developed and used in the empirical analysis of Uganda's health service system (the results of which are presented in Chapter Five) is the disease specific rate of successful treatment.

Second, linear programming techniques were utilized in a comparative analysis of the three health delivery systems in Uganda. By incorporating the rate of successful treatment and the distribution of diseases of the service-demanders into the linear programming model, the linear program permitted explicit consideration of the problem of quality and disease mix in evaluating alternative health service delivery systems.

Finally, the use of Lorenz curves and Gini coefficients was introduced in Chapter Six in order to compare the relatively inequitable distribution of complementary factors of production in health services.

Policy Implications

Specific to the Health Service System

Numerous policy implications emerge from the study of Uganda's health delivery system. First, the maintenance of a record system, for purposes of management and control of policy decision-making, is essential. Uganda's health service system has a generally well-designed record system for the accounting of patients, but the record system dealing with health service resources was generally found to be lacking. As a consequence, many original data had to be collected by sample analyses in the course of the research. For example, in many districts, clerical staff could not provide information about the consumption of specific drugs, let alone disaggregated on a disease-specific basis. Also, the Ministry of Health had no up-to-date record of the number of employees - by category - working in each government hospital. More attention should be given by the government to an accounting of the health resources possessed and the uses to which they are put. Even the relatively well-developed patient record system can easily be lost, not only by intention or mis-reporting, but by neglect. The Third Plan's recommendation to expand the cadre of trained medical records officers is admirable, and should be implemented.[1]

Second, the results of the comparative linear programming analysis reported in Chapter Five suggest several health policy implications. There appears to be no economic justification for expanding the number of bedded health facilities throughout the country, with the exception of maternity beds and related facilities. A reallocation of existing beds, however, is not feasible, particularly where buildings do not presently exist. An expansion of the number of health facilities, therefore, is warranted not for economic reasons, but on grounds of geographic equity. The expansion of health facilities for equity reasons is particularly justified with respect to outpatient and maternity services.

In addition, health-service-providing resources in the country generally appear to be misallocated between the three sectors; this is particularly true in regard to government hospitals and government rural units. Given the large proportion of slack found in many manpower categories, particularly with respect to doctors and medical assistants, a reallocation of these types of personnel from hospitals to rural units is warranted, as one means of reducing the qualitative differential between hospitals and rural "primary care" facilities. A reallocation of a certain proportion of available drugs and medical supplies from hospitals to rural units is also implied by the findings presented in Chapter Five.

Third, reappraisal should be made of the expanded health manpower training program of the Third Plan; the analysis in Chapter Five, although based on a number of important assumptions, indicates that unless trained individuals are able to establish private health service organizations, there will be an increasing proportion of slack input in the existing sectors. In addition, the implications for government recurrent cost of guaranteed jobs in government service for all persons upon completion of training are very great. The recurrent cost implication particularly is inconsistant with Uganda's objective of placing a ceiling of six percent per year on recurrent cost increases for health and education.[2] Without the guarantee of government employment upon the completion of training, there is a possibility of underemployed medical manpower "school leavers" by 1980/81.

Fourth, the linear programming solutions suggest that transportation facilities represent an important constraint in the delivery of health services in all three sectors of the health service system. The government is expanding the ambulance fleet for both hospitals and rural units,[3] but little attention seems to have been given to the development and improvement of the medical capabilities of the driver cadre. The absence of these skills can be remedied by inservice training for current drivers and a short introductory course for new drivers.

Finally, and fifth, there are policy implications for the mission hospitals which can be drawn from the linear programming solutions. The mission hospital system appears to be experiencing a period of reappraisal and revaluation. In general, the inpatient rate of successful treatment was highest in mission hospitals. The linear programming solutions, regardless of the objective function used, suggest that a greater range of disease types were treated on an inpatient basis in mission hospital than in either government sector. These findings warrant investigation by the Ministry of Health into the procedures used by mission hospitals so as to increase the rate of successful treatment without incurring inordinate resource costs.

With respect to the service-providing inputs, mission hospitals will experience constraints in 1980/81 which are different than those experienced in 1968/69. The most important shifts appear to be in the high-level manpower categories where the relative proportion of slack declines dramatically over the period. Doctors, for instance, will become a binding constraint by 1980/81. At the same time, however, the missions intend to continue to expand their enrolled nurse and midwifery training programs. This does not appear to be warranted, given the larger proportion of slack recorded for this cadre of staff by 1980/81. Given the large decline in the relative proportion of slack in the student input, however, there is a strong possibility that the nature of the job performed by nurses and midwives will change such that they perform a greater number of the tasks previously performed by student personnel.

The policy implications for the government of the shift in manpower constraints in the mission sector appear to be two-fold. First, it is very important that the government include mission training programs in its manpower analysis, particularly since it pays a part of the training costs incurred by missions. Without some careful monitoring of the country's manpower requirements for nurses and midwives, mission hospitals may exacerbate a potential over-supply of enrolled nurses and midwives resulting from government training programs. Second, it appears that doctors and professionally trained nurses and midwives in mission hospitals will be in very short supply by 1980/81. Perhaps some of the enrolled level nurse and midwife mission-oriented training programs could be upgraded to the professional level and the nurses' role redefined as primary diagnostician. If a redefinition of the nurses role were to change in conjunction with improved training, the doctor could be replaced in the outpatient clinic of mission hospitals. This type of action might alleviate the binding doctor constraint indicated by the 1980/81 linear programming solution and, at the same time, bring about a more effective utilization of other slack resources.

Macro-Economic Policy Implications

Several findings of this study bear on more general economic planning and policy questions. First, there is no conclusive evidence to suggest that the availability and use of curative health facilities in Uganda has led to a more rapid rate of population growth in the country than would have otherwise occurred. The limited statistical results do suggest, however, the possibility that the availability of health services may exacerbate the present high rate of population growth on a short or medium term basis, particularly if there is no provision for family planning services. It is unfortunate that dissagregated statistical information is unvailable on such variables as income and education in order to test a more complete model relating health to indices of demographic change.

Second, the analysis indicated the existance of important linkages between the health service system and secondary employment in impacts other sectors of the economy, particularly the construction industry. Given the Third Plan's policy of shifting health priority to rural areas, construction employment induced by health expenditures will decline. If there is an expansion in the government's production of drugs, medical supplies and equipment, the decline in construction employment could be partially absorbed through the secondary employment impact in these industries.

Third, the analysis of the public debt impact of health facility financing during the period 1966-1971 indicates that the mechanism of contractor-finance was inappropriately used. When health facilities are financed by external sources, it is important that economic planners analyze the potential public debt impact of the procedures utilized. Moreover, an analysis of the impact of each project on the balance of payments is essential. Such an analysis would serve two purposes; it would indicate (1) whether Uganda has the foreign reserves needed to pay for the required imports, and (2) whether such items can be produced domestically as a part of a more general import substitution policy. In this regard, it is significant that the Uganda government is selectively expanding its domestic capacity to produce drugs and medical supplies. Given the high estimate of the income elasticity to import drugs and related supplies, this type of government action is even more important.

Comments on an Unfinished Agenda

This study represents an initial effort to analyze the output and resource cost of delivering curative health services in Uganda. Many questions related to the role of health in a developing country remain unanswered, however, as do several important questions related to the allocation of scarce resources to a health service system in a less developed country. In addition, much conceptual and theoretical work remains to be done in order to improve upon the health and economic policy implications outlined in the study. In particular, parametric programming and possibly simulation could be used to analyze additional policy questions and explore alternatives left unanswered in the present study.

With respect to the economics of the health service system in a less developed country, the following problem areas require additional research. First, what is the optimal transportation system for emergencies and the movement of drugs and supplies? This question prompts a related query: where should each type of health facility be located, not only from the point of view of transportation and emergency services, but also from the perspective of social equity? A linear programming framework appears to be one feasible means of addressing these two problems; equity considerations could be included as constraint variables in the system.

A second set of questions is related to preventive health services. To date, there has been little substantive research on the economic implications of alternative delivery systems for preventive health services (as described in Chapter Two). The conceptual and theoretical issues related to output specification and production relationships have not been adequately explored. Little systematic research has been conducted on the economic impact of different preventive health services;[5] such research is urgently needed in the areas of health and maternal and child health services, among others. Impact analyses in these areas must take into consideration the demographic impact of the provision of such services, which in turn implies longitudinal research.

Finally, an economic analysis of medical research priorities and existing projects much be undertaken. Although the question of medical research was not discussed in this thesis, the issue is important in developing countries, for they often support medical schools which have research programs. Where medical research priorities do not focus on those diseases which afflict the majority of the indigenous population, serious questions may legitmately be raised in regard to short run resource allocation decisions.

Two major paths of inquiry require additional research in order to determine the role of health in socio-economic development. First, more systematic research is needed into the socio-economic factors which affect the epidemiological transition of the distribution of disease incidence and prevalence. Dr. Omran suggests many intriguing linkages between social and economic factors and the changing pattern of diseases in developing countries;[6] these potential linkages provide fruitful research possibilities for economists working in concert with epidemiologists and other medical researchers. Second, the relationship between population growth, demographic change and health remains an important research priority. To some extent, these relationships may be explored in epidemiological transition research, but additional, supplemental research is needed in this area.[7]

Improvements in the quality of life of human populations living in developing countries is a dominant concern of many persons throughout the world. This study is consistent with such a concern. It has analyzed the health service system of Uganda in order that policy makers can plan for an improved quality of life through an understanding of the economic implications of resource allocation decisions made in the provision of health services.

Footnotes

1. See Republic of Uganda, Plan Three, paragraph 17.76, p. 322.

2. See Republic of Uganda, Plan Three, Table VIII-6, p. 124.

3. See Republic of Uganda, Plan Three, paragraphs 17.32 and 17.47, pp. 310 and 314.

4. The discussion assumes that the mission hospital sector will remain a quasi-autonomous sector of the health service delivery system. If the government decides to absorb it into the existing hospital system, the set of policy decision and choices becomes much more pervasive in nature. That situation is left to a separate study, should it become necessary.

5. See Michael Zubkoff and David Dunlop, "Consumer Incentives in Preventive Health Services," a paper presented at the Milbank Roundtable on Consumer Incentives in Health Care, Georgetown University, June, 1973, for a systematic review of U. S. literature on this point. Barlow's research in Ceylon, Robin Barlow, The Economic Effects of Malaria Erradication,(Ann Arbor: University of Michigan, 1968) and the research of others cited in Chapters Three and Six comprise the important international exceptions.

6. See Abdel R. Omran, "The Epidemiologic Transition: A Theory of the Epidemiology of Population Change", Milbank Memorial Fund Quarterly, 49, 4, Part 1 (October 1972), 509-538.

7. Dr. William Butz of the Rand Corporation is apparently beginning a study focussing on many of these questions; the project is at the initial field research stage.

APPENDICES

APPENDIX A

APPENDIX A

Classification of Health Units in Uganda

The following classification of health units in Uganda is taken from Galea, J., "An Inventory of Government Medical Units in Uganda," W.H.O. Development of Basic Health Services Project, a mimeographed paper distributed through the Ministry of Health, Entebbe, 1968.

Hospital: a medical unit where in-patient and out-patient comprehensive medical care is provided and where the services of a qualified doctor are always available.

Health Center: a medical unit where in-patient and out-patient elementary medical care is provided by a medical assistant, in-patient midwifery services are provided by a qualified midwife and where the services of a health visitor are available for home visiting within the defined area around the unit. Preventive care is also available through Public Health staff.

Dispensary/Maternity Unit: a medical unit where in-patient and out-patient elementary medical care is provided by a medical assistant and where in-patient midwifery services are provided by a qualified midwife.

Dispensary: a medical unit where in-patient and out-patient elementary medical care is provided by a medical assistant or lower grade auxiliary.

Sub-Dispensary: a medical unit where out-patient elementary medical care only is provided by a trained auxiliary.

Aid Post: a medical unit where out-patient elementary medical care only is provided by trained staff from a "parent" unit, usually on one day a week only.

Maternity Unit: a medical unit where in-patient and out-patient midwifery services only are provided by a qualified midwife.

For a more detailed classification of the range of services provided in each type of health facility, including mission units, see Tables A.1 and A.2.

APPENDIX A

Table A.1

Curative Services by Facility Type

Service Delivery Mechanism	Outpatient:					Inpatient:									Supportive Service for In and Out Patient	
	Diagnostic Auxiliary	Diagnostic Professional	Treatment-Drugs	Treatment-Therapy	Treatment-Minor Surgery	Diagnostic Auxiliary	Diagnostic Professional	Nutrition (food)	Beds	Treatment-Drugs	Treatment-Therapy	Treatment-Minor Surgery	Treatment-Major Surgery	Other Specialized Treatment Services Maternity	Laboratory	Radiography- X-ray
Government																
Central Referral Hospital	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Regional Referral Hospital	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
District Hospital	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Health Centers	x		x	x	x	x		ø	x	x	x	x		x	ø	
Dispensary/Maternity Units	x		x	x	x	x			x	x	x	x		x	ø	
Dispensary	x		x	x	x	x			x	x	x	x				
Sub-Dispensary	x		x	x	x											
Maternity Center	x		x	x		x			x	x				x		ø
Aid Posts	x		x	x												
Natl. Immunization Team																
Dist. Health Inspector Team																
City Health Team																
Ankole P.P.P.	x		x	x												
Military Health Services	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Private																
Mission Hospitals	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Industry Hospitals	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Mission Dispensary/ Maternity Units	x		x	x	x	x			x	x	x	x		x		
Mission Dispensary	x		x	x	x	x			x	x	x	x				
Mission Sub-Dispensary	x		x	x	x											
Mission Maternity Center	x		x	x		x			x	x				x		
Mission Aid Post (Safari Centers)	x		x	x												
Urban Private Physicians Offices		x	x	x	x										x	x

ø = Maybe

APPENDIX A

Table A.2

Preventive and Other Health Services by Facility Type

Service Delivery Mechanism	Preventive Health Services: Individual: Immunizations	Ante-Natal	Family Planning	Health Edu. Nutrition	Sanitation	Vector Transmission	Child Welfare	Spec. Disease Screening	Follow-up	Societal: Water Purification	Sewage Treatment	Vector Removal (Malaria) clearing	Health Education	Food and Meat Stds.	Building Standards	Occupational Safety	Transportation Safety	Other Health Services: Medical Manpower Training Doctor	Medical Asst.	Nurses & Midwives prof.	Nurses & Midwives aux.	Public Health
Government																						
Central Referral Hospital	x	x	x	x	x	x	x	x	x									x		x		
Regional Referral Hospital	x	x	x	x	x	x	x	x	x										x		x	x
District Hospital	x	x	x	x	x	x	x	x	x													
Health Centers	x	x	ø	x	x	x	x	x	x				#									
Dispensary/Maternity Units	x	x					x															
Dispensary	x						ø															
Sub-Dispensary	x						ø															
Maternity Center	x	x	ø	x	x	x	x															
Aid Posts	x						ø															
Natl. Immunization Team	x							x														
District Health Inspector Team	x							x		x	x	x	x	x	x							
City Health Team	x	x					x	x		x	x	x	x	x	x							
Ankole P.P.P.	x	x	x	x	x	x	x	x														
Military Health Services	x																					
Private																						
Mission Hospitals	x	x	*	x			x	x														
Industry Hospitals	x																					
Mission Dispensary/ Maternity Units	x	x		x	x	x	x	x														
Mission Dispensary	x						x															
Mission Sub-Dispensary	x						ø															
Mission Maternity Center	x	x		x	x	x	x															
Mission Aid Post (Safari Center)	x																					
Urban Private Physicians Offices	x		x				x															

ø = maybe

* = the service is offered by Protestant units only

\# = health education is conducted within the defined area

APPENDIX B

APPENDIX B

Administrative Relationships in Uganda's Health Service System [1]

Until very recently, at least three types of administrative relationships were important to understanding the operations of the health service delivery system and its prospects for future development:[2] (1) the relationship between the several government ministries which have jurisdiction over various aspects of the health care system; (2) the relationship between the central government and various local units of government; and (3) the relationships between government at all levels and the private sector of the health service system, which includes mission medical bureaus, large firms, and private physicians and pharmacies.

The administrative relationships of importance are found in three areas of policy: (a) medical standards, as related to personnel, care, and operating methods; (b) financial support policy; and (c) developmental policies related to future expansion of the service delivery system. Administrative relationships relative to these policy matters have their genesis in historical, political events, in the development of the role of governmental organizations, particularly since Independence, and in the recurring financial problems faced by private health organizations.

Central Government, Inter-Ministerial Relationships

Until the recently announced Plan III, two ministries in the central government had to correlate their activities relative to health services. The Ministry of Health had (and continues to have) major responsibility for establishing broad medical policy in such areas as minimum qualifications for several types of medical personnel, the development of pharmacological policy, etc. The Ministry develops the medical, administrative, and financial policies related to the operation of all government hospitals. It is responsible for all medical education in the country, with the exception of the education of medical doctors, which is administered by the University; in conjunction with this responsibility, there are Ministry-run schools attached to the larger hospitals in the country to train

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[1] The information presented in this Appendix was gathered in an informal way and there is no one source which can be cited for authenticity of the information presented. The author is responsible for any mistakes which may exist in facts or interpretation.

[2] At the end of this Appendix the implications of the recently announced administrative policy changes described in Uganda's Plan III op. cit., pp. 306 and 307, paragraphs 17.20 - 17.24, which strengthen the powers of the central government's Ministry of Health vis a vis those of local governments, are examined.

professional nurses and midwives, auxiliary level nurses and midwives, medical assistants, professional and auxiliary radiography and laboratory personnel, and public health personnel. The Ministry establishes medical policy for all government rural health facilities, through its appointed district medical officers. It also develops the broad national public health strategy and, where appropriate, develops national legislation related to health matters for consideration by Parliament. Finally, the Ministry of Health is involved in planning for the improvement of the health of the people of Uganda. In this capacity, it has assisted in planning for the expansion of health facilities, as well as expansion of the supply of other necessary inputs such as personnel, drugs, and equipment. This latter responsibility is undertaken in cooperation with the Ministry of Planning and Economic Development.

The other Ministry, the Ministry of Regional Administrations, has had control over the activities of each local government's department of health. This Ministry approves proposed recurrent and capital budgets for each district and city and determines the taxing capacity of each. This Ministry also determines the criteria for dispersing central government funds to cover recurrent and capital budgetary requirements of the local governments.

It has been essential that the Ministry of Health work in close cooperation with the Ministry of Regional Administrations in order to attain the medical objectives which the Ministry of Health may have developed for the country; this has been especially important given the rapid expansion of hospitals and rural health centers during the second five year development planning period, 1966-1971. Decisions about timing of new construction, facility type, financing, and location of facilities have been made initially at the local level, but are reviewed by the Ministry of Regional Administrations. The policies of this Ministry, therefore, have been vital to the way in which the health service system operates, particularly in rural areas where approximately 90-95% of the population live.

The individual directly responsible for the daily operation and expenditures of health facilities in all districts, however, remains the district medical officer (DMO), who is a direct appointee of the Ministry of Health. Many trained medical staff (medical assistants and other more highly trained auxilliary staff) in the districts are seconded to the districts from the Ministry of Health. A large percentage of all drugs and equipment (approximately 95%) used in the districts have been purchased from the Ministry of Health. Patients who cannot be adequately cared for in local rural health facilities are transferred to the district government hospital, which is run by the Ministry of Health. The operation of the health service system, thus, has been subject to the coordination between the two Ministries.

Central and Urban Government Relationships

The relationship between the largest municipalities (Kampala, Jinja, Mbale and Masaka) and the Ministry of Health is not as strong as the

Ministry's relations with the districts, as the municipalities hire their own personnel and coordinate their activities with the Ministry of Health primarily on such items as national immunization campaigns. In addition, a large percentage of the municipalities' purchases of drugs and equipment are made from local suppliers, rather than from the Ministry of Health's central stores. The municipalities' finances are reviewed by the Ministry of Regional Administrations, but because they are largely able to finance their recurrent and capital expenditures on their own, their activities are not subject to the same degree of scrutiny as are the districts.

Urban authorities and smaller towns remain tied more directly to the central government because of their inability to finance their own services completely. The Ministry of Regional Administrations is involved in their budgetary matters and in arranging the financing of their capital projects. The Ministry of Health is also involved with the urban authorities and towns, because the disctrict medical officer is often the town's medical officer of health as well. The towns' most direct link to the Ministry of Health lies in the administration of public health policy, inasmuch as nearly all health services provided by the smaller towns are related to public health.

Central Government and Private Health Services

The private health sector interacts with the government in several ways. Private physicians are related through licensing which is administered by the Ministry of Health. At present, there are about 250 doctors in private practice in the country, nearly all of whom are located in the 10 largest cities and towns. Chemists are also licensed by the Ministry of Health, and must receive a special license in order to dispense chemical formulas appearing on the government's list of poisons. This licensing is the only direct link between the government and chemists. However, the Ministry of Health purchases a large percentage of its drugs, equipment and stores from local chemists and other vendors; this relationship is strictly contractual and is usually negotiated on an annual basis.

The labor laws of Uganda state that firms which employ a certain number of workers must provide a minimum set of health services by qualified medical personnel. If a firm employs more than 1,000 persons, it must maintain a full range of hospital facilities. Such private hospitals are operated by three industrial firms at the present time: Kilembe mines, Mahdvani and Co. Ltd., and the Uganda Sugar Factory Ltd. These hospitals and the less complete curative services maintained by smaller firms are monitored by the district medical officer and must conform to the medical standards of the Ministry of Health. Also, industrial health and hygiene is monitored by the central government's Ministry of Labor and its personnel investigate plant safety standards and monitor general standards of hygiene.

The government and mission health services have had a long relationship. Mission hospitals received central government financial assistance at least as early as 1932, and this support continues to the present time. Today the government provides grants to approve nurse and midwifery training schools operated by mission hospitals. In addition, the Ministry of Health provides recurrent grants to the mission hospitals on the basis of the number of doctors and registered nurses on the staff. Mission health facilities, however, have been experiencing increased financial difficulties. The mission medical bureaus contend that government grants are much too small, but the amount of the grants likely reflects the government's general set of objectives, which does not lend much support to mission health facilities. The district administration governments have also provided some financial support to mission health facilities in the past.

Besides the financial relationship between the government and mission health facilities, the government controls mission activities by a form of accreditation. Each mission hospital must abide by medical standards established by the Ministry of Health in order to obtain the financial support provided by the central government. Every doctor working in a mission facility must also be licensed by the Ministry of Health.

Central Government and Makerere Medical School

Makerere Medical School has primary jurisdiction over medical education of doctors in Uganda. The School is related to the central government in several important ways, however. Since 1968, medical students have been required to agree formally to serve in government hospitals for two years after completing school. In addition, the Medical School must cooperate with the Ministry of Health in using Mulago Hospital, the largest hospital in Uganda, in the training of its students. Because it is a part of the national university, the Medical School receives a large proportion of its recurrent operating funds from the central government's Ministry of Education. The Medical School also receives funds from the World Health Organization and other international foundations, but the central government, through the Ministry of Health reviews the appropriateness of the particular research or teaching project to be funded by international organizations.

New methods of delivering medical care services have been developed or adapted by various departments of the Medical School, but the rate of innovation diffusion to date has been slow. Recently however, there appears to be more receptivity to change and cooperation between the Medical School and the Ministry of Health. The cause for optimism is related to the government's willingness to help fund the following programs: (a) the Kasangati Teaching Health Center (previously funded by the W. Mengo District Administration); (b) the Ankole Preschool Protection Program (previously funded by the Oxfam Foundation and the Ankole District Administration); (c) the Mobile Maternal and Child Health Clinic program in the rural areas near Kampala (previously supported by the W. Mengo District Administration); and (d) the rural health service system improvement project operated by medical students and professors in the W. Mengo District (previously supported by the District).

Plan III's Announced Administrative Policy Change for Health Services

In Uganda's Plan III, 1971/72 - 1975/76, the government announced a major health administration policy change. The major facet of this change strengthens the powers of the central government Ministry of Health vis a vis and local authorities, primarily the district administrations. The essence of the policy change is as follows:

> "The most difficult problems of coordination have arisen in connection with the health activities of local authorities. In the past, each local authority developed its health service without any regard to the activities of other local authorities. Also there has been very inadequate coordination between the activities of the local authorities, on the one hand, and those of the Government, on the other. This has created problems especially in relating to the provision (by Government) of staff for local authorities' health establishments. With a view of alleviation these problems, it has been decided to transfer the responsibility for setting up and administering health centres and all other rural medical units completely away from district administrations to the Ministry of Health. The district administrations will thus cease to have any direct responsibilities in the field of health. It is anticipated that the net effect on government recurrent expenditure of the take-over of rural medical units will be neutral, as block grants to local authorities will no longer cover the operation of these units". (Paragraph 16.22, pp. 306 & 307)

It is clear, thus, that a major shift in the organization of Uganda's health service system has been announced. Such a change has precedent in Uganda, for in 1966, the central government established its control in the field of education services. The announced shift in health administration policy was not as inclusive as was the case in education, however, since mission health facilities can still maintain a considerable degree of financial, administrative and medical control over their operations. The primary change is in the administration and financial control of rural health services; such a change may be viewed as a step by the central government to further support the interest of people living in rural areas and is an important institutional and administrative development.

APPENDIX C

APPENDIX C

A Further Elaboration of the Variables, Methods, and Procedures used in Chapter Five

The Data, Methods and Procedures Used to Determine the Value of the Elements of the Input Vector and Technological Matrix

This section of Appendix C provides supplementary information on data sources, as well as methods and procedures used to estimate the value of (a) the service-providing and service-demanding inputs and (b) the elements of the technological matrices, including the elements of the diagonal submatrices.

Values for the second part of the input vector - the service demanders by major disease classification for government and mission hospitals - were developed from data appearing in Ministry of Health annual statistical records.[1] The distribution of new cases by major disease classification for inpatient and outpatient cases was obtained directly from that source. Reattendances (persons returning for treatment of a new illness episode during the year) by disease category were determined by an allocation procedure based on analysis of a sample of reattendances at one government hospital (Mbarara) and two government rural health facilities (Namwendwa, Busoga District, and Kinoni, Ankole District). The distribution of diseases according to major disease categories was derived by adding the new case attendance data to the estimated distribution of reattendances for the hospital sectors.

Additional adjustments were necessary for rural health facilities in order to classify new cases in the major disease categories used by hospitals. Sample information was obtained from the daily record books of three rural health facilities (Kinoni, Ankole district; Buikwe, East Mengo district; and Busesa, Busoga districts) on the disease distribution of the "other disease" category used by the rural health facilities. These data, and the above-mentioned information on reattendances, were used in constructing the distribution of diseases treated on an outpatient basis in rural facilities.

The disease distribution of rural facility inpatients was also developed by analysis of a sample of inpatient records (Kinoni, Ankole district; Namwendwa, Nsinze and Busesa, Busoga district; and Buikwe, East Mengo district). This was supplemented by an analysis of rural maternity center returns at the same locations in order to incorporate diseases of pregnancy and puerperium and delivery-without-complication into the analysis.

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[1] Republic of Uganda, Ministry of Health, Medical Services Statistical Records, 1st July 1968 to 30th June 1969, (Entebbe: Government Printer, 1969).

Several procedures were used to estimate the service-providing element. For each sector, an accounting of the total available personnel, disaggregated into the eleven categories, was developed. (See Table C.1 for an analysis of how specific occupational categories were combined into eleven categories used in this research.) These data were procured from several sources: (a) annual district budgets (for rural facilities in districts which were not visited by the researcher), (b) health facility survey information (for hospitals and rural units in districts visited by the researcher), (c) the publications of the Catholic Medical Bureau and the Protestant Medical Bureau,[2] and (d) Ministry of Health pay records. Data for other inputs (beds, drugs, food, etc.) were obtained from budget and expenditure records.

For the manpower inputs, two adjustments were made to obtain the value used in the input constraint vector. The first adjustment deducted the amount of time engaged in administrative duties. This adjustment is particularly important in the high level medical manpower categories, where a large proportion of time is spent in "running the operation" rather than in direct service provision. Information on this adjustment was obtained from interviews of personnel in each sector of the health service system. (Although it may be possible to reorganize the health service delivery system in such a way as to conserve particularly scarce manpower resources for delivery of health services, the existance of the present organizational constraints was deemed sufficiently important to warrant inclusion in the calculations.)

A second adjustment deducted from several manpower categories the amount of time spent in specialized clinics which were not providing direct service to the vector of initial demanders. Such specialized clinics include many preventive services discussed in Chapter Two. Estimates of the amount of time spent in such activities were developed from interview information.

It is important to note that the manpower inputs are expressed in man hours. The estimated number of man-hours for each category of worker was developed on the basis of interviews and observation of normal working schedules. The author is aware that not all doctors work the average, and the case of the all-night operation is well known. The calculations are based on estimated averages and it is obvious that the system is elastic enough to attend to "emergency" situations.

It was assumed that other service-providing inputs were consumed in the process of delivering services to the vector of initial demanders. Although some of these inputs are consumed in administrative duties and/or the provision of specialized clinics, the amounts were assumed to be minimal (except for drugs and supplies, and in that case an adjustment was made for specialized clinics).

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[2] See Survey of All Our Catholic Medical Units (Kampala: Catholic Medical Bureau, 1969), and Jane Hallway, A Survey of Church Related Hospitals in the Anglican Province of Uganda, Rwanda and Burundi (Kampala: Provincial Medical Board, 1972).

Given these two adjustments, net inputs were determined. In Table C.2 the figures used to adjust the gross manpower inputs to the net inputs are shown. It may be noted that high level manpower time in rural health facilities is consumed primarily in administrative duties or in specialized clinic assistance.

Table C.3 presents the amount of each service-providing input allocated to each disease-specific initial demander. According to the three basic criteria specified in Chapter Five (diagnostic time for inputs used in the outpatient treatment process, length of stay for inputs used in the inpatient treatment process, and service-specific information, where data exist for appropriate use of this criterion), these calculations were necessary in order to estimate the value of each element in each sector's technological matrix. The figures are disaggregated according to sector and treatment process.

Table C.4 presents data which show the average diagnostic time for each disease type. The data were obtained from two health facilities in West Mengo district, Mpigi Health Center and Kajansi Sub-dispensary. The data on diagnostic time were collected by direct observation of the diagnostic process. Timing began when the patient commenced interaction with the primary diagnostician and ended after treatment was prescribed. This period included time required for patient examination. The total number of observations at the two locations was 450.

In Table C.5, data are presented on the average length of inpatient stay at government hospitals, mission hospitals and rural health units. This summarized information was obtained from inpatient record books at a sample of facilities from each sector. The names of the facilities and the number of observations from each facility is shown below.

Government Hospitals		Mission Hospitals		Rural Units		
Jinja	1362	Ishaka	534	Kinoni	HC	582
Iganga	9790	Kagando	214	Kinoni	MC	599
Mbarara	619			Namwendwa	HC	712
Kawolo	346			Namwendwa	MC	490
Bombo	1158			Buikwe	HC	440
				Busesa	MC	370
				Nsinze	MC	486
Total	13275	Total	748	Total		3679

With respect to the service-specific allocation criteria, data in Tables C.6, C.7 and C.8 show the proportion of surgical services, laboratory services, and X-ray services, consumed by each disease category in each sector. The data for these tables were obtained from the departmental records of a sample of health facilities in Uganda.

A detailed analysis was made of the quantities of each drug consumed in the treatment of each disease listed on the hospital outpatient medical form (MF 75; see Appendix F). Data for this analysis came from the outpatient record books of four rural facilities (Kinoni Health Center, Ankole district; Busesa Dispensary Maternity Unit, Busoga district; and Mpigi Health Center and Kajansi Sub-dispensary, East Mengo District) and were supplemented by (a) information on the average number of treatments provided to each major disease classification and (b) two books on the diagnosis and treatment of most diseases found in Uganda.[3] The cost of drugs used in various treatments was calculated from the Ministry of Health's drug price list. The average cost of drugs per major disease classification was calculated for each sector by summing up the total cost of drugs used to treat each disease in the category and dividing it over the total number of persons treated in the category. The proportion of the total cost of drugs and medical supplies constituted by medical supplies alone was then used as a factor (74%) to increase the average cost of drugs consumed for each major disease category; for the category, injuries and accidents, however, drug cost was doubled to reflect the greater usage of medical supplies.

The figures used in estimating the disease-specific rate of use of drugs and medical supplies for each sector and treatment process are presented in Table C.9.

In order to estimate the value of the elements in the diagonal submatrices for each sector of Uganda's health service system, data were gathered on (a) the disease-specific transfer rate; (b) the disease-specific death rate; and the disease-specific rate of unsuccessful treatment. Transfer rate data were obtained from the primary records of a sample of health facilities in each sector of the health service system. Data on the number of inpatient transfers were obtained from the following government hospitals: Mbarara, Bombo, Iganga, Kawolo, and Jinja. For rural units, the data were obtained from Kinoni Health Center, Ankole district; Nsinze and Namwendwa Health Centers and Busesa Dispensary Maternity Unit, Busoga district; and Buikwe Health Center, East Mengo district. In the case of outpatient transfers from rural health units, the data used to estimate the disease-specific rates of transfer were obtained from monthly attendance data of 19 rural health units. (See Table 2.12 for the list of the units and the data obtained). The average transfer rate for all 19 units was then used in prorating the inpatient disease - specific rates obtained. In the case of government hospitals, it was assumed that the rate of

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[3] Data on the average number of treatments provided to each disease category was obtained in the patient followup survey in Ankole district and supplemented by data obtained in an analysis of diagnostic time requirements in Mpigi Health Center and Kijansi sub-dispensary in East Mengo district. The books are Republic of Uganda, Uganda National Formulary, (Entebbe: Government Printer, 1967), and J. R. Billinghurst, Trowell's Diagnosis and Treatment of Diseases in the Tropics, (London: Bailliere, Tindall and Cassell, 1968).

transfer was one-half the disease-specific inpatient transfer rate. There was no information available on transfers from mission hospitals. However, there were few (a) inter-sectoral transfers between mission and government hospitals and (b) intra-sectoral transfers between mission hospitals. Also, most mission hospitals did not offer ambulance services. For these reasons, it was assumed that no outpatients were transferred from mission facilities and that inpatients were transferred at a constant rate of 1 per 1000 patients.

Information on the number of deaths by disease category for the two hospital sectors was obtained from the Annual Statistical Report of the Ministry of Health. Information on the number of deaths for the rural health units was estimated from inpatient records of the five rural units listed above.

Finally, several sources of data were used to estimate the disease-specific rate of unsuccessful treatment for each sector of the health service system. For the inpatients of each sector, information on the final disposition of the case was obtained from inpatient records. Discharge dispositions included "well", "improved", "transferred", "died", or other, including "run away" or "on request". It was assumed that cases discharged in as run-aways or on-request were unsuccessfully treated, at least to the point of discharge. Others discharged as "improved" or even "well" may not have been successfully treated in the sense of being able to return to prior major activity; it was assumed for these calculations, however, that discharge notations could be taken at face value.

Outpatient figures were estimated in two ways. For the rural health units, rates of successful treatment were estimated from information obtained on a patient follow-up study conducted in Ankole district. (See Appendix F for a copy of the survey form used in the follow-up study.) No comparable data were obtained on hospital outpatient services. As a consequence, it was assumed that hospital disease-specific outpatient rates of unsuccessful treatment were 50% greater than the estimated inpatient rate.

The elements of the diagonal submatrices for each sector of the health service system were estimated on the basis of the above described data. The disease-specific rates of transfer, death, and unsuccessful treatment for each sector and treatment process are summarized in Tables C.10, C.11 and C.12 in the third section of this appendix.

The Data and Procedures Used in Specifying the Factors Affecting the Output and Resources of the Health Service System in Uganda

The following discussion provides supplementary information on a selected number of the variables used in the empirical analysis presented in Chapter Five.

Price of Curative Health Services, b.

Government health facilities do not charge fees for services except for private and semi-private inpatient rooms. Mission health facilities, however, charge fees for all services; there is generally a consistent fee structure within the health facilities operated by a particular mission organization, but not across mission organizations. It is assumed that change in prices charged in health facilities is functionally related to the change in the ratio of mission health facilities in the country $(\frac{M}{H})$. The major thrust of this assumption is that the relative importance of fee-charging health facilities is declining in the country.

The Average Distance to Health Facilities, d.

Although the location of each health facility in Uganda is known, the distance to the nearest facility from every point in the country has never been systematically analyzed. It is assumed that the average number of attendances at a health facility per person per year can be used as a reasonable proxy variable, since it has been domonstrated that distance and the number of attendances per person are highly negatively correlated. This proxy measure is available for the period 1949-1969/70, incorporating 20 observations.

Total Number of Health Facilities, H.

Data on the number of health facilities are available from the Ministry of Health's annual reports. This series began in 1900 and has continued to the present. In some cases, data contained in the Ministry's reports were corrected, where delays in reporting the opening of health facilities (particularly in rural areas and by missions) could be documented by mission medical board reports and district medical records. A detailed annual series including 22 observations from 1949 to 1969/70 was compiled.

Ratio of Mission Facilities to Total Health Facilities, $(\frac{M}{H})$.

Data used to develop this series were found in the Ministry of Health's Annual Reports. The series, composed of 22 observations, was compiled for the period 1949-1969.

Ratio of Government Rural Units to Total Government Health Facilities, $(\frac{GR}{G})$.

The data used to compile this series were taken from the Ministry of Health's Annual Reports. The series of 22 observations covered the years from 1949 to 1969/70.

Input Mix Providing Diagnostic Services, $(\frac{V_r}{V_{r1}})$.

Although every resource used in the production of diagnostic services is of potential importance to an analysis of the effect of changes in the input mix on the rate of successful treatment, the most important input resource is the primary diagnostian. The measure used to indicate changes in the resource mix is the ratio of doctors to non-doctors engaged in diagnostic work. Doctors who are primary specialists, consultants, or administrators are excluded. Similarly, medical assistants who are working in anesthetics or some other non-diagnostic role are excluded. The index is constructed such that it can vary from 1.00 to 5.00. A value of 1.00 means that all persons providing primary diagnostic services in a health facility are doctors, whereas a value of 5.00 means that all services are provided by untrained personnel, such as dressers or ward maids. A non-integer value such as 2.50 indicates that the primary diagnosticians at a particular health facility are not homogeneous. The data were gathered from interviews at rural health facilities, unpublished district administration medical and personnel records, unpublished medical and personnel records of the Ministry of Health, and unpublished documents of the Catholic and Protestant Medical Bureaus; these data were used to construct the index for 64 health facilities for the year 1968/69.

Ratio of Service Providing Inputs to Initial Demanders, $(\frac{V^*}{S^*})$.

An aggregated measure of this ratio can be developed by (a) quantifying all service-providing inputs in monetary terms and (b) measuring initial demanders in the aggregate as the total number of initial attendences at a particular type of health facility. Aggregate attendance data were available for the years 1948-1969/70. Ministry of Health and district administration recurrent expenditure data were used to develop an aggregated measure for government hospitals and rural health units for the period 1948-1969/70, incorporating 23 observations.

Capacity to Import, C.

Two measures of this variable are possible: (a) the change in total exports, and (b) the change in the size of the visible trade balance. The first measure provides a good indication as to the upper limit on total imports since, in most less developed countries, it is not realistic to contemplate the continued possibility of financing imports from the combination of net inflows of factor income and capital loans or grants. The second measure provides a better indication of the potential to increase total imports, since it is a net figure - exports less imports. In addition, this figure provides an indication of the country's long run import preferences, preferences which tend to be relatively constant in the short run. Although Uganda has substantially curtailed certain types of imports through taxes and quotas, the trend of the visible trade balance provides a good indication as to the extent to which the importation of health-service-related commodities can be expanded. Data on the visible trade balance were available for the period 1948 to 1969/70.

The other variables are self-explanatory or are discussed in the body of the text. Tables D.8 - D.11 present additional results of the regression analysis using the variables described above.

Summary of Linear Programming Solution for Uganda Government Hospitals, Mission Hospitals, and Government Rural Units for 1968/69, Where a Minimum of One-Half of Every Type of Initial Demander Must be Treated

In Table C.13, an alternative linear programming solution for Uganda's health service system in 1968/69 is presented. The differences between this solution and the one discussed in the text are due to the constraint imposed on the objective function, which requires that a minimum of one-half of each type of initial demander, both inpatient and outpatient, must be treated. As a consequence, all disease types are included in each sector's output solution, whereas the linear programming solution presented in the text incorporated only those disease types which had the highest rates of successful treatment and the lowest use of resources. Only after treating one-half of all initial demanders from each disease type, could the present linear programming problem use the remaining resources to maximize output.

The case types having shadow prices (see Section II of Table C.13) indicate the disease types which were treated after one-half of each disease-specific initial demander was treated. In the case of the government hospitals, most of the case types having shadow prices were treated on an outpatient basis, whereas for missions, the opposite is the case, with the inpatient treatment process predominating.

A significant similarity between this set of solutions for each sector and the one presented in Chapter Five is that the service-providing input constraints remain the same in each sector as indicated by the service-providing input shadow prices presented in Section III of Table C.13. Although the actual shadow prices may differ in magnitude between the two solutions, the policy implications discussed in Chapter Five, particularly with respect to health manpower training, are further supported by the results shown in Table C.13.

Finally, it is important to mention that the imposition of the constraint on the linear programming solution as presented in Table C.13 makes the cost considerable in terms of the total number of successfully treated. A comparison of the objective function figures in Table 5.6 and C.13 makes evident the magnitude of the tradeoff facing Uganda between (a) maximizing the number of successfully treated persons and (b) allowing all diseases to enter the solution, with at least 50% of all initial demanders receiving treatment.

Number Successfully Treated

	No Constraints on Objective ftn.	Constraints on Obj. ftn.	Difference
Government Hospitals	4,663,032	3,880,243	782,789
Mission Hospitals	614,749	480,416	134,333
Government Rural Units	5,192,066	4,235,417	956,649
Total	10,469,847	8,596,076	1,873,771

Given this tradeoff, it is clearly a political decision which must determine the course of health policy: should it focus on the objectives of maximizing output and quality (as defined in this study), or should it make curative health care accessible to all Ugandans, regardless of the illness contracted?

APPENDIX C

Table C.1

A Reconciliation Between the Eleven Manpower Input Categories Used in Chapter Five and the Health Occupational Titles Used in the Ugandan Health Service System

Manpower Categories		Included Occupational Titles	
(1)	Doctors	(1)	All Medical Officers, including Specialists, Surgeons, Residents, and Medical Superintendents
(2)	Medical and Nursing Assistants	(2)	Medical Assistants and Nursing Assistants including Senior designations
(3)	Professional Nurses/ Midwives	(3)	Uganda Registered Nurses and/or Midwives, Nursing Sisters, Sister Tutors, and Health Visitors
(4)	Enrolled Nurses/ Midwives	(4)	Uganda Enrolled Level Nurses and/or Midwives
(5)	Trained Lab Staff	(5)	Laboratory Technicians and Assistant Laboratory Technicians
(6)	Trained X-Ray Staff	(6)	Radiographers and Assistant Radiographers
(7)	Other Trained, Medical Staff	(7)	Pharmacists, Assistant Health Visitors, Theater Attendants, Dental Technicians, Storemen, Blood Donor Attendant, Dispenser, Orthopaedic Assistants
(8)	Other Trained, Non-Medical Staff	(8)	All Clerical Office Staff (including Hospital Secretary, Assistant Hospital Secretary and Clerk), Ambulance Drivers, Clinic Writers, Statistical Clerks, Headman, Seamstress, Domestic Assistant, Laboratory Attendant, Carpenter and Mechanic
(9)	Other Non-Trained, Medical Staff	(9)	Ward Assistants (including Ward Maids and Nursing Assistants) and Dressers
(10)	Other Non-Trained, Non-Medical Staff	(10)	Sweepers, Porters, Manual Laborers, Cooks, Orderlies (Pharmacy, Laboratory, X-Ray), Office Messengers, Watchmen, Peelers and Dhobies.
(11)	Students	(11)	All Medical, Medical Assistant, and Nursing School Students.

APPENDIX C

Table C.2

Adjustments Made to the Availability of Service Providing Inputs for Each Sector of Uganda's Health Service System

Service Providing Input		Government Hospitals				Mission Hospitals				Rural Health Units			
		Gross Inputs	% Adm	% Special Clinics	Net Inputs	Gross	% Adm	% Special Clinics	Net Inputs	Gross Inputs	% Adm	% Special Clinics	Net Inputs
1. Doctors	hrs.	734,400	25	—	550,800	162,720	22	—	126,921	45,792	100	--	0
2. Med. Assts./ Nursing Assts.	hrs.	575,400	—	—	575,400	6,300	--	—	6,300	457,800	5	15	366,240
3. Prof. Nurses/ Midwives	hrs.	662,400	20	—	529,920	365,760	20	--	292,608	60,480	90	10	0
4. Enrolled Nurses/ Midwives	hrs.	2,522,100	—	5	2,395,995	425,400	—	5	404,130	357,000	5	20	273,105
5. Trained Lab Staff	hrs.	126,000	—	--	126,000	105,000	--	--	105,000	10,500	--	—	10,500
6. Trained X-Ray Staff	hrs.	50,400	—	--	50,400	23,100	--	—	23,100	------	--	--	------
7. Other Trained Med. Staff	hrs.	441,000	—	10	396,900	14,700	--	5	13,965	145,530	9	25	61,110
8. Other Trained Non-Medical Staff	hrs.	1,223,250	80	—	244,650	78,750	90	--	7,875	117,250	--	--	117,250
9. Non-Trained Medical Staff	hrs.	2,832,900	—	5	2,691,255	942,900	—	5	895,755	945,000	--	5	897,750
10. Non-Trained Non-Medical Staff	hrs.	5,222,700	20	—	4,178,160	1,031,100	18	--	845,502	1,732,500	3	5	1,593,900
11. Students	hrs.	1,854,000	—	—	1,854,000	770,000	--	--	770,000	------	--	--	------
12. Beds	Bed days	1,956,035	—	--	1,956,035	1,111,060	--	--	1,111,060	1,281,880	--	--	1,281,880
13. Drugs/Medical Supplies	shs.	10,987,509	—	5	10,438,134	2,081,802	—	5	1,977,712	2,398,626	E 4	5	2,173,626
14. Food	shs.	4,167,795	—	—	4,167,795	734,373	—	—	734,373	285,935	--	--	285,935
15. Vehicle Operation and Maint.	shs.	747,723	—	--	747,723	393,242	--	—	393,242	1,757,191	--	—	1,757,191
16. Electricity	shs.	2,880,252	—	—	2,880,252	656,442	—	—	656,442	122,676	—	--	122,676
17. Other Operation and Maint.	shs.	1,945,927	—	—	1,945,927	978,549	--	—	978,549	1,103,507	5	7	969,392

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Table C.3

The Allocation of Service Providing Inputs According to the Diagnostic Health Service System, 1968/69

Service Providing Input		Government Hospitals — Amount Allocated According to the Following Criteria: (1) Diagnostic Time O.P.	(2) Length of Stay I.P.	(3) Service Specific[1]		Total	Mission Hospitals — Amount Allocated According to the Following Criteria: (1) Diagnostic Time O.P.	(2) Length of Stay I.P.	(3) Service Specific[1]		Total	Rural Units With Beds — Amount Allocated According to the Following Criteria: (1) Diagnostic Time O.P.	(2) Length of Stay I.P.	(3) Service Specific[1]		Total
1. Doctors	hrs.	71,197	259,283	220,320(a)		550,800	26,035	58,579	42,307(a)		126,921					
2. Med/Nursing Assts.	hrs.	518,000		57,400(a)		575,400	4,305	1,995			6,300	251,790	114,450			366,240
3. Prof. Nurses/Midwive	hrs.	99,360	430,560			529,920	54,864	237,744			292,608					
4. Enrolled Nurses/Mdw.	hrs.		2,143,785	252,210(a)		2,395,995		361,590	42,540(a)		404,130	5,355	267,750			273,105
5. Trained Lab Staff	hrs.	126,000				126,000	105,000				105,000	10,500				10,500
6. Trained X-Ray Staff	hrs.	50,400				50,400	23,100				23,100					
7. Other Trained Med.	hrs.	66,150	330,750			396,900	2,205	11,760			13,965	27,300	33,810			61,110
8. Other Trained Non-Med. Staff	hrs.		61,162	61,163(b)	122,325(e)	244,650	3,938	3,937			7,875			117,250(e)		117,250
9. Non Tr. Med. Staff	hrs.	991,515	1,699,740			2,691,255	141,435	754,320			895,775	425,250	472,500			897,750
10. Non Tr. Non Med. St.	hrs.	1,044,540	3,133,620			4,178,160		618,660	113,621(b)	113,421(c)	845,502	952,875	641,025			1,593,900
11. Students	hrs.		1,854,000			1,854,000		770,000			770,000					
12. Beds	bed days		1,956,035			1,956,035		1,111,060			1,111,060		1,281,800			1,281,800
13. Drugs/Med. Supplies	shs.	4,006,544	3,894,701	2,536,889(a)		10,438,134	669,858	784,154	523,700(a)		1,977,712	1,409,944	763,682			2,173,626
14. Food	shs.		4,167,795			4,167,795		734,373			734,373		285,935			285,935
15. Vehicle Op. & Maint.	shs.			373,862(d)	373,861(e)	747,723			196,621(d)	196,621(e)	393,242			878,596(d)	878,595(e)	1,757,191
16. Electricity	shs.	144,013	1,584,139	576,050(a)	288,025(b) 288,025(c)	2,880,232	32,822	361,044	131,288(a) 65,644(c)	65,644(b)	656,442	18,401	104,275			122,676
17. Op. & Maint. Exp.	shs.	195,593	1,751,334			1,945,927	97,855	880,694			978,549	261,736	707,656			969,392

Notes: The service specific allocation methods include: (a) surgery, (b) laboratory, (c) X-Ray, (d) drugs and medical supplies, and (e) transportation (transferred patients). The letters (a) through (e) behind the figures in this column refer to the allocation methods used.

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Table C.4

Average Diagnostic Time for Each Major Disease Category Treated on an Outpatient Basis at Mpigi Health Center and Kajansi Sub-dispensary, West Mengo District, Uganda, September and October 1970.

Disease Category	No. of Cases	Average Diagnostic Time (in minutes)
I&P	144	2.00
NG	1	0.67
AMB	5	2.05
NS	25	1.51
Circ	--	--
Resp	76	1.91
Alim	38	1.92
GU	21	1.87
Preg & Puer	--	--
Del w/o	--	--
S&MS	45	1.18
NB	--	--
Ill Def	27	2.37
Inj	68	1.04
TOTAL	450	1.74

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Table C.5

Average Length of Inpatient Stay for Each Major Disease Category Treated on an Inpatient Basis in each Sector of Uganda's Health Service System 1968/69.

Disease Category	Government Hospitals (days)	Mission Hospitals (days)	Rural Units with Beds (days)
I&P	3.12	6.78	3.72
NG	10.87	13.82	2.50
AMB	5.17	9.03	3.82
NS	6.26	8.71	3.75
Circ	8.43	18.92	5.29
Resp	3.49	5.99	4.07
Alim	3.57	6.93	2.98
GU	4.51	6.41	3.58
Preg & Puer	3.76	6.66	2.00
Del w/o	1.65	4.03	2.17
S&MS	6.70	9.46	4.70
NB	4.69	8.69	2.75
Ill Def	5.06	4.09	2.82
Inj	6.33	7.56	6.12
TOTAL	4.03	7.17	3.38

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Table C.6

Proportion of Surgical Services Consumed in the Treatment of Each Major Disease Category in Each Sector of Uganda's Health Service System 1968/69.

Disease Category	Government Hospitals %	Mission Hospitals %
I&P	---	0.1
NG	2.7	4.5
AMB	0.2	---
NS	0.3	0.8
Circ	---	---
Resp	0.3	0.2
Alim	25.5	15.8
GU	26.5	17.6
Preg & Puer	6.9	21.5
Del w/o	---	---
S&MS	27.3	8.0
NB	---	0.2
Ill Def	---	0.1
Inj	10.3	31.1

Note: (1) Surgical services reported here are consumed on an inpatient basis.

(2) There are only minor surgical services provided in rural units. The records of rural units indicated that such services were infrequent. When a person required surgery, he was transferred to a government hospital.

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Table C.7

Proportion of Laboratory Services Consumed in the Treatment of Each Major Disease Category in Each Sector of Uganda's Health Service System 1968/69.

Disease Category	Government Hospitals (days)	Mission Hospitals (days)	Rural Units with Beds (days)
I&P	66.44	79.90	99.40
NG	0.01	0.46	---
AMB	29.72	11.45	0.60
NS	0.41	---	---
Circ	---	---	---
Resp	1.33	0.01	---
Alim	---	0.19	---
GU	---	0.06	---
Preg & Puer	2.08	0.01	---
Del w/o	---	---	---
S&MS	---	1.49	---
NB	---	---	---
Ill Def	---	6.42	---
Inj	---	---	---

Note: Laboratory services are generally consumed in the process of diagnosis -- an outpatient activity. As a result the disease categories refer to the outpatient treatment process.

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Table C.8

Proportion of X-Ray Services Consumed in the Treatment of Each Major Disease Category in Each Sector of Uganda's Health Service System 1968/69.

Disease Category	Government Hospitals %	Mission Hospitals %
I&P	39.66	61.87
NG	0.40	0.27
AMB	---	---
NS	0.84	0.53
Circ	4.40	2.80
Resp	0.25	0.16
Alim	4.96	3.15
GU	0.23	0.14
Preg & Puer	0.45	0.29
Del w/o	---	---
S&MS	7.51	4.77
NB	---	---
Ill Def	---	---
Inj	41.06	26.04

Note: X-Ray services are generally consumed on outpatient basis, prior to inpatient admission. As a result, it is assumed that such services are consumed on an outpatient basis.

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Table C.9

Average Cost of Drugs and Medical Supplies Consumed in the Treatment of an Initial Demander in Each Major Disease Category and in Each Sector of Uganda's Health Service System in 1968/69.

Disease Categories	Government Hospitals			Mission Hospitals			Rural Units with Beds		
	Ave. Drug Cost OP(1)	Ave. Drug & Med. Supplies Cost OP	Ave. Drug & Med. Supplies Cost IP(3)	Ave. Drug Cost OP	Ave. Drug & Med. Supplies Cost OP	Ave. Drug & Med. Supplies Cost IP(3)	Ave. Drug Cost OP	Ave. Drug & Med. Supplies Cost OP	Ave. Drug & Med. Supplies Cost IP(3)
I & P	0.54	0.95	27.81	0.71	1.23	11.12	0.24	0.41	3.95
NG	0.03	0.05	9.65	0.03	0.05	9.65	0.02	0.03	2.41
AMB	3.57	3.70(2)	17.33	1.12	1.16(2)	4.31	0.10	0.18	1.79
NS	0.15	0.26	16.82	0.13	0.23	2.56	0.09	0.15	1.41
Circ	0.36	0.63	51.48	0.37	0.65	14.03	0.22	0.38	4.67
Resp	0.28	0.48	20.78	0.27	0.47	3.89	0.16	0.28	2.90
Alim	0.10	0.17	7.64	0.16	0.28	2.57	0.12	0.21	1.74
GU	0.28	0.48	18.08	0.30	0.52	4.48	0.17	0.30	2.80
Preg & Puer	0.01	0.02	10.39	0.01	0.02	6.00	0.01	0.01	2.00
Del w/o	----	----	2.24	----	----	2.50	----	----	1.00
S&MS	0.38	0.67	45.91	0.37	0.65	7.60	0.22	0.39	4.41
NB	0.11	0.19	10.22	0.09	0.15	1.67	0.06	0.10	0.83
Ill Def	0.45	0.79	43.76	0.45	0.79	4.93	0.27	0.47	3.79
Inj	0.34	0.68	38.95	0.33	0.67	11.40	0.20	0.35	4.77

Note:

(1) All figures are in Ugandan Shillings.

(2) The average drug cost of this disease category is so high due to the continued treatment regime required by a limited number of diabetes patients who comprise a proportion of this disease category.

(3) The estimated inpatient average cost figure was derived by using the average outpatient cost of drugs and medical supplies and adjusting it according to two criteria: (a) a severity factor and (b) length of inpatient stay. The severity factor assumed that the average consumption of drugs and medical supplies would double during the first two days of inpatient care. After that period, it was assumed that the average outpatient consumption of drugs and medical supplies would approximate the average daily cost of drugs and medical supplies consumed on an inpatient basis.

APPENDIX C

Table C.10

Elements, a, of the Diagonal Submatrix for the Government Hospital Sector in Uganda in 1968/69.

Service Demanding Inputs	Estimate of a	S_j (1968/69)	Rate of T_j	Rate of U_j	Rate of D_j	S_{ipj}
<u>Outpatient</u>						
I & P	1.08	1,856,893	0.66	4.95	----	37,464
NG	2.50(E)	4,819	2.17	13.04	----	4,085
AMB	1.34	57,181	1.46	5.47	----	10,467
NS	1.17	316,427	0.70	11.54	----	6,107
Circ	4.60	5,422	0.70	6.66	----	3,845
Resp	1.05	1,086,744	0.50	2.25	----	23,642
Alim	1.06	760,258	0.50	2.51	----	22,505
GU	1.12	141,520	0.54	4.06	----	8,830
Preg & Puer	1.72	30,838	0.70	1.98	----	25,017
Del w/o	----	-----	----	-----	----	41,911
S & MS	1.04	763,935	0.70	1.92	----	10,379
NB	1.38	11,448	0.70	9.38	----	1,976
Ill Def	1.11	245,761	2.03	6.09	----	4,371
Inj	1.10	533,597	0.96	3.58	----	24,103
<u>Inpatient</u>						
I & P	1.11	------	1.32	3.30	5.07	37,464
NG	1.23	------	4.35	8.69	5.41	4,085
AMB	1.20	------	2.92	3.65	10.10	10,467
NS	1.19	------	1.40	7.69	7.00	6,107
Circ	1.19	------	1.40	4.44	10.24	3,845
Resp	1.10	------	1.00	1.50	6.95	23,642
Alim	1.09	------	1.00	1.67	5.56	22,505
GU	1.06	------	1.09	2.71	1.78	8,830
Preg & Puer	1.04	------	1.40	1.32	0.76	25,017
Del w/o	1.00	------	----	-----	----	41,911
S & MS	1.04	------	1.40	1.28	0.86	10,379
NB	1.27	------	1.40	6.25	13.36	1,976
Ill Def	1.15	------	4.07	4.06	5.21	4,371
Inj	1.07	------	1.91	2.39	2.54	24,103

Notes: (1) (E) = an assumed figure

(2) $$a_{opj} = \frac{S_j}{S_j - S_j(T_j + U_j) - S_{ipj}}$$

(3) $$a_{ipj} = \frac{S_{ipj}}{S_{ipj} - S_{ipj}(T_j + U_j + D_j)}$$

APPENDIX C

Table C.11

Elements, a, of the Diagonal Submatrix for the Mission Hospital Sector in Uganda in 1968/69.

Service Demanding Inputs	Estimate of a	S_j (1968/69)	Rate of T_j	Rate of U_j	Rate of D_j	S_{ipj}
Outpatient						
I & P	1.16	170,837	0.00	6.00	----	29,147
NG	2.50(E)	1,203	0.00	9.60	----	1,855
AMB	1.46	22,138	0.00	4.05	----	8,876
NS	1.18	25,586	0.00	9.00	----	2,971
Circ	2.54	3,061	0.00	4.95	----	1,758
Resp	1.12	55,345	0.00	1.65	----	11,526
Alim	1.17	53,873	0.00	1.50	----	12,039
GU	1.32	16,228	0.00	3.75	----	5,498
Preg & Puer	1.75	7,605	0.00	1.50	----	8,888
Del w/o	----	---	----	----	----	16,359
S & MS	1.06	39,783	0.00	1.50	----	3,980
NB	1.83	3,228	0.00	6.90	----	2,558
Ill Def	1.23	9,313	0.00	4.50	----	3,461
Inj	1.21	10,655	0.00	2.70	----	3,081
Inpatient						
I & P	1.06	---	0.10	4.00	1.66	29,147
NG	1.12	---	0.10	6.40	4.15	1,855
AMB	1.06	---	0.10	2.70	2.44	8,876
NS	1.11	---	0.10	6.00	3.43	2,971
Circ	1.11	---	0.10	3.30	6.59	1,758
Resp	1.05	---	0.10	1.10	3.58	11,526
Alim	1.05	---	0.10	1.00	3.25	12,039
GU	1.03	---	0.10	2.50	0.60	5,498
Preg & Puer	1.02	---	0.10	1.00	0.68	8,888
Del w/o	1.00	---	----	----	----	16,359
S & MS	1.02	---	0.10	1.00	0.62	3,980
NB	1.22	---	0.10	4.60	13.40	2,558
Ill Def	1.05	---	0.10	3.00	1.47	3,461
Inj	1.04	---	0.10	1.80	1.55	3,081

Notes: (1)(E) = an assumed figure.

(2) $$a_{opj} = \frac{S_j}{S_j - S_j(T_j + U_j) - S_{ipj}}$$

(3) $$a_{ipj} = \frac{S_{ipj}}{S_{ipj} - S_{ipj}(T_j + U_j + D_j)}$$

APPENDIX C

Table C.12

Elements, a, of the Diagonal Submatrix for the Government Rural Unit Sector in Uganda in 1968/69.

Service Demanding Inputs	Estimate of a	S_j	Rate of T_j	Rate of U_j	Rate of D_j	S_{ipj}
Outpatient						
I & P	1.15	2,524,020	2.19	7.00	----	89,954
NG	4.62(E)	153	10.75	----	----	480
AMB	1.25	50,015	6.61	10.00	----	1,570
NS	1.27	358,048	3.40	18.00	----	480
Circ	3.86(E)	136	3.40	----	----	369
Resp	1.20	1,670,109	1.80	12.50	----	40,453
Alim	1.49	836,656	6.47	25.00	----	11,226
GU	1.05	150,793	3.40	0.00	----	2,659
Preg & Puer	1.06	65,725	3.91	0.00	----	1,330
Del w/o	----	----	----	----	----	57,995
S & MS	1.12	938,236	5.86	4.00	----	7,976
NB	1.09	2,682	3.40	0.00	----	129
Ill Def	1.11	493,659	4.42	2.60	----	12,925
Inj	1.30	609,980	10.32	10.00	----	15,104
Inpatient						
I & P	1.16	----	5.10	4.76	4.03	89,954
NG	1.52	----	25.00	6.21	2.94	480
AMB	1.43	----	15.38	11.54	2.94	1,570
NS	1.21	----	7.91	6.21	2.94	480
Circ	1.38	----	7.91	16.67	2.94	369
Resp	1.15	----	4.18	5.82	2.99	40,453
Alim	1.23	----	15.05	2.69	1.08	11,226
GU	1.24	----	7.91	6.82	4.55	2,659
Preg & Puer	1.27	----	9.09	9.09	2.94	1,330
Del w/o	1.00	----	----	----	----	57,995
S & MS	1.29	----	13.64	7.57	1.52	7,976
NB	1.21	----	7.91	6.21	2.94	129
Ill Def	1.38	----	10.28	15.42	1.87	12,925
Inj	1.57	----	24.00	9.20	2.94	15,104

Notes: (1) (E) = an assumed figure

(2) $$a_{opj} = \frac{S_j}{S_j - S_j(T_j+U_j) - S_{ipj}}$$

(3) $$a_{ipj} = \frac{S_{ipj}}{S_{ipj} - S_{ipj}(T_j+U_j+D_j)}$$

APPENDIX C

Table C.13

Summary of Linear Programming Solution for Uganda Government Hospitals, Mission Hospitals and Government Rural Units for 1968/69.

Objective Function: Rate of Successful Treatment

A Minimum of One-half of Each Type of Initial Demander Must be Treated

I Optimum Number of Cases Treated

Outputs	(A) OUTPATIENT I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj
Government Hospitals (1)	0.46	0.20	0.37	0.86	0.11	0.95	0.79	0.89	0.29	-	0.48	0.73	0.90	0.45
Current Values of (3) Initial Demanders	1,856,893	4,969	57,181	316,427	5,422	1,080,744	760,258	141,520	30,838	-	763,935	11,448	245,761	533,597
Mission Hospitals (1)	0.43	0.20	0.34	0.42	0.20	0.56	0.43	0.38	0.29	-	0.47	0.55	0.41	0.41
Current Values of (3) Initial Demanders	357,826	1,245	32,459	46,811	3,157	125,270	93,821	26,308	10,720	-	105,501	3,320	23,867	21,382
Government Rural Units (1)	0.49	0.11	0.40	0.49	0.13	0.83	0.34	0.48	0.47	-	0.45	0.46	0.45	0.39
Current Values of (3) Initial Demanders	2,524,020	153	50,015	358,048	136	1,670,109	846,656	150,793	65,725	-	938,236	2,682	493,659	609,980

Outputs	(B) INPATIENT I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj	Objective Function Equals	Total No. Initial Demanders
Government Hospitals (1)	0.65	0.41	0.42	0.42	0.42	0.45	0.46	0.47	0.48	1.00	0.48	0.40	0.43	0.47	3,880,243	
Current Values of (3) Initial Demanders	37,464	4,085	10,467	6,107	3,845	23,642	22,505	8,830	25,017	41,911	10,379	1,976	4,371	24,103		6,033,695
Mission Hospitals (1)	0.94	0.45	0.73	0.90	0.45	0.95	0.96	0.97	0.98	1.00	0.49	0.82	0.95	0.97	480,416	
Current Values of (3) Initial Demanders	29,147	1,855	8,876	2,971	1,758	11,526	12,039	5,498	8,888	16,359	3,980	2,558	3,461	3,081		963,684
Government Rural Units (1)	0.43	0.33	0.35	0.41	0.36	0.44	0.41	0.40	0.39	1.00	0.39	0.41	0.36	0.32	4,235,417	
Current Values of (3) Initial Demanders	89,954	480	1,570	480	369	40,453	11,226	2,659	21,872	57,995	7,976	129	12,925	15,104		7,973,404

II Shadow Prices of Case Types Appearing in the Linear Programming Solution and the Cost of Forcing Non-Optimal Case Types into the Solution

Initial Demanders	(A) OUTPATIENT I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj
Government Hospitals														
(a) Shadow Prices	0.00	0.00	0.00	0.42	0.00	0.83	0.00	0.61	0.00	-	0.00	0.63	0.56	0.00
(b) Cost of Non-Optimal	2.82	6.29	0.89	-	68.63	-	-	-	1.00	-	1.18	-	-	11.41
Mission Hospitals														
(a) Shadow Prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.32	0.00	0.00
(b) Cost of Non-Optimal	64.42	36.74	5.59	3.07	162.62	-	9.89	1.00	6.21	-	20.70	-	-	435.25
Government Rural Units														
(a) Shadow Prices	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal	-	2.64	1.05	-	0.65	-	0.91	0.01	0.16	-	0.73	0.37	0.31	2.04

Initial Demanders	(B) INPATIENT I & P	NG	AMB	NS	Circ	Resp	Alim	GU	Preg.& Puer	Del w/o	S & MS	NB	Ill Def	Inj
Government Hospitals														
(a) Shadow Prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal	-	2.44	0.80	0.77	1.30	0.03	0.05	0.29	0.17	-	0.88	0.42	0.98	0.88
Mission Hospitals														
(a) Shadow Prices	0.23	0.00	0.00	0.03	0.00	0.32	0.22	0.28	0.26	0.55	0.00	0.03	0.52	0.16
(b) Cost of Non-Optimal	-	0.53	-	-	1.09	-	-	-	-	-	0.05	-	-	-
Government Rural Units														
(a) Shadow Prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
(b) Cost of Non-Optimal	0.51	6.06	3.65	1.17	1.12	0.24	3.46	1.35	1.69	-	3.05	1.42	2.02	6.07

III Shadow Prices and Slack Quantities of Service-Providing Inputs

Inputs (2)	(1) Drs.	(2) Med/N Assts.	(3) Prof. N/MW	(4) Enrolled N/MW	(5) Tr.Lab.	(6) Tr.XRay	(7) O. Tr. Med	(8) O. Tr. Non Med	(9) O. Non Tr. Med	(10) O.Non Tr. Non Med	(11) Students	(12) Beds	(13) Drugs etc.	(14) Food	(15) Vehicle Op.&Maint.	(16) Electr.	(17) O.Op.& Maint.
Government Hospitals																	
(a) Shadow Prices (6)	0.00	0.00	0.00	0.00	0.00	164.85	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	202,782	427,520	275,780	1,061,941	10,073	0	120,694	0	369,038	938,786	917,038	1,445,818	4,366,239	1,819,208	277,362	960,624	691,345
(c) Current Values (3)	550,800	575,400	529,920	2,395,995	126,000	50,400	396,900	244,650	2,691,255	4,178,160	1854,000	1,956,035	10,438,134	4,167,795	747,723	2,880,252	1,945,927
Mission Hospitals																	
(a) Shadow Prices (6)	0.00	42.92	0.00	0.00	0.60	772.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	8,232	0	22,628	41,577	0	0	1,119	241	73,347	59,449	81,553	420,215	506,357	77,773	34,573	43,346	88,753
(c) Current Values (3)	126,921	6,300	292,608	404,130	105,000	23,100	13,965	7,875	895,755	845,502	770,000	1,111,060	1,977,712	734,373	393,242	656,442	978,549
Government Rural Units																	
(a) Shadow Prices (6)	-	0.00	-	0.00	47.41	-	0.00	44.44	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
(b) Slack Quantities	-	158,084	-	43,912	0	-	11,228	0	153,719	168,187	-	774,072	205,541	122,744	82,442	42,624	274,403
(c) Current Values (3)	-	366,240	-	273,105	10,500	-	61,110	117,250	897,750	1,593,900	-	1,281,880	2,173,626	285,935	1,757,191	112,676	969,392

Notes: (1) The optimum number of successfully treated cases is expressed as a proportion of the current value figure which is the number of initial demanders.

(2) Inputs numbered 1-11 are measured in hours; input 12 is measured in bed days; and inputs 13-17 are measured in shs.

(3) The current value figures under the optimum number of cases treated and slack quantities of service-providing inputs represent the two parts of the input vector, the service-demanding and service-providing inputs respectively.

(4) The shadow prices of initial demanders show the amount by which the objective function could increase if an additional initial demander with the given disease characteristics were to demand service.

(5) The cost of adding a non-optimal case to the solution shows the amount by which the objective function would decline if one of those types of cases were treated as opposed to those cases which are treated.

(6) The shadow price of the service-providing inputs shows the amount by which the number of successfully treated persons would increase if one additional unit of that input were made available.

APPENDIX D

APPENDIX D

Other Supporting Tables

Supporting Tables to Chapter Two

D.1 Health Facilities in Uganda

D.2 Selected Indices on Size and Structure of Uganda's Health Service System

D.3 Structure of Attendances at Uganda Government Health Facilities

D.4 Number of Attendances at Government Health Facilities

APPENDIX D

Table D.1

Health Facilities in Uganda

	Hospitals Gov.	Hospitals Vol.	Hospitals Tot.	Hospital Beds Gov.	Hospital Beds Vol.	Hospital Beds Total	Health Centers Govt.	Dispensary Mat. Units Govt.	Dispensary Mat. Units Vol.	Dispensaries Govt.	Dispensaries Vol.	Total Beds Including Mat. Beds Govt.	Sub-Disp. Govt.	Sub-Disp. Vol.	Mat. Units Govt.	Mat. Units Vol.	Sub-Dispt. Mat.Units Govt.	Sub-Dispt. Mat.Units Vol.	Aid Posts Govt.	Aid Posts Vol.	Mental Hosp. (Govt.) No.	Mental Hosp. (Govt.) Beds
1914	15			161																		
1932	22			1145																		
1947	24	9		2484																		
1949	27			2834						70		993	72						96			
1950	27	9		2753				30		44		1298	73		2				96		1	322
1951	26	9		2715	677	3392		33		63		1458	52		2				100		1	322
1952	26	8		2711	731	3442		32		64		1383	57		2				101		1	322
1953	22	9		2562	654	3216		36		77		1528	42		1				101		1	322
1954	22	9		2723	684	3407		37		82		1718	35		1				99		1	322
1955	22	9		2932	684	3616		36		77		1718	47		1				98		2	426
1956	25	9		2946	1492	4438		33		82		1958	43		4						2	426
1967	23	18		3017	1708	4755		37	4	89	6	2222	41	19	2	20					2	446
1958	23	16		3149	1447	4596	3	36	14	92	2	2381	45	17	2	23					2	446
1959	24	16		3308	1470	4778						2468									2	552
# 1960	24	16		3360	1466	4826	9	30	17	95	4	2477	37	18		18					2	652
1960/61	24	20		3420	1884	5304	16	31	14	84	2	2595	40	21	1	20					3	650
1961/62	23	20		3499	1883	5382						2595									3	782
1962/63	22	26		3847	2464	6311	12	35	14	83	3	2775	45	23	2	17					1	786
1963/64	22	24		4024	2428	6452	18	27	13	92	5	2807	46	23	3	17					1	786
1964/65	22	26		4013	2747	6760						2995									1	786
1965/66	23	26		4294	2988	7282	23	50	14	75	-	3158	82	31	4	17					1	907
1966/67	24	26		4370	3053	7423	27	47	16	76	-	3298	75	30	4	16			145		1	967
1967/68	28	25		4912	2985	7897						3328										967
* 1968/69	31	25		5341	3044	8385	31	53		70		2512	107		7				149			967
** 1969/70	34	26		5650 E	3142 E	8792	40	55	6	67	3		139	15	7	21			166		1	967
1970/71																						

Notes: E = Estimated from available data. * = Except for the number of government and voluntary hospitals, the data refer to the stock of facilities as of December 31, 1968. ** = except for the number of govt. and voluntary hospitals, the data refer to the stock of facilities as of Dec. 31, 1969. # = Data are for January - June 1960 only, due to change in reporting years.

General Notes: (a) Figures include African Units only where the distinction is made between African, Asian and European units.

(b) Figures exclude Prison and Army hospitals and dispensaries.

(c) Sources for the data are as follows: Annual Reports of the Ministry of Health through 1963/64; Ministry of Health Services Statistical Records, 1964/65-1968/69; J. Galea, Inventory Appraisal and Assessment of the Basic Health Services of Uganda (W.H.O., Kampala, 1967/68) updating of Galea's work by Dr. Van Der Hoeven, December 1969, (W.H.O., Kampala); data for 1969/70 and 1970/71 were obtained from personal communication and interview with Uganda's Ministry of Health and the Mission Medical Bureaus.

APPENDIX D

Table D.2

Selected Indices on Size and Structure of Uganda's Health Service System

	Average Size Govt. Hosp. (# of Beds)	Average Size Vol. Hosp. (# of Beds)	Index of Hosp. Beds (1951=100) Govt.	Vol.	Tot.	Index of Govt. Disp. Beds (1951=100)	Total Govt. Facilities (excl. aid posts)	Hosp. % of Total	Rural Units With Beds**	% of Total	Total Vol. Facilities	Hospital % of Total	Rural Unit With Beds % of Total
1914	10.7		5.4										
1932	52.0		42.2										
1947	103.5		91.5										
1949	105.0		104.4			68.1	169	16.0	70	41.4			
1950	102.0		101.4			89.0	176	15.3	76	43.2			
1951	104.4	75.2	100.0	100.0	100.0	100.0	176	14.8	98	55.7			
1952													
1953	116.4	72.7	94.4	96.6	94.8	111.7	178	12.4	114	64.0	50	18.0	
1954	123.8	76.0	100.3	101.0	100.4	117.8	177	12.4	120	67.8	50	18.0	
1955	133.3	76.0	108.0	101.0	106.6	117.8	183	12.0	114	62.3	50	18.0	
1956													
1957	132.5	94.9	112.2	252.3	140.2	152.4	192	12.0	128	66.7	67	26.9	44.8
1958	136.9	90.4	116.0	213.7	135.5	163.3	201	11.4	133	66.2	72	22.2	54.2
1959	137.8	91.9	121.8	217.1	140.9	139.3							
# 1960	140.0	91.6	123.8	216.5	142.3	169.9	197	12.2	136	69.0	73	21.9	53.4
1960/61	142.5	94.2	126.0	278.3	156.4	178.0	196	12.2	132	67.3	77	26.0	46.8
1961/62	152.1	94.2	128.9	278.2	158.7	178.0							
1962/63	174.9	94.8	141.7	364.0	186.1	190.3	199	11.1	132	66.3	83	31.3	41.0
1963/64	182.9	101.2	148.2	358.6	190.2	192.5	208	10.6	140	67.3	82	29.3	42.7
1964/65	182.4	105.7	147.8	405.8	199.3	205.4							
1965/66	186.7	114.9	158.2	441.4	214.7	216.6	257	8.9	152	59.1	88	29.5	35.2
1966/67	182.1	117.4	161.0	451.0	218.8	226.2	253	9.5	154	60.9	88	29.5	36.4
1967/68													
1968/69							299	10.4	161	53.8			
1969/70	157.9	120.8	197.8	464.1	250.9		342	9.9	169	49.4	71	36.6	42.3

* The information presented in this Table is derived from data compiled in Table D.1, Health Facilities in Uganda.
** Rural Units with beds include Health Centers, Dispensary/Maternity Units, Dispensaries, and Maternity Units.
\# Figures are for January - June 1960, only, due to change in reporting year.

APPENDIX D

Table D.3

Structure of Attendances at Uganda Government Health Facilities (1)

Year	Index of Total Cases All Units	Index of Total Outpatients All Units New	Index of Total Outpatients All Units Reatt.	Index of Inpatient Admissions All Units	Index of Total Hosp. Attendances Inpatient & Outpatient	Index of Total Rural Units Attendance Inpatient & Outpatient	Ratio of Total Unit Cases to Hospital Cases	Rural Total	Ratio of Rural Unit Inpatient Cases To Hospital Inpatient Cases
1914	1.9	3.8	N.A.	1.4					
1932	62.4	129.5	N.A.	19.8	69.4	58.9	1.68		0.09
1950	102.5	98.8	197.5	73.7	112.2	97.6	1.72		N.A.
1951	100.0	100.0	100.0	100.0	100.0	100.0	1.98		0.39
1952	97.7	99.7	95.7	100.2	98.4	97.3	1.96		0.51
1953	99.0	99.0	98.9	100.7	93.8	101.6	2.15		0.59
1954		99.5	N.A.	105.3		(2)	2.27		0.64
1955	112.0	117.3	107.2	106.8	109.0	113.6	2.06		0.68
1956									
1957	132.4	137.1	128.0	130.2	147.0	125.0	1.69		0.77
1958	146.5	157.4	136.1	143.3	144.8	147.3	2.01		0.81
1959	148.7	165.1	133.0	145.9	152.1	147.0	1.91		0.73
1960 (3)	159.8	186.1	134.0	167.4	164.3	157.4	1.90		0.74
1960/61	178.6	200.0	159.0	158.8	162.0	186.9	2.29		0.75
1961/62	202.0	249.5	157.5	177.3	229.9	187.9	1.62		0.93
1962/63	192.5	234.6	150.7	217.0	190.4	193.5	2.01		1.07
1963/64	187.0	213.5	161.7	183.1	188.0	186.5	1.96		1.04
1964/65									
1965/66	268.5	308.2	233.6	202.2	274.8	265.3	1.91		0.77
1966/67	314.3	363.0	270.8	248.7	327.4	307.7	1.86		0.69
1967/68					352.0				
1968/69					399.6				
1969/70									

(1) 1951 = 100.0 Data are derived from Table 9.
(2) Figure was calculated on the basis of data recorded for 1954. The data on reattendance were poorly recorded in this year, and are not included.
(3) Figures are for January - June 1969, only, due to change in reporting year.

APPENDIX D

Table D.4

Number of Attendances at Governmental Health Facilities (1)

Year	Total No. of Cases Hosp.	Total No. of Cases Rural U.	Total No. of Cases Total	Outpatient- New Cases Hosp.	Outpatient- New Cases Rural U.	Outpatient- New Cases Total	Outpatient-Reattendances Hosp.	Outpatient-Reattendances Rural U.	Outpatient-Reattendances Total	Inpatient-Admissions Hosp.	Inpatient-Admissions Rural U.	Inpatient-Admissions Total	Total Population at beginning of period	Estimated Ave. No of cases per person/yr.
1914			90.7	N.A.	N.A.	89.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	2,904.5 (2)	0.03
1932	1,134.7	1,906.3	3,041.0	1,112.5	1,904.4	(3) 3,016.9	N.A.	N.A.	N.A.	22.2	1.9	24.1	3,568.9 (4)	0.85
1949	1,725.7	3,198.4	4,924.1	829.8	1,452.0	2,281.9	895.8	1,746.3	2,642.1	89.6	23.9	113.5	5,078.0	0.97
1950	1,834.8	3,160.6	4,995.4	797.2	1,504.5	2,301.7	947.7	1,656.0	2,603.1	89.9	N.A.	89.9	5,192.0	0.96
1951	1,634.7	3,238.3	4,873.0	775.5	1,553.5	2,329.0	771.2	1,650.8	2,422.0	88.0	34.0 (5)	122.0	5,322.0	0.92
1952	1,608.1	3,152.1	4,760.8	744.6	1,577.1	2,321.7	783.1	1,533.7	2,316.8	81.0	41.3	122.3	5,455.0	0.87
1953	1,532.7	3,291.5	4,824.2	675.5	1,630.8	2,306.3	779.9	1,615.1	2,395.0	77.3	45.6	122.9	5,591.0	0.86
1954				669.7	1,648.4	2,318.1	N.A.	N.A.		78.3	50.2	128.5	5,731.0	
1955	1,781.5	3,678.2	5,459.7	811.2	1,921.1	2,732.3	892.6	1,704.4	2,597.1	77.7	52.6	130.3	5,874.0	0.93
1956	1,813.5	3,733.1	5,546.6	874.1	1,923.0	2,797.1	852.7	1,756.7	2,609.4	86.7	53.4	140.1	6,021.0	0.92
1957	2,402.8	4,049.5	6,452.3	1,085.7	2,108.5	3,194.2	1,227.4	1,871.8	3,099.2	89.7	69.2	158.9	6,172.0	1.05
1958	2,367.2	4,769.8	7,137.0	1,200.0	2,464.7	3,664.7	1,070.8	2,226.7	3,297.5	96.4	78.4	174.8	6,326.0	1.13
1959	2,485.7	4,759.6	7,245.3	1,299.1	2,546.9	3,846.0	1,083.8	2,137.5	3,221.3	102.8	75.2	178.0	6,370.0	1.14
* 1960	1,343.3	2,549.1	3,892.4	759.0	1,408.6	2,167.6	525.6	1,097.1	1,622.7	58.7	43.5	102.1	6,573.0	1.18 (6)
1960/61	2,647.6	6,053.2	8,700.8	1,366.9	3,290.1	4,657.0	1,170.0	2,680.1	3,850.0	110.1	83.0	193.7	6,823.0	1.28
1961/62	3,758.6	6,084.1	9,842.7	2,435.3	3,376.4	5,811.7	1,211.0	2,603.7	3,814.7	112.3	104.0	216.3	7,082.0	1.39
1962/63	3,112.4	6,265.7	9,378.1	1,896.0	3,567.4	5,463.4	752.3 (7)	2,561.5	3,650.0 (8)	127.9	136.8	264.7	7,351.0	1.28
1963/64	3,073.8	6,039.4	9,113.2	1,597.4	3,375.6	4,973.1	1,367.0	2,549.8	3,916.8	109.4	113.9	223.4	7,630.0	1.19
1964/65													7,920.0	
1965/66	4,492.2	8,591.7	13,082.9	2,459.0	4,719.6	7,178.6	1,894.2	3,764.4	5,658.6	139.0	107.7	246.7	8,221.0	1.59
1966/67	5,351.6	9,964.8	15,316.4	3,014.1	5,440.0	8,454.1	2,158.4	4,400.5	6,558.9	179.1	124.3	303.4	8,533.0	1.60
1967/68	5,754.2	9,918.0	15,672.2	3,051.0	5,414.6	8,465.6	2,512.8	4,323.9	6,836.7	190.4	179.5	369.9	8,857.0	1.77
1968/69	6,532.7	11,293.8	17,826.5	3,441.3	6,096.0	9,537.3	2,870.9	5,013.1	7,884.0	220.5	184.7	405.2	9,191.0	1.94
(10) 1969/70			20,004.6							231.0 (9)			9,526.0	2.10 est.

Notes: * = Figures shown are for January - June 1960 only, due to change in reporting year NA = Not available

(1) All figures are given in thousands, Sub-totals may not equal totals exactly due to rounding of figures. All data except where indicated, were compiled from information available from Ministry of Health Annual Reports.

(2) This is the figure available as of March 31, 1914, for estimated total "Native Population". See Kuczynski, R. R., Demographic Survey of the British Colonial Empire, Vol. 2, (London: Oxford University Press, 1949), p. 239.

(3) Figures shown for new cases also include reattendances for this year.

(4) This is the figure available as of December 31, 1932. See Kuczynski, R. R., op.cit., p. 239.

(5) This is an estimated figure shown in the Annual Report of the Medical Department, 1951, p. 56, Table 27.

(6) This is an estimated figure, calculated by doubling the recorded number of visits in the first half of 1960.

(7) Figures for the Northern Region are not included.

(8) Figures for the Northern Region are estimated and included in the estimated figures.

(9) This number is estimated from preliminary figures.

(10) These are unofficial figures calculated from the working papers of the Ministry of Health's Statistician.

Supporting Tables to Chapter Five

D.5 Technological Matrix for Uganda Government Hospitals 1968/69

D.6 Technological Matrix for Uganda Mission Hospitals 1968/69

D.7 Technological Matrix for Uganda Government Rural Units with Beds 1968/69

D.8 Results of the O.L.S. Regression Analysis of the Factors Affecting the Total Number of Initial Demanders

D.9 Results of the O.L.S. Regression Analysis of the Factors Affecting the Rate of Successful Treatment

D.10 Results of the O.L.S. Regression Analysis of the Factors Affecting the Availability of Drugs

D.11 Results of the O.L.S. Regression Analysis of the Factors Affecting the Ugandan Governments Recurrent Health Budget

APPENDIX D

Table D.5

Technological Matrix for Uganda Government Hospitals 1968/69

O U T P A T I E N T

Service-Providing Inputs	I & P 1	NG 2	AMB 3	NS 4	Circ 5	Resp 6	Alim 7	GU 8	Preg & Puer 9	Del w/o 10	S & MS 11	NB 12	Ill Def 13	Inj 14
1. Doctors	0.0112	0.1568	0.0302	0.0147	0.0117	0.0054	0.0182	0.0352	0.1305	-	0.0116	0.1848	0.1721	0.0206
2 Med.& Nursing Assts.	0.0333	0.0289	0.0342	0.0251	0.0289	0.0318	0.0319	0.0312	0.0289	-	0.0197	0.0289	0.0395	0.0173
3 Prof. N/MW	0.0032	0.0028	0.0033	0.0024	0.0028	0.0031	0.0031	0.0030	0.0028	-	0.0019	0.0028	0.0038	0.0017
4 Enrolled N/MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5 Tr. Lab Staff	0.0896	0.0026	0.9306	0.0029	-	0.0033	-	-	0.1164	-	-	-	-	-
6 Tr. XRay Staff	0.0215	0.0418	-	0.0023	0.4216	0.0002	0.0055	0.0013	0.0101	-	0.0124	-	-	0.0742
7 O. Tr. Med. Staff	0.0263	0.0206	0.0212	0.0225	0.0167	0.0225	0.0196	0.0216	0.0212	-	0.0213	0.0213	0.0211	0.0211
8 O. Tr. Non Med. Staff	0.0780	0.1130	0.5280	0.0380	0.0371	0.0277	0.0261	0.0282	0.0929	-	0.0366	0.0362	0.1060	0.0501
9 O. Non Tr. Med. Staff	0.3813	0.3292	0.3918	0.2877	0.3385	0.3643	0.3653	0.3574	0.3303	-	0.2250	0.3287	0.4513	0.1979
10 O. Non Tr. Non Med.	0.4017	0.3468	0.4127	0.3031	0.3566	0.3838	0.3849	0.3765	0.3480	-	0.2371	0.3463	0.4754	0.2085
11 Students	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Beds	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Drugs etc.	0.9474	0.0523	3.7010	0.2587	0.6272	0.4810	0.1742	0.4848	0.0209	-	0.6705	0.1941	0.7874	0.6820
14 Food	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15 Vehicle Op. & Maint.	0.1054	0.3414	0.2332	0.1118	0.1135	0.0798	0.0798	0.0861	0.1113	-	0.1118	0.1105	0.3238	0.1533
16 Electricity	0.3829	0.2929	2.1841	0.0617	2.4531	0.0619	0.0845	0.0592	0.3717	-	0.1034	0.0477	0.0655	0.4528
17 O. Op. & Maint.	0.0748	0.0646	0.0769	0.0565	0.0664	0.0715	0.0717	0.701	0.0648	-	0.0442	0.0645	0.0886	0.0388

I N P A T I E N T

Service-Providing Inputs	I & P 15	NG 16	AMB 17	NS 18	Circ 19	Resp 20	Alim 21	GU 22	Preg & Puer 23	Del w/o 24	S & MS 25	NB 26	Ill Def 27	Inj 28	
1. Doctors	0.8935	4.5879	1.5171	1.9035	2.4198	1.0280	3.5163	7.9091	1.6818	0.4726	7.7052	1.3384	1.4474	2.7568	1
2 Med.& Nursing Assts.	-	0.3850	0.0093	0.0291	0.0015	0.0075	0.6499	1.7240	0.1576	-	1.5076	-	-	0.2460	2
3 Prof. N/MW	1.4837	5.1646	2.4599	2.9752	4.0089	1.6591	1.6970	2.1455	1.7882	0.7849	3.1860	2.2225	2.4035	3.0100	3
4 Enrolled N/MW	7.3874	27.4066	12.2889	14.9418	19.9669	8.22938	11.3049	18.2574	9.5961	3.9079	22.4873	11.0661	11.9671	16.0677	4
5 Tr. Lab Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
6 Tr. XRay Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
7 O. Tr. Med. Staff	1.1398	3.9674	1.8896	2.2855	3.0795	1.2745	1.3036	1.6481	1.3737	0.6029	2.4474	1.7073	1.8463	2.3122	7
8 O. Tr. Non Med. Staff	0.2797	0.9612	0.5025	0.4947	0.6427	0.2880	0.2933	0.3616	0.3269	0.1115	0.5257	0.3962	0.5541	0.5271	8
9 O. Non Tr. Med. Staff	5.8573	20.3886	9.7109	11.7454	15.8259	6.5496	6.6993	8.4698	7.0593	3.0985	12.5773	8.7740	9.4884	11.8826	9
10 O. Non Tr. Non Med.	10.7984	37.5881	17.9030	21.6536	29.1765	12.0748	12.3507	15.6149	13.0145	5.7123	23.1874	16.1756	17.4926	24.9066	10
11 Students	6.3880	22.2390	10.5920	12.8110	17.2620	7.1440	7.3070	9.2390	7.7000	7.3800	17.7190	9.5700	10.4500	19.9610	11
12 Beds	3.1200	10.8700	5.1700	6.2600	8.4300	3.4900	3.5700	4.5100	3.7600	1.6500	6.7000	4.6900	5.0600	6.3300	12
13 Drugs etc.	27.8138	26.6686	17.7447	18.1063	51.5499	21.1165	36.3598	94.2729	17.3592	2.2440	112.5446	10.2192	43.7548	49.8200	13
14 Food	14.3600	50.0000	23.8100	28.8000	38.8100	16.0600	16.4300	20.7700	17.3100	7.6000	30.8400	21.5200	23.2700	29.1400	14
15 Vehicle Op. & Maint.	0.2106	0.6956	0.4679	0.2204	0.2236	0.1597	0.1595	0.1736	0.2227	-	0.2233	0.2460	0.6500	0.3040	15
16 Electricity	5.4600	22.8638	9.1436	11.2424	14.7650	6.1755	12.7620	25.1900	8.619	2.8900	26.8497	8.1800	8.8400	13.5388	16
17 O. Op. & Maint.	6.0400	21.0100	10.0100	12.1000	16.3100	6.7500	6.9000	8.7300	7.2700	3.1900	12.9600	9.0400	9.7800	12.2400	17

Notes: (1) inputs 1 through 11 are measured in hours
(2) input 12 is measured in bed days
(3) inputs 13 through 17 are measured in shillings

APPENDIX D

Table D.6

Technological Matrix for Uganda Mission Hospitals 1968/69

OUTPATIENT

Service-Providing Inputs	I & P 1	NG 2	AMB 3	NS 4	Circ 5	Resp 6	Alim 7	GU 8	Preg & Puer 9	Del w/o 10	S & MS 11	NB 12	Ill Def 13	Inj 14
1 Doctors	0.0675	0.0606	0.0693	0.0509	0.0587	0.0644	0.0647	0.0637	0.0585	-	0.0399	0.0589	0.0800	0.0349
2 Med.& Nursing Assts.	0.0112	0.0100	0.0115	0.0084	0.0097	0.0107	0.0107	0.0105	0.097	-	0.0066	0.0097	0.0132	0.0058
3 Prof. N/MW	0.1423	0.1277	0.1460	0.1072	0.1237	0.1358	0.1363	0.1332	0.1234	-	0.0840	0.1241	0.1685	0.0736
4 Enrolled N/MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5 Tr. Lab Staff	0.4911	0.4015	0.5431	-	-	0.0002	0.0037	0.0039	0.0014	-	0.0393	-	0.7238	-
6 Tr. XRay Staff	0.0837	0.0480	-	0.0048	0.2113	0.0007	0.0135	0.0020	0.0088	-	0.0277	-	-	0.5645
7 O. Tr. Med. Staff	0.0060	0.0048	0.0049	0.0038	0.0053	0.0051	0.0045	0.0049	0.0048	-	0.0049	0.0048	0.0048	0.0048
8 O. Tr. Non Med. Staff	0.0102	0.0092	0.0105	0.0077	0.0089	0.0097	0.0098	0.0096	0.0089	-	0.0060	0.0089	0.0121	0.0053
9 O. Non Tr. Med. Staff	0.3668	0.3292	0.3763	0.2764	0.3188	0.3501	0.3513	0.3434	0.3180	-	0.2165	0.3198	0.4343	0.1898
10 O. Non Tr. Non Med.	0.9413	0.6694	0.5866	0.0235	1.0375	0.0035	0.0703	0.0140	0.0448	-	0.1785	-	0.7819	2.7719
11 Students	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Beds	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Drugs etc.	1.2325	0.0523	1.1649	0.2324	0.6528	0.4737	0.2805	0.5188	0.0209	-	0.6454	0.1523	0.7874	0.6662
14 Food	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15 Vehicle Op. & Maint.	0.1475	0.0001	0.1394	0.0277	0.0771	0.0568	0.0336	0.0618	0.0026	-	0.0771	0.0183	0.0950	0.0793
16 Electricity	0.6298	0.4638	0.4268	0.0777	0.6745	0.0832	0.1222	0.0878	0.0997	-	0.1535	0.0742	0.5533	1.6484
17 O. Op. & Maint.	0.2537	0.2278	0.2604	0.1012	0.2206	0.2422	0.2430	0.2376	0.2200	-	0.1498	0.2213	0.3005	0.1313

INPATIENT

Service-Providing Inputs	I & P 15	NG 16	AMB 17	NS 18	Circ 19	Resp 20	Alim 21	GU 22	Preg & Puer 23	Del w/o 24	S & MS 25	NB 26	Ill Def 27	Inj 28	
1 Doctors	0.5155	2.0793	0.6844	0.7730	1.4328	0.4628	1.0814	1.8424	1.5269	0.3054	1.5693	0.6975	0.3248	4.8387	1
2 Med.& Nursing Assts.	0.0175	0.0357	0.0233	0.0225	0.0488	0.0155	0.0179	0.0165	0.0172	0.0104	0.0244	0.0225	0.0106	0.0195	2
3 Prof. N/MW	2.0857	4.2550	2.7776	2.6807	5.8151	1.8440	2.1328	1.9718	2.0490	1.2397	2.9091	2.6767	1.2639	2.3227	3
4 Enrolled N/MW	3.1737	7.5082	4.2245	4.1903	8.8444	2.8131	3.8028	4.3630	4.1439	1.8854	5.2817	4.1093	1.9359	7.8225	4
5 Tr. Lab Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
6 Tr. XRay Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
7 O. Tr. Med. Staff	0.1032	0.2105	0.1374	0.1326	0.2876	0.0916	0.1055	0.0975	0.1014	0.0613	0.1439	0.1324	0.0625	0.1149	7
8 O. Tr. Non Med. Staff	0.0345	0.0705	0.0460	0.0444	0.0963	0.0305	0.0353	0.0327	0.0339	0.0205	0.0482	0.0443	0.0209	0.0385	8
9 O. Non Tr. Med. Staff	6.6175	13.5005	8.8129	8.5055	18.4504	5.8508	6.7669	6.2563	6.5010	3.9332	9.2300	8.4927	4.0103	7.3694	9
10 O. Non Tr. Non Med.	5.4274	11.0725	7.2279	6.9758	15.1322	4.7986	5.5499	5.1311	5.3318	3.2259	7.5700	6.9654	3.2890	6.0440	10
11 Students	6.7550	13.7811	8.9961	8.6823	18.8339	5.9724	6.9076	6.3863	6.6361	4.0150	9.4219	8.6693	4.0936	7.5226	11
12 Beds	6.7800	13.8200	9.0300	8.7100	18.9200	5.9900	6.9300	6.4100	6.6600	4.0300	9.4600	8.6900	4.0900	7.5600	12
13 Drugs etc.	11.1397	22.4133	4.3124	3.9500	14.0321	3.9935	9.4553	21.2764	18.6506	2.5000	18.1535	2.1434	5.0940	64.2129	13
14 Food	6.4427	13.1435	8.5799	8.2805	17.9625	5.6961	6.5879	6.0908	6.3291	3.8292	8.9859	8.2682	3.9042	7.1745	14
15 Vehicle Op. & Maint.	3.0890	4.4412	2.2728	2.2237	3.4336	2.2330	2.8875	4.3022	3.9886	2.0553	3.9275	2.0062	2.3633	9.4386	15
16 Electricity	3.1723	9.6608	4.2181	4.4201	8.8310	2.8266	4.9641	7.2044	6.2830	1.8826	7.0634	4.1829	1.9611	16.7668	16
17 O. Op. & Maint.	7.7261	15.7623	10.2893	9.9304	21.5414	6.8310	7.9006	7.3044	7.5901	4.5922	10.7763	9.9156	4.6821	8.6040	17

Notes: (1) inputs 1 through 11 are measured in hours
(2) input 12 is measured in bed days
(3) inputs 13 through 17 are measured in shillings

APPENDIX D

Table D.7

Technological Matrix for Uganda Government Rural Units With Beds 1968/69

OUTPATIENT

Service-Providing Inputs	I & P 1	NG 2	AMB 3	NS 4	Circ 5	Resp 6	Alim 7	GU 8	Preg & Puer 9	Del w/o 10	S & MS 11	NB 12	Ill Def 13	Inj 14
1. Doctors	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Med. & Nursing Assts.	0.0333	0.0289	0.0342	0.0251	0.0289	0.0318	0.0319	0.0312	0.0289	-	0.0197	0.0289	0.0395	0.0173
3 Prof. N/MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 Enrolled N/MW	0.0014	0.0012	0.0014	0.0010	0.0012	0.0013	0.0013	0.0013	0.0012	-	0.0008	0.0012	0.0016	0.0007
5 Tr. Lab Staff	0.0075	-	0.0021	-	-	-	-	-	-	-	-	-	-	-
6 Tr. XRay Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7 O. Tr. Med. Staff	0.0074	0.0062	0.0063	0.0049	0.0064	0.0065	0.0059	0.0063	0.0061	-	0.0056	0.0062	0.0066	0.0055
8 O. Tr. Non Med. Staff	0.0145	0.0820	0.0439	0.0225	0.0372	0.0120	0.0430	0.0226	0.0260	-	0.0389	0.0309	0.0294	0.0685
9. O. Non Tr. Med. Staff	0.1135	0.0952	0.1043	0.0785	0.0979	0.1026	0.0964	0.0996	0.0949	-	0.0798	0.0962	0.1122	0.0754
10 O. Non Tr. Non Med.	0.2479	0.2132	0.2531	0.1868	0.2118	0.2367	0.2374	0.2328	0.2160	-	0.1462	0.2156	0.2934	0.1286
11 Students	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Beds	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Drugs etc.	0.4101	0.0311	0.1825	0.1459	0.3803	0.2836	0.2070	0.2981	0.0124	-	0.3910	0.1029	0.4679	0.3489
14 Food	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15 Vehicle Op. & Maint.	0.2747	0.6267	0.4040	0.2278	0.4323	0.2042	0.4055	0.2898	0.1992	-	0.4497	0.2736	0.4091	0.6545
16 Electricity	0.0048	0.0041	0.0049	0.0036	0.0041	0.0046	0.0046	0.0045	0.0042	-	0.0028	0.0042	0.0057	0.0025
17 O. Op. & Maint.	0.681	0.0586	0.0695	0.0513	0.0582	0.0650	0.0652	0.0635	0.0593	-	0.0402	0.0592	0.0806	0.0353

INPATIENT

Service-Providing Inputs	I & P 15	NG 16	AMB 17	NS 18	Circ 19	Resp 20	Alim 21	GU 22	Preg & Puer 23	Del w/o 24	S & MS 25	NB 26	Ill Def 27	Inj 28	
1. Doctors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
2 Med. & Nursing Assts.	0.4877	0.3100	0.4884	0.4769	0.6824	0.5237	0.3833	0.4606	0.2574	0.2792	0.6041	0.3549	0.3631	0.7873	2
3 Prof. N/MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
4 Enrolled N/MW	0.1383	0.0948	0.1415	0.1395	0.1959	0.1514	0.109	0.1329	2.8414	3.0835	0.1749	0.1038	0.1048	0.2276	4
5 Tr. Lab Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
6 Tr. XRay Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
7 O. Tr. Med. Staff	0.1414	0.0916	0.1443	0.1409	0.2016	0.1547	0.1132	0.1361	0.0761	0.0825	0.1785	0.1048	0.1073	0.2326	7
8 O. Tr. Non Med. Staff	0.0339	0.1588	0.1046	0.0489	0.0477	0.0278	0.1003	0.0529	0.0606	-	0.0911	0.0545	0.0680	0.1591	8
9. O. Non Tr. Med. Staff	1.9766	1.2797	2.0164	1.9688	2.8171	2.1620	1.5826	1.9014	1.0629	1.1528	2.4940	1.4651	1.4988	3.2503	9
10 O. Non Tr. Non Med.	2.6816	1.7361	2.7356	2.6709	3.8218	2.9331	2.1470	2.5795	1.4420	1.5640	3.3835	1.9877	2.0334	4.4096	10
11 Students	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
12 Beds	3.7200	2.5000	3.8200	3.7500	5.2900	4.0700	2.9800	3.5800	2.0000	2.1700	4.7000	2.7500	2.8400	6.1200	12
13 Drugs etc.	3.9479	2.4131	1.7873	1.4122	4.6656	2.8972	1.7350	2.7995	2.0000	1.0000	4.4086	0.8277	3.7953	4.7673	13
14 Food	1.1961	0.7744	1.2202	1.1914	1.7048	1.3083	0.9577	1.1506	0.6432	0.6976	1.5093	0.8866	0.9070	1.9669	14
15 Vehicle Op. & Maint.	1.8678	2.1050	1.5110	0.9152	2.2620	1.3795	1.4557	1.5199	1.2613	0.4045	2.4675	0.7423	2.0461	3.1179	15
16 Electricity	0.4362	0.2824	0.4450	0.4345	0.6217	0.4771	0.3493	0.4196	0.2346	0.2544	0.5504	0.3233	0.3308	0.7173	16
17 O. Op. & Maint.	2.9603	1.9166	3.0199	2.9486	4.2191	3.2390	2.3702	2.8477	1.5918	1.7266	3.7352	2.1943	2.2448	4.8679	17

Notes: (1) inputs 1 through 11 are measured in hours
(2) input 12 is measured in bed days
(3) inputs 13 through 17 are measured in shillings

APPENDIX D

Table D.8

Results of O.L.S. Regression Analysis of the Factors Affecting the Number of Initial Demanders (S)

Eq. No.	Dependent Variable No. of Initial Demanders (S_1 or S_2)	N	Constant $\hat{a}$	Population Growth (O) $\hat{b}_1$	GDP Per Capita (Y) $\hat{b}_2$	Ratio: Mission to Total Health Facilities $(\frac{M}{H})$ $\hat{b}_3$	Total Number of Health Facilities (H) $\hat{b}_4$	Ratio: Rural to Total Government Facilities $(\frac{GR}{G})$ $\hat{b}_5$	R^2	$\bar{R}^2$	D.W.	Functional Form
4	S_1	20	-9,170.20		-515.89 (254.60)*		94.75 (6.00)***		.975	.972	1.91	Linear
5	S_1	20	-9,178.69		-437.08 (299.88)	-32.69 (61.84)	93.09 (6.90)***		.975	.971	1.90	Linear
6	S_1	20	10,867.51		-471.60 (251.94)*		99.68 (7.00)***	-250.73 (193.11)	.978	.973	2.01	Linear
7	S_1	20	11,896.12		-488.32 (300.38)	7.88 (70.77)	100.34 (9.32)***	-263.57 (230.35)	.978	.972	2.02	Linear
8	S_1	20	22,345.86	2.48 (0.68)***	-339.85 (226.32)	-80.88 (57.82)	43.49 (17.05)**	-397.97 (174.66)**	.989	.984	2.01	Linear
22	Log S_1	20	-2.04		-0.42 (0.43)		2.64 (0.19)***		.972	.970	1.71	Log-Log
23	Log S_1	20	-2.29		-0.81 (0.43)*	0.26 (0.13)*	2.79 (0.19)***		.978	.974	2.10	Log-Log
24	Log S_1	20	-1.13		-0.41 (0.44)		2.68 (0.25)***	-0.52 (1.92)	.973	.968	1.67	Log-Log
25	Log S_1	20	2.27		-0.92 (0.43)**	0.35 (0.14)**	3.04 (0.26)***	-2.66 (1.86)	.981	.976	2.27	Log-Log
26	Log S_1	20	2.05	1.61 (0.42)***	-0.69 (0.31)**	0.19 (0.11)*	1.53 (0.44)***	-3.83 (1.38)**	.991	.988	2.17	Log-Log
13	S_2	20	-5,833.36		-347.67 (186.47)*	60.37 (38.46)	53.39 (4.29)***		.969	.963	1.99	Linear
15	S_2	20	6,066.76		-376.61 (188.21)*	83.27 (44.34)*	57.49 (5.85)***	-148.83 (144.33)	.971	.963	2.05	Linear
16	S_2	20	12,885.79	1.62 (0.41)***	-279.72 (135.98)*	25.35 (35.74)	20.39 (10.24)*	-236.53 (104.94)**	.986	.981	2.33	Linear
31	Log S_2	20	-3.21		-0.95	0.58 (0.16)***	2.95 (0.24)***		.968	.962	1.98	Log-Log
33	Log S_2	20	2.96		-1.11 (0.55)*	0.70 (0.18)***	3.30 (0.33)***	-3.60 (2.37)	.973	.965	2.22	Log-Log
34	Log S_2	20	2.67	2.12 (0.51)***	-0.82 (0.38)**	0.49 (0.13)***	1.30 (0.53)**	-5.15 (1.68)***	.988	.983	2.37	Log-Log

*Significant at $\leq$ 0.10

** Significant at $\leq$ 0.05

***Significant at $\leq$ 0.01

APPENDIX D

Table D.9

Results of O.L.S. Regression Analysis of the Factors Affecting the Rate of Successful Treatment (a)[1]

	Constant	Index of Diagnosticians $\left(\frac{V_r}{V'_r}\right)$	Ratio of Total Expenditures to Initial Demands $\left(\frac{E}{I}\right)$	Hospital-Nonhospital Dummy HOSP	Rural Unit with Beds Nonrural Unit with Beds Dummy GRB	Government-Mission Dummy GOVMI	I & P	N	MD	NS	CIRC	RESP	ALIM	GU	Preg & Puer	Del Up	S & M S	N B	Ill Def	Inj	n	R^2	$\bar{R}^2$ [2]
Rural Health Facilities O.P.																							
RHP-1	447.70	0.59 (0.82)	0.51 (0.31)		4.40 (0.58)***		- 4.31 (14.64)		- 5.01 (14.50)	- 4.30 (14.58)		- 4.46 (14.64)	- 4.27 (14.68)	- 4.38 (14.63)	49.18 (78.51)		- 4.43 (14.63)		-14.21 (20.50)	- 4.69 (14.65)	39	.79	.69
RHP-2	1421.36	0.50 (1.47)	0.15 (0.54)				-16.27 (25.95)		-15.20 (25.70)	-13.94 (25.83)		-14.15 (25.96)	-13.87 (26.03)	-13.01 (25.96)	-10.63 (139.01)		-14.20 (25.94)		-15.47 (36.13)	-14.30 (25.98)	39	.32	.02
RHP-6	1641.14						-16.45 (23.30)		-17.41 (23.16)	-16.07 (23.27)		-16.34 (23.32)	-16.05 (23.38)	-15.14 (23.25)	-22.84 (112.70)		-16.38 (23.29)		-15.92 (34.95)	-16.75 (23.32)	39	.31	.06
Hospitals O.P.																							
HOP-4	4.84		0.06 (0.09)			10.18 (5.34)*	0.14 (0.32)					- 0.10 (0.30)	0.29 (0.64)				- 1.01 (0.59)		0.39 (0.75)	0.56 (1.14)	25	.52	.28
HOP-5	7.96		0.14 (0.09)			9.51 (5.57)	0.01 (0.13)					- 0.11 (0.24)							0.45 (0.71)	- 0.43 (1.07)	25	.40	.37
HOP-6	229.59						-1.96 (1.39)		- 3.04 (2.04)	- 2.41 (1.52)		- 2.32 (1.38)	- 1.74 (1.44)	- 0.78 (1.50)	- 3.20 (1.87)		- 2.93 (1.18)***		- 1.98 (1.61)	- 3.01 (2.11)	25	.57	.26
Rural Health Facilities and Hospitals O.P.																							
RHH-1	244.55	-0.71 (1.87)	0.13 (0.07)*		3.01 (1.74)***		-2.32 (0.72)***		- 3.08 (1.05)***	- 2.39 (0.80)***		- 2.39 (0.71)***	- 2.37 (0.74)***	- 1.23 (0.83)	- 2.71 (1.03)**		- 2.34 (0.72)***		- 2.81 (0.81)***	- 2.90 (0.81)***	64	.77	.71
RHH-2	299.46	3.96 (2.27)*	0.08 (0.07)	4.38 (2.60)*	5.96 (1.68)***	9.33 (3.00)***	-2.37 (0.67)***		- 3.37 (0.99)***	- 2.20 (0.74)***		- 2.36 (0.66)***	- 2.33 (0.69)***	- 1.42 (0.76)*	- 3.00 (0.97)***		- 2.58 (0.66)***		- 2.42 (0.76)***	- 2.75 (0.75)***	64	.81	.70
RHH-9	302.70						-2.85 (0.77)***		- 3.95 (1.11)***	- 2.39 (0.86)***		- 2.93 (0.76)***	- 3.01 (0.78)***	- 0.83 (0.87)	- 3.68 (1.07)***		- 3.16 (0.75)***		- 3.57 (0.85)***	- 3.66 (0.83)***	64	.70	.65
Hospitals I.P.																							
HIP-4	-0.72	-0.30 (0.58)	0.00 (0.01)				0.54 (0.35)		0.29 (0.10)***			- 0.01 (0.09)	- 0.12 (0.10)		0.09 (0.08)	0.05 (0.04)				0.28 (0.15)*	25	.61	.37
HIP-5	4.92		-0.00 (0.01)				0.01 (0.04)					- 0.16 (0.08)*	- 0.02 (0.11)		0.11 (0.07)	-0.03 (0.04)					25	.34	.33
HIP-7	4.18						0.01 (0.37)					- 0.16 (0.08)*	0.03 (0.11)		0.12 (0.08)	-0.03 (0.04)					25	.35	.13

*Significant at 0.10 Level
**Significant at 0.05 Level
***Significant at 0.01 Level

[1] The regression results presented in this table are for the dependent variable 1-a. It may be interpreted as the rate of "unsuccessful treatment".

[2] The $\bar{R}^2$ is generally much lower in value than the R^2 figure due to the large number of independent variables included in the regression and the limited number of observations.

APPENDIX D

Table D.10

Results of O.L.S. Regression Analysis of the Factors Affecting Drug Imports (VNI)

Eq. No.	Dependent Variable[1]	N	$\hat{a}$	Total Monetary GDP[1] $\hat{b}_1$	Capacity to Import[1] $\hat{b}_2$	Total Import $\hat{b}_3$	Total Number of Initial Demanders New and Reattendances $\hat{b}_4$	b_4 Lagged by One Year $\hat{b}_5$	R^2	$\bar{R}^2$	D.W.	Functional Form
2	V_{N1}	16	-0.479	0.0087 (0.0005)***	0.0003 (0.0030)				.97	.96	2.31	
3	V_{N1}	16	-0.478	0.0089 (0.0013)***		-0.0002 (0.0027)			.97	.96	2.33	
5	V_{N1}/W_N	16	-0.181	0.0056 (0.0005)***	0.0023 (0.0027)				.93	.92	1.76	
6	V_{N1}/W_N	16	-0.167	0.0062 (0.0013)***		-0.0009 (0.0027)			.93	.92	1.81	
9	V_{N1}	16	-0.449	0.0083 (0.0018)***			0.000003 (0.000010)	0.809	.97	.96	2.33	
10	V_{N1}	16	-0.396	0.0073 (0.0016)***				0.00001 (0.00001)	.97	.96	2.26	
12	$\text{Log}_{\text{Log}}\ V_{N1}$	16	-4.163	1.874 (0.120)***	0.010 (0.109)				.96	.95	1.52	
13	$\text{Log}_{\text{Log}}\ V_{N1}$	16	-4.256	2.003 (0.289)***		-0.101 (0.214)			.96	.95	1.64	
19	$\text{Log}_{\text{Log}}\ V_{N1}$	16	-4.158	1.855 (0.458)***			0.012 (0.225)		.96	.95	1.51	
20	$\text{Log}_{\text{Log}}\ V_{N1}$	16	-4.163	1.795 (0.422)***				0.045 (0.219)	.96	.95	1.49	
1	V_{N1}	16	-0.476	0.0088 (0.0004)***					.97	.96		
11	Log V_{N1}	16	-4.160	1.878 (0.107)***					.96	.95		

[1]Measured in Shillings.

*Significant at $\leq$ 0.10

**Significant at $\leq$ 0.05

***Significant at $\leq$ 0.01

APPENDIX D

Table D.11

Results of O.L.S. Regression Analysis of the Factors Affecting the Recurrent Government Budget for Health (VGB).

Eq. No.	Dependent Variable	N	$\hat{a}$	Total Monetary GDP $\hat{b}_1$	Proportion of Govt. Recurrent Budget Spent on Health $\hat{b}_2$	Proportion of Govt. Rural Health Facilities is of Total Govt. Health Facilities. b_3	Govt. Capital Budget for Health $\hat{b}_4$	Govt. Capital Budget Lagged One Year $\hat{b}_5$	Govt. Capital Budget Lagged Two Years $\hat{b}_6$	R^2	$\bar{R}^2$	D.W.	Functional Form
6	VGB	20	-68.87	0.034 (0.005)***	3.261 (1.243)**		0.478 (0.241)*			.97	.97	1.75	
7	VGB	20	-73.52	0.034 (0.003)***	3.625 (0.872)***			0.561 (0.166)***	0.004	.98	.98	1.81	
16	VGB	20	-91.58	0.039 (0.003)***	4.741 (0.964)***				0.331 (0.216)	.97	.96	1.90	
19	Log VGB Log	20	-6.84	2.275 (0.990)***	0.853 (0.181)***					.97	.97	1.78	
20	Log VGB Log	20	-18.23	1.700 (0.139)***	1.171 (0.200)***	6.176 (2.415)**				.98	.98	1.58	
24	Log VGB Log	20	-5.47	1.899 (0.198)***	0.637 (0.194)***		0.100 (0.047)**			.99	.98	1.65	
25	Log VGB Log	20	-5.77	1.959 (0.152)***	0.759 (0.162)***			0.086 (0.034)**		.98	.98	2.02	
34	Log VGB Log	20	-6.05	2.026 (0.152)***	0.843 (0.166)***				0.069 (0.034)*	.98	.97	2.25	
1	VGB	20	-98.13	0.043 (0.002)***	4.923 (0.994)***					.97	.96	1.62	
2	VGB	20	-249.68	0.040 (0.003)***	5.784 (1.279)***	1.607 (1.513)				.97	.96	1.38	

*Significant at $\leq$ 0.10

**Significant at $\leq$ 0.05

***Significant at $\leq$ 0.01

Supporting Tables to Chapter Six

D.12 Results of O.L.S. Regression Analysis of the Demand for Employees in Uganda Using 1960 GDP Series Data

D.13 Results of O.L.S. Regression Analysis of the Demand for Employees in Uganda Using 1966 GDP Series Data

D.14 Estimated Health Expenditures by District in Uganda: 1968/69

APPENDIX D.

Table D.12

Results of O.L.S. Regression Analysis of the Demand for Employees in Uganda Using 1960 GDP Series Data

Linear Functional Form

Industry	$\hat{a}$	$\hat{b}_1$ VA60		$\hat{b}_2$ W		R_2	$\bar{R}_2$	d_w	$\overline{VA60}$	$\bar{W}$	$\bar{E}$	$r_{VA60,w}$
Agriculture	36.447	0.287	(0.115) .027	-0.003	(0.0031 .311	0.623	0.565	2.28 A	51.15	961.16	48.29	.943
Forest Fishing Hunting	3.395	0.4438	(0.3881) .273	-0.0006	(0.0004) .145	0.169	0.042	2.03 A	2.41	1454.16	3.53	.885
Mining and Quarrying	8.337	-2.4424	(0.7296) .005	0.0019	(0.00056) .005	0.472	0.391	1.90 A	2.40	1752.15	5.82	.931
Manufacture of Food Products	3.949	4.3713	(1.9420) .042	0.00054	(0.00062) .398	0.281	0.170	1.03 D	1.33	1608.28	8.90	.373
Miscellaneous Manufacturing	6.358	1.5993	(0.5143) .008	0.0018	(0.00075) .031	0.819	0.791	1.33 D	5.40	1970.21	18.57	.739
Construction	9.670	5.3358	(0.9626) <.0005	-0.00003	(0.0020) .987	0.730	0.689	1.42 D	4.48	1488.96	33.52	-.354
Commerce	2.216	0.6256	(0.3095) .064	-0.0012	(0.0011) .268	0.467	0.385	0.69 B	16.13	2424.51	9.35	.958
Transport and Communication	6.762	0.9907	(0.3738) .020	-0.0014	(0.0007) .078	0.535	0.464	1.21 D	6.45	2554.40	9.62	.972
Local Government	1.701	14.9100	(1.4023) <.0005	-0.0021	(0.0007) .011	0.989	0.987	1.15 D	2.10	1551.55	29.82	-.917
Miscellaneous Services	0.346	3.8135	(0.3857) <.0005	-0.0017	(0.0011) .142	0.977	0.973	1.95 A	12.01	2534.52	41.74	.933
Education Services												
Health Services												
Entire Economy	55.611	2.2391 .001	(0.5571)	-0.0516 .008	(0.0164)	0.704	0.658	1.27 D	119.72	1798.66	230.82	.979

Linear in Logarithmic Functional Form

Industry	$\hat{a}$	$\hat{b}_1$ VA60		b_2 W		R_2	$\bar{R}_2$	d_w	$\overline{VA60}$ Log	$\bar{W}$ Log	$r_{VA60,w}$	$\bar{E}$ Log
Agriculture	1.339	0.294	(0.115) .023	-0.053	(0.048) .287	0.587	0.524	2.22 A	1.70	2.94	.929	1.68
Forest Fishing Hunting	1.150	0.3282	(0.2987) .292	-0.2326	(0.1685) .191	0.133	0.000	1.95 A	0.369	3.124	.896	0.544
Mining and Quarrying	-0.948	-1.2502	(0.3606) .004	0.6800	(0.2048) .006	0.481	0.401	2.37 A	0.353	3.158	.960	0.763
Manufacture of Food Products	1.197	0.6290	(0.2939) .052	-0.1043	(0.0890) .262	0.269	0.157	1.01 D	0.119	3.159	.343	0.942
Miscellaneous Manufacturing	0.353	0.3582	(0.1548) 0.38	0.1998	(0.0791) .025	0.747	0.708	1.28 D	0.722	3.253	.695	1.261
Construction	1.074	0.7591	(0.1097) .0005	-0.0136	(0.0703) .851	0.819	0.791	1.45 D	0.641	3.150	-.406	1.518
Commerce	1.055	1.9344	(0.8865) .048	-0.7212	(0.4732) .151	0.557	0.489	0.91 B	1.192	3.328	.983	0.960
Transport and Communication	1.583	0.6538	(0.2859) .040	-0.3317	(0.2093) 1.37	0.521	0.447	1.13 D	0.792	3.376	.976	0.981
Local Government	1.165	1.2779	(0.1146) <.0005	-0.0343	(0.0398) .404	0.979	0.976	1.14 D	.316	3.133	-.875	1.461
Miscellaneous Services	0.778	1.0973	(0.1207) <.0005	-0.1009	(0.0661) .151	0.974	0.970	1.86 A	1.065	3.359	.938	1.608
Education Services												
Health Services												
Entire Economy	1.197	1.1626	(0.2162) <.0005	-0.3870	(0.0877) .001	0.756	0.718	1.78 A	2.070	3.207	.971	2.362

Notes:

(1) n=16 observations

(2) For details of model specification and data sources see notes to Table 6.10

(3) VA60 = Value added in shillings in 1960 prices
W = Wages per employee
E = Number of Employees in Industry

(4) The line over the top of the variable designation represents the average

APPENDIX D

Table D.13

Results of O.L.S. Regression Analysis of the Demand for Employees in Uganda Using 1966 GDP Series Data

Industry	Linear Functional Form $\hat{a}$	$\hat{b}1_{VA66}$		$\hat{b}_{2\,w}$		R^2	$\bar{R}^2$	dw	$\overline{VA66}$	$\bar{W}$	$\bar{E}$	$r_{VA66,w}$	Linear in Logarithmic Functional Form $\hat{a}$	$\hat{b}1_{VA66}$		$\hat{b}_{2\,w}$		R^2	$\bar{R}^2$	dw	$\overline{VA66}$	$\bar{W}$	$\bar{E}$	$r_{VA66,w}$
Agriculture	35.762	0.0045	(0.0046) .360	0.0053	(0.0039) .222	0.763	0.684	1.54 A	1415.11	1288.27	49.03	.856	0.903	0.1285	(0.1473) .417	0.1234	(0.1035) .278	0.724	0.633	1.43 D	3.146	3.101	1.690	0.865
Forestry, Fishing, Hunting	4.191	0.0134	(0.0255) 0.619	- .00085	(0.00093) .396	0.175	0.000	2.23 A	64.22	1895.3	3.44	.895	1.399	0.1851	(0.4659) .705	-0.3667	(0.4471) .443	0.158	0.000	2.35 A	1.799	3.269	0.533	.878
Mining and Quarrying	6.994	-0.0530	(0.0442) .275	0.0012	(0.0005) .060	0.473	0.298	2.31 A	76.00	2485.4	5.90	.602	0.665	-0.8437	(0.5877) .201	0.4989	(0.2119) .057	0.482	0.309	2.12 A	1.879	3.381	0.766	.675
Manufacture of Food Products	4.088	0.0665	(0.1419) .656	0.0015	(0.0024) .542	0.111	0.000	0.98 B	25.22	2151.93	9.04	.158	-0.610	0.1562	(0.3433) .665	0.4030	(0.5104) .460	0.134	0.000	1.10 D	1.395	3.330	.950	.121
Misc. Manufacturing	1.579	0.1433	(0.0356) .007	-0.0057	(0.0028) .090	0.903	0.871	1.88 A	233.55	2593.54	20.39	.957	-0.112	1.6168	(0.3582) .004	-0.7059	(0.2921) .052	0.905	0.873	2.03 A	2.360	3.402	1.303	.951
Construction	7.395	0.4241	(0.0725) .001	-0.0089	(0.0040) .068	0.885	0.847	2.88 D	94.67	1837.71	31.17	.764	0.612	1.2448	(0.2324) .002	-0.4841	(0.2236) .074	0.862	0.816	2.62 D	1.969	3.257	1.487	.761
Commerce	13.061	-0.0075	(0.0076) .364	-0.0009	(0.0009) .325	0.165	0.000	1.37 D	767.11	3263.16	10.30	.963	1.220	-0.1815	(0.7112) .807	0.0902	(0.3297) .794	0.013	0.000	1.12 D	2.880	3.489	1.012	.974
Transport and Communication	6.884	0.0279	(0.0114) .051	-0.0009	(0.0007) .244	0.714	0.618	3.12 C	211.11	3255.17	9.80	.942	0.679	0.6021	(0.2814) .076	-0.3094	(0.2545) .270	0.655	0.540	3.03 C	2.317	3.503	0.990	.950
Local Government																								
Misc. Services	1.880	0.1380	(0.0318) .005	-0.0021	(0.0032) .540	0.918	0.890	1.71 A	385.78	3355.59	48.03	.888	-0.532	1.1853	(0.3430) .014	-0.2421	(0.2834) .426	0.881	0.842	1.72 A	2.577	3.512	1.672	.915
Education Services	2.822	0.1830	(0.0343) .001			0.802	0.774	1.82 A	103.44		21.75		-0.360	0.8405	(0.2129) .006			0.690	0.646	1.73 A	1.99		1.31	
Health Services	1.002	0.2137	(0.0257) <.0005	-0.0003	(0.0011) .824	0.972	0.961	1.90 A	60.50	3585.04	12.99	.786	-0.187	0.9869	(0.1397) .001	-0.1289	(0.3608) .736	0.961	0.946	1.88 A	1.774	3.553	1.107	0.794
Entire Economy	70.288	0.059	(0.025) .134	-0.029	(0.038) .474	0.758	0.678	1.44 D	3946.0	2404.62	234.20	.974	-0.335	1.110	(0.577) .103	-0.381	(0.363) .334	0.733	0.644	1.62 A	3.591	3.369	2.368	.973

A=Accept Ho - No auto correlation
B=Reject Ho - Positive auto correlation 5% level of acceptance
C=Reject Ho - Negative auto correlation 5% level of acceptance
D=Unclear

Notes:

(1) n=9 observations
(2) For details of model specification and data sources see notes to Table 6.10
(3) VA66 = Value added in shillings in 1966 prices
W = Wages per employee
E = Number of employees in industry
(4) The line over the top of the variable designation represents the average

APPENDIX D

Table D.14

Estimated Helath Expenditures by District in Uganda: 1968/69

	Central Govt. Hospitals	District Admin.	Cities and Munic.	Total Government	Catholic Hospitals	Catholic MC's & Disp's	Protestant Hospitals	Total Govt. and Private	Persons 1969	Shs/Capita Dist. Adm.	Shs/Capita Total
Buganda	8,403,747	5,810,433	904,518	15,118,698	1,639,415	510,555		17,268,668	2,336,632	2.49	7.39
E. Mengo	1,972,444	1,560,778	177,720	3,710,942	221,473	226,006		4,158,421	851,583	1.84	4.88
W. Mengo	1,514,347	1,620,288	226,798	3,361,433	330,324	119,375		3,811,132	513,498	3.16	7.42
Mosaka	3,128,048	1,578,102	500,000	5,206,150	1,087,618	98,051		6,391,819	640,596	2.46	9.98
Mubende	1,788,908	1,051,265		2,840,173		67,123		2,907,296	330,955	3.18	8.78
East	9,094,604	7,911,865	1,603,565	18,610,034	821,560	656,306	442,661	20,530,561	2,480,490	3.19	8.28
Busoga	1,377,831	2,783,144		4,160,975	559,402	69,326		4,789,703	896,875	3.10	5.34
Bugisu	4,116,340	1,099,261	1,103,637	6,319,238		84,725		6,403,963	397,889	2.76	15.20
Bukedi	1,771,346	1,651,635	223,830	3,646,811	262,158	215,465		4,124,434	527,090	3.13	7.82
Sebei	433,904	251,337		685,241		27,712		712,953	64,464	3.90	11.06
Teso	1,395,183	2,126,488	276,098	3,797,769		259,078	442,661	4,499,508	570,628	3.73	7.89
North	7,544,774	5,366,689	800,460	13,711,923	1,589,065	455,472	373,945	16,130,405	1,915,966	2.80	8.42
Karamoja	813,247	1,012,715	125,091	1,951,053		62,895	151,945	2,165,893	284,067	3.57	7.62
Acholi	2,409,803	1,274,112	274,257	3,958,172	1,033,757	38,989		5,030,918	463,844	2.75	10.85
Lango	2,504,834	1,278,462	199,250	3,982,546	309,500	111,406		4,403,452	504,315	2.54	8.73
W. Nile	1,327,466	1,423,298	179,724	2,930,488	245,808	242,182	222,000	3,640,478	573,762	2.48	6.34
Madi	489,424	378,102	22,137	889,663				889,663	89,978	4.20	9.89
West	9,278,904	5,367,120	960,976	15,607,000	1,032,867	286,788	778,561	17,705,216	2,432,550	2.21	7.28
Kigezi	2,253,682	1,028,660	261,970	3,544,312	513,597		167,017	4,224,926	647,988	1.59	6.52
Ankole	1,943,239	1,825,850	166,182	3,935,271	69,022	148,091	271,788	4,424,172	861,145	2.12	5.14
Toro	2,514,802	1,064,578	261,836	3,841,216	450,248	67,392	339,756	4,698,612	571,514	1.86	8.22
Bunyoro	2,567,181	1,448,032	270,987	4,286,200		71,305		4,357,505	351,903	4.11	12.33
Kla	26,333,893		9,020,160	35,354,053	3,020,015		1,295,440	39,894,068	330,700		120.64
Jinja	4,390,422		3,380,000	7,770,422				7,770,422	52,509		147.98
Totals	65,046,344	24,456,107	-16,669,679	106,172,130	8,102,922	1,909,121	3,115,167	119,299,340	9,548,847		12.49
Total excl. Kla & Jinja	34,332,092	24,456,107	- 4,269,519	63,057,718	5,082,907	1,909,121	1,595,167	71,644,913	9,165,638	2.67	7.82

Note: All figures are in Ugandan Shillings (shs.)

APPENDIX E

Notes to Tables Included in the Text

E.I Notes for Table 2.8

E.II Notes to Table 2.9

E.III Notes to Table 2.10

E.IV Notes to Table 6.11

APPENDIX E.I

Notes for Table 2.8

E = Estimated on the basis of expenditures of recent periods.

E-1 = Estimated on the basis of partial figures. Kampala and Mbale figures for the year 1969.

(1) Excluding expenditures on environmental health services such as water supplies and sewer systems. All figures include recurrent and capital expenditures.

(2) The figure for central government expenditure on health does not include health expenditures made by the Army, Prisons, vocational rehabilitation schools, of the Department of Labor on occupational hygiene. An estimate of the health expenditures of these four units is difficult, at best. A figure for the Army and Prisons can be estimated from the number of beds in facilities they operate, assuming that the average cost per bed in other facilities is similar; this figure, in the case of the Army, can be corraborated by a constant percentage estimate of total expenses for purchases of drugs from the Ministry of Health (this would be a minimum estimate, because the Army very likely purchases some drugs and equipment from private chemists). A minimum estimate of the Department of Labor's expenditures on health can be made from establishment available in the annual estimates. Figures for operating rehabilitation programs and schools for the handicapped are available in the annual government estimates.

The estimated recurrent expenditure for health made by these different programs and departments is shown below for the year 1968/69 (in thousands of shillings):

(1) Army		
One hospital, 35 beds	220.00	
Six sub-dispensaries (estimated minimum), assuming 0 beds	200.00	
		420.00
(2) Prisons		
10 units, with 141 beds (1966/67)	380.00	380.00
(3) Ministry of Labor - Occupational Hygiene Section		
Eight persons	120.00	
Other expenses	40.00	
		160.00
(4) Ministry of Culture and Community Development - Vocational Rehabilitation	752.00	752.00
(5) Schools for Handicapped Children	87.00	87.00
Total		1,799.00

(3) All Urban Authority expenditures are for preventive health services and are related primarily to environmental health services, such as malaria control, public conveniences, rodent and pest control, Abattoir cleanliness, and refuse collection.

(4) Data for government expenditures are derived from various issues of (a) Uganda's Statistical Abstract, (b) Government Estimates of Development and Recurrent Expenditures, (c) District and Municipal Estimates and Financial Statements. The latter two sources (b and c) were used for estimating the most recent year's expenditures.

(5) These figures do not include the cost to mission organizations of high level expatriate personnel or gifts of drugs and equipment.

(6) Estimated from recent figures and corraborated with data available in Health and the Developing World by John Bryant (Ithaca: Cornell University Press, 1969), p. 267.

(7) The estimated figures for 1958/59 and 1963/64 are speculative and were made solely on the basis of (a) whether the service existed and (b) in the case of Army and Prisons, some idea as to the number of beds in the facilities.

(8) Data taken from W.H.O. official records, financial reports for various years, and from UNICEF (Regional Office), Progress Report 1969 (Kampala, 1970). Expenditure data were converted from U.S. dollars to Uganda shillings at the official rate of exchange: U.S. $1 = 7.14 U. shs.

(9) Expenditures by industrial firms on health services were estimated on the basis of an estimated average recurrent cost per bed per year for each of the three years. This estimate, thus, is solely for medical care services and does not include the cost incurred by the firms for preventive services and plant safety.

In 1968/69, the average recurrent cost per bed in a 100-bed government hospital was approximately 10,000 shs. Corresponding figures for Protestand and Catholic mission hospitals were 5,150 shs. and 3,090 shs., respectively. The mission figures, however, do not include all of the costs of expatriate skilled manpower, particularly in the case of the Catholic units, or the value of donated drugs and equipment. Using these figures as a guide, and considering that very large costs are not allowed for by mission facilities at present, a figure of 8,000 shs. per bed per year was arrived at and used as an estimated cost figure for industrial firm medical care services. The number of industrial firm beds for the three years is found in Annual Reports of the Ministry of Health. The average cost per bed figure was adjusted further for rises in the price of resources. From 1961 to 1969, retail prices in Kampala for all income classes rose 44% (see Table UO 1(a), (b), and (c), Statistical Abstract 1969). In terms of increases in the private medical sector, wages rose 49% from 1959 to 1968, and 27% from 1963 to 1968. Using these figures as a basis, it was assumed that the average recurrent cost per bed rose by 40% from 1958/59 to 1968/69, and 25% from 1963/64 to 1968/69. The figures, thus, are derived as follows:

1958/59	350 beds x 5,700 shs. per bed =	1,995,000 shs.
1963/64	395 beds x 6,400 shs. per bed =	2,528,000 shs.
1968/69	477 beds x 8,000 shs. per bed =	3,816,000 shs.

(10) An estimate of the expenditures on specific health projects funded by internal to international sources is very difficult to obtain. Some of these organizations assist in medical research, others fund special projects (such as the Ankole Preschool Protection Programe or the Uganda Foundation for the Blind/U.S. Peace Corps National Campaign Against Trachoma), and others assist various Ministry of Health Programs (such as the National Immunication Team or food supplements for small children).

For the earliest two periods, 1950/59 and 1963/64, an estimate is not attempted, but the fact that a certain level of expenditure did occur at these times is indicated by a token 0.5 million shs. For the latter period, a minimum estimate will be made from available data. The expenditures for some programs or organizations are not available to the author at this time, so that this minimum estimate is subject to upward revision at a future time. The following list of organizations and the specific program funded (if any), and the level of expenditure by the organization is indicated below:

Oxfam	Ankole PPP; medical research	255,800 shs.	(PPP)
Uganda Foundation for the Blind	Trachoma campaign	119,182	
Uganda Red Cross			
Save the Children Fund			
Swedish Red Cross	Refugee Health services	70,000	(min)
U.S. A.I.D.			
U.S. Peace Corps	Trachoma campaign	1,000,000	($7,000/ vol. for 20 vols.)
British V.S.O.	Protestant Medical Bur. study	15,000	
Nuffield Foundation	Research		
Obote Foundation	Nutrition, polio immunization	100,000	(min)
	Estimated minimum total	1,559,982	

This list is not exhaustive. It does indicate, however, that such sources spend fairly large sums on various services. Additional research in this area is indicated. Private Family Planning Services will be included in any revision made.

(11) Data is taken from Table UM.15 of the Uganda Statistical Abstract for the years 1962, 1967, 1968, and 1969. The assumption was made that one-third of the medical research and health expenditures of the East African Common Services Organization was spent in Uganda.

(12) Private consumption expenditures on health were estimated as follows. Over the ten years since 1958, the Uganda Government has taken periodic expenditure surveys of unskilled African workers (and coffee growers in the Buganda Region) in various cities through the country. One expenditure

item classified for the survey was medicine. According to the data collected on total and medicine expenditure for 26 classifications of workers (classified by income and social variables, such as tribe), medical expenditures comprised 1.54% of the total expenditures by workers. It is recognized that other socio-economic groups (either Europeans, Asians, or Africans with a higher or lower - i.e., subsistence - income) may spend a greater or smaller percentage of their income on medicine and other health items, but this estimate is taken to be a first approximation.

Given this figure (1.54%) the total private expenditure on health for the year 1961 was estimated by multiplying it by the estimated total paid employment compensation (wages) figure in gross domestic product estimates by source of income. It is likely that a certain proportion of the rent and profit component of national income is also spent on health, but there is no evidence available on which to base an estimate.

To make estimates for other years - before and after 1961 - the following equation was used:

$d_i = p + y\, n_i$, where

d = the rate of increase in demand for commodity i (i-health),

y = the rate of increase in income (total paid employment compensation was used as a proxy for this item, with awareness of potential problems of shifts in the distribution in income or in the proxy variable, and the problem of failing to allow for price changes,

n_i = income elasticity of demand for commodity i.

p = rate of change in total population.

As an estimate of population changes, 1959 and 1969 census figures were used. (1959 figures are available from published sources and the preliminary figures for 1969 are available from the Ministry of Planning and Economic Development). During the decade of the 1960's, the rate of natural increase of the population (excluding net in-migration during the period) was 3.3% per year.

For an estimate of the income elasticity of demand for health service expenditures, a value estimated from recent Kenyan data was used: see Massell, Benton and Heyer, Judith, "Household Expenditure in Nairobi: A Statistical Analysis of Consumer Behavior," Economic Development and Cultural Change, Jan. 1969, pp. 212-234. Massell and Heyer estimated five values for the income elasticity of demand for health expenditures, using several different functional forms, and the values varied from 1.07 to 1.42, with three of the values around 1.20 - 1.25. A simple average of the five estimates (1.22) was used for estimation purposes.

Because the definition of health services (from drug purchases to private medical care to the services rendered by traditional healers) varied in scope (primarily in the narrow direction) in the several studies used to obtain estimated values of the variables required, and because the proxy variable used for income does not allow for expenditures in health out of profits (surpluses) and rents, the estimate is a minimal estimate.

APPENDIX E.II

Notes to Table 2.9

(1) Expenditures are reported in millions of shillings.

(2) Non-direct services includes administrative services, manpower training services, and research services related to delivery of curative or preventive health services.

(2) The estimation procedure used to allocate Ministry of Health expenditures involved (a) analysis of each line item in the Ministry's recurrent and capital budget for 1968/69 and (b) deletion of those items which were related to preventive or other health services. The estimated expenditure on curative services is thus a residual estimate. Those line items which included expenditures for all three categories of service - such as personal emoluments, transportation, office, and miscellaneous expenses - were segregated according to the percentage of total Ministry employees directly employed in delivering that category of service. A further check was made of the relative distribution of personnel according to pay scales to determine whether there were significant differences between the three groups. There did not appear to be any major differences, so that for a first approximation these line items were allocated according to each service type's percentage of total employment. The percentages for 1968/69 were as follows: 8.25% for preventive services, 9.25% for other (non-direct) services, and the remaining 82.50% to curative services.

With further analysis of expenditures at the hospital level (which will be undertaken in the near future), a reallocation of the percentages could occur. Such a reallocation would increase the percentage of the total manpower commitment engaged in preventive services. At this time, the magnitude of this shift cannot be predicted. Therefore, the figures for preventive services should be viewed as minimum estimates and correspondingly the curative estimate is likely to be a maximum figure.

Within a year or so, budget estimates for all Ministries in the central government will be presented on a program basis with line items within each program. This budgetary procedure will facilitate the analysis undertaken in Table 2.9.

(4) For a first approximation, the expenditures of two districts (Ankole and Busoga) for 1969 were analyzed by line item, including personal emoluments, and the percentage estimates of the two districts' recurrent health budgets used in the delivery of the three types of service were obtained in this way. The results were as follows: 1% to other (non-direct) services, 31% to preventive services, and 68% to curative services. These percentages were applied to the total 1969 recurrent health expenditures (estimates in the case of ten districts) for all 17 districts in Uganda in order to obtain the estimates presented in the Table. It was assumed that all capital expenditures were related to expanding the

curative service system. This assumption will subsequently be checked and some shifting is likely to occur (particularly in relation to new health center construction), but the amount of shifting is unlikely to have a major impact on the conclusions to be drawn from the data presented in Table 2.9.

(5) Expenditures on curative services were estimated directly from the municipalities' financial reports. The remainder of the municipalities' health expenditures were related to preventive services, primarily of a societal nature. (See Appendix A for explanation of the distinction between individual and societal preventive health services.)

(6) The mission medical services were allocated between curative and other health services on the basis of 1968/69 recorded expenditures. The other health expenditures were for medical manpower training programs (nurses and midwives) operated by mission hospitals. On more thorough analysis of mission hospital data, expenditures on preventive services will be included, thereby decreasing the total curative expenditure.

(7) The allocation of W.H.O. expenditures was made on the basis of an analysis of the estimated 1969 program budget for Uganda, wherein each W.H.O. program or project is listed separately. In addition, an estimate was made of the total expenditures by the Office of the W.H.O. Representative to Uganda, and this figure was included in the Other (Non-direct) Services category.

(8) The analysis was made on the basis of figures shown in Note 10, for Table 2.8, Appendix E.I. Undoubtedly, the figures may change upon receipt of additional information.

APPENDIX E.III

Notes to Table 2.10

(1) The period of time is dependent upon the reporting period used by the various units. Hospital data is for 1968/69; other facility data is for 1969.

(2) Personnel emoulments do not include the cost of fringe benefits such as social security, retirement, and workman's compensation.

(3) The estimated expenditure for the Health Center does not include the percentage of the total expenditure used to operate one or two weekly Aid Posts, which involves transporting of staff and some supplies from the Health Center to the site of the Aid Post.

(4) Figures for maintenance and repair costs are not available due to the accounting proceedures used by the Department of Public Works, which has responsibility for these services. This figure is therefore not included in the total estimated expenditure for hospitals.

(5) Skilled personnel refers to persons who have received some formal training (medical or public health) necessary to fill the position they hold.

(6) Total employment figure for the large hospital does not include the 40 or more students in the training schools adjacent to the hospital who work in the hospital as a part of their training.

APPENDIX E.IV

Notes to Table 6.11

(1) Not all industries are included in the list. It is assumed that those not included do not have significant purchases made from them by the health service industry. This assumption is based on an analysis of financial statements of the respective governmental admission sectors of the health services industry.

(2) Source: an analysis of the 1968/69 financial statements from the appropriate jurisdictions responsible for health services in the central, districts and municipal governments and the Protestant and Catholic mission organizations.

(3) Estimates are rounded to the nearest ten employees.

(4) The estimated secondary employment impact in Agriculture was made as follows. I took the monetary sectors estimated value, added in agriculture (for 1968 and 1969) per Table 1.2 in the Republic of Uganda, Background to the Budget 1970-71, Statistics Division, Ministry of Planning and Economic Development, Entebbe, 1970, and made an assumption that it represented 80% of total receipts by that sector. I divided each year's figure by two to get an estimate of receipts for each half of the 1968/69 fiscal year. These estimates were added together and were divided by the estimated number of total employees in agriculture for the fiscal year 1968/69 (by averaging the 1968 and 1969 figures in the same manner as described above), per the Republic of Uganda's Enumeration of Employees, June 1963 and 1969.

Est. Receipts in Agriculture (mill. shs.)	Est. Total Employees (thousands)	Est. Receipts per Employee Ratio (mill. shs)
2092.9	52.85	0.0396

(5) The receipts-per-employee ratio was estimated from data in Republic of Uganda, Survey of Industrial Production, 1967, Statistics Division, Ministry of Planning and Economic Development, Entebbe, 1969. Table 3.118, p. 83.

(6) Receipts-per-employee ratio was estimated from data in Uganda Government, Survey of Indistrial Production: Building and Construction, 1964, Statistics Division, Ministry of Planning and Community Development, 1964. Appendix Table 1. Labor productivity data in construction was analyzed to determine the extent to which the figures should be adjusted to reflect the 1968/69 situration. The annual rate of increase in productivity over that period was about 0.5%

(7) The industry receipts from health services is estimated as follows:

		mill. shs.	mill. shs.
(a)	Drugs and Equipment	19.10	
	Less Direct Imports	2.47	16.63
(b)	Misc. Commerce Purchases		0.28
(c)	Transport, Petroleum and Related Purchases		4.72
	TOTAL		21.63

The receipts-per-employee ratio was estimated from data in The Republic of Uganda, Census of Distribution 1966, Statistics Division, Ministry of Planning and Economic Development, 1967, Table A, IV, p. 35, and Table BIII,p.45).

(8) The receipts-per-employee ratio was estimated as follows. It was assumed that the average labor cost per employee in miscellaneous services in 1968/69 was 6,000 shs. It was then assumed that labor cost constituted 50% of total receipts in miscellaneous services. On the basis of these two assumptions the receipts-per-employee ratio was estimated. Data on average cash wages in Misc. Services in 1968 and 1969 was approximately 4100 and 4500 shs., respectively. It is assumed that labor costs such as pensions, workmans compensation, social security and non-wage benefits comprise the difference. See Republic of Uganda, Enumeration of Employees, 1968 and 1969, Appendix Table XX.

APPENDIX F

APPENDIX F

International Classification of Diseases

Successful Treatment Followup Survey Form

Uganda Government Medical Forms

MF 74

MF 75

MF 77

APPENDIX F

Table F.1

International Classification of Diseases

W.H.O. Major Disease Classification	Uganda Government Inpt. & Outpt. Major Disease Classification	Author's Major Disease Classification
(1) Infective & Parasitic Diseases	(1) Infective & Parasitic Diseases	(1) Infective & Parasitic
(2) Neoplasms	(2) New Growths (Neoplasms)	(2) New Growths
(3) Endocrine, Nutritional, & Metabolic Diseases	(3) Allergic, Metabolic, & Blood Diseases	(3) Allergic, Metabolic & Blood
(4) Diseases of Blood & Blood-forming organs	(as #3 above)	(as #3 above)
(5) Mental Disorders (6) Diseases of Nervous System & Sense Organs	(4) Diseases of Nervous System & Sense Org.	(4) Diseases of the Nervous Sys. & Sense Organs
(7) Diseases of the Circulatory System	(5) Circulatory Diseases	(5) Circulatory
(8) Diseases of the Respiratory System	(6) Respiratory Diseases	(6) Respiratory
(9) Diseases of the Digestive System	(7) Alimentary (Digestive) Diseases	(7) Alimentary
(10) Diseases of the Genito-Urinary System	(8) Genito-Urinary Diseases	(8) Genito-Urinary
(11) Complications of Pregnancy, Childbirth and the Puerperium	(9) Diseases of Pregnancy & Puerperium	(9) Diseases of Pregnancy & Puerperium
		(10) Delivery (Child birth) without complication
(12) Diseases of the Skin and Subcutaneous Tissue (13) Diseases of the Musculo-skeletal System & Connecting Tissue	(10) Skin and Musculo-skeletal Diseases (included in #10)	(11) Skin and Musculo-skeletal
(14) Congenital Anomalies (15) Certain Causes of Perinatal Morbidity & Mortality	(11) Diseases of the New Born (included in #11)	(12) Diseases of the New Born (included in #12)
(16) Symptoms of Ill-defined Conditions	(12) Ill-defined Diseases	(13) Ill-defined
(17) Accidents, Poisonings, & Violence	(13) Injuries (including poisoning)	(14) Injuries

Note: The table indicates the correlation between W.H.O. classification of diseases into major groups, the Uganda government's classification, and the author's classification (which deviates in only one respect from Uganda's classification).

Successful Treatment Followup
Survey Form

(A)(1) Health Facilty Name ________________ [| | | | | |] 1 2 3 4 5 6 7

(A)(2) Patient Name ________________

(A)(3) Patient Number (from record book) ________ [| | | | | |] 8 9 10 11 12 13

(A)(4) Date of original attendance ________________

(A)(5) Place of residence (address):
(a) Village ________________
(b) Gombolola ________________
(c) Other address information (how to find house, etc.)__
____

(A)(6) Distance in miles between health facility and place of residence
Give number of miles ________________ [|] 14 15

(A)(7) Method of travel between residence and health facility: [ ] 16

(1) walking
(2) bicycle
(3) taxi
(4) bus
(5) private car
(6) motor cycle
(7) other

(A)(8) Diagnosis ________________ [|] 17 18

(A)(9) Age: (1) infant
(2) child (1-6 years)
(3) school age
(4) adult
[ ] 19

(A)(10) Sex: (1) Male
(2) Female
[ ] 20

* * * * * * * * * * * * * * *

(B)(1) Does ________________ live here?
(patient's name)
(1) yes
(2) no
[ ] 21

(a) if the answer is NO, ask "Where does this person live?"

(i) Village

(ii) Gombolola

(iii) Other address information

(b) if the answer is YES, continue to question (B)(2)

(B)(2) Let me see your medical chit (MF-5) 22
(1) yes
(2) no

(If he/she gives you the MF-5, answer the questions from the information recorded on the MF-5, asking the person about it when necessary).

(If he/she does not give you the MF-5, answer the following questions the best you can by talking with the person and asking him these questions).

(a) Diagnosis or complaint ______________________ 23 24

____

(b) How many treatments were prescribed? Give number ______________________________ 25

(c) Did you receive all of the prescribed treatments? 26
(1) yes
(2) no

If the answer is NO, ask, "How many treatments did you actually receive?"
Record the number here ______________________ 27

(d) Name of diagnostician 28

(1) Doctor
(2) Medical Assistant
(3) Dresser
(4) Nursing Assistant
(5) Other (specify)

(e) How many days has it been since you first visited the health facility for treatment of this illness of complaint?
Give number of days __________________________ 29 30

Record the date shown on the MF-5 for this sickness:

____

(B)(3) What was your job before you became sick and went to the health facility? 31

(1) farmer or herdsman
(2) porter
(3) clerk
(4) private business/ taxi driver
(5) professional: teacher, lawyer, accountant, doctor, nurse
(6) other paid employment: service station worker, cook, factory employee
(7) housewife
(8) school
(9) unemployed (if school leaver age or older)
(10) pre-school age
Other: please specify ______________________________

(B)(4) Are you doing the same job or work now?
(If a child, is he/she back in school now, playing normally, etc.?) [ ] 32
(1) yes
(2) no

(a) If YES, when did you begin your work or job here: ______
____

Determine the number of days that he did not work or do his job from the date recorded above and the date of original attendance. Write down the number of days that he did not work. ______________________________ [ ][ ] 33 34

(b) If NO, why aren't you doing the same job or work now?
(1) not well yet
(2) no job or work available now [ ] 35
(3) changed work or job
(4) on vacation or leave
(5) other: please specify _________________________

(c) If the answer was "Not well yet", go on to question (B)(5). If the answer was (2), (3), (4), or (5), then ask:

When did you:
find out that there is no work available?
change your job or work?
go on vacation or leave?
begin the "other" reason specified in (5) above?

Give date here ______________________________________

Determine the number of days between the date given and the date of original attendance at the health facility. Record that number here ______________ [ ][ ] 36 37

(B)(5) Did you go to any other health facility or person (for example, see list below) for treatment of your sickness after going to the health facility?

(1) Yes
(2) No

[ ] 38

(If NO, the interview is finished.)

(If YES, answer these next questions.)

(a) Did you go to another health facility?

(1) Yes
(2) No

[ ][ ] 39 40

Give name of facility or place here: ______________________

Did you go to an Asian doctor or take traditional medicine?

(1) Asian doctor
(2) Traditional medicine
(3) Neither

[ ] 41

Did you visit any other kind of health facility (e.g., Mobile health clinic)?

(1) Yes
(2) No

[ ] 42

Give name of facility here: ______________________

(b) How far in miles did you travel to this person or place? Give the number of miles ______________________

[ ][ ] 43 44

(c) Did you pay something for your treatment from this person or place?

(1) Yes
(2) No

[ ] 45

(i) if yes, what was the form of the payment?

(1) an animal (what kind?)
(2) other gift (what kind?)
(3) money

[ ] 46

(ii) if you paid money, how much money did you pay? Write number of shillings here ______________

[ ][ ][ ] 47 48 49

(d) What was the sickness or condition for which you were treated by this person or health facility? Write diagnosis here ______________________

[ ][ ] 50 51

(e) After you received your treatment from this person or place did you feel better?

(1) Yes
(2) No

[ ] 52

(f) After you received treatment from this person or place, did you go back to your work or job or to a new job or work?
(1) Yes
(2) No

53

(i) If yes, when did you go back to work or to your new work?
Write date here ______________________________

* * * * * * * * * * * * * * *

Note to interviewer:

(C)(1) Who did you talk to for this information?

(1) Patient
(2) Adult relative or friend
(3) Child relative or friend

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Interviewer's name ______________________________

Today's date ______________________________

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RETURN OF DISEASES (IN-PATIENTS) .... HOSPITAL

For the month of .... 19......

Code	List No.	DISEASES	ADMISSIONS			DEATHS		
			Male	Female	Total	Male	Female	Total
		INFECTIVE AND PARASITIC DISEASES						
001–008	A.1	Tuberculosis of Respiratory System						
010	A.2	T.B. of Meninges and Central Nervous System						
011	A.3	T.B. of Intestines, Peritoneum and Mesenteric Glands						
012, 013	A.4	Tuberculosis of Bones and Joints						
014–019	A.5	Tuberculosis all other forms						
020	A.6	Congenital Syphilis						
021	A.7	Early Syphilis (I and II)						
024	A.8	Tabes Dorsalis						
025	A.9	General Paralysis of Insane						
022, 023	A.10a	Cardio Vascular Syphilis						
026–029	A.10c	All other Syphilis						
030, 031	A.11a	Gonococcal Infections Genito-Urinary						
033	A.11b	Gonococcal Infections of Eye						
032, 034, 035	A.11c	Gonococcal Infections other forms						
040	A.12	Typhoid Fever						
041, 042	A.13	Paratyphoid and other Salmonella Infections						
043	A.14	Cholera						
044	A.15	Brucellosis (Undulant Fever)						
045	A.16a	Bacillary Dysentery						
046	A.16b	Amoebiasis (excluding Symptomless Carriers)						
047, 048	A.16c	Other Unspecified Dysentery						
050	A.17	Scarlet Fever						
051	A.18	Streptococcal Sore Throat						
052	A.19	Erysipelas						
053	A.20	Septicaemia and Pyaemia						
055	A.21	Diphtheria						
056	A.22	Whooping-cough						
057	A.23	Meningococcal Infections						
058	A.24	Plague						
060	A.25	Leprosy						
061	A.26	Tetanus						
062	A.27	Anthrax						
080	A.28	Acute Poliomyelitis						
082	A.29	Acute Infectious Encephalitis						
081, 083	A.30	Late effects Poliomyelitis and Encephalitis						
084	A.31a	Smallpox Variola Major						
084	A.31b	Smallpox Variola Minor						
085	A.32	Measles						
091	A.33	Yellow Fever						
092	A.34	Infectious Hepatitis						
094	A.35	Rabies						
100	A.36a	Louse-borne Epidemic Typhus						
101	A.36b	Flea-borne Endemic Typhus						
104	A.36c	Tick-borne Typhus						
107	A.36d	Unspecified Typhus						
N.O.S. 102-108	A.36e	Other Rickettsial Diseases						
110	A.37a	Vivax Malaria (B.T.)						
111	A.37b	Malariae Malaria (Qt.)						
112	A.37c	Falciparum Malaria (S.T.)						
113, 114, 116, 117	A.37d	Other Unspecified Malaria						
115	A.37e	Blackwater Fever						
123·0	A.38a	Schistosomiasis Vesical						
123·1	A.38b	Schistosomiasis Intestinal						
125	A.39	Hydatid Disease						
127	A.40a	Onchocerciasis						
127	A.40b	Filariasis Bancrofti						
127	A.40c	Elephantiasis of Filarial Origin						
127	A.40d	Other Filariasis						
129	A.41	Ankylostomiasis						
126	A.42a	Tapeworm						
130·0	A.42b	Ascariasis						
130·1	A.42c	Guinea-worm						
N.O.S. 124–130	A.42d	Other Helminths						
037	A.43a	Lymphogranuloma Venereum (Vural)						
038	A.43b	Granuloma Inguinale Venereal						
036, 039	A.43c	Other and Unspecified Venereal Disease						
		TOTAL PAGE 1 ..						

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RETURN OF DISEASES (IN-PATIENTS) .... HOSPITAL

For the month of .... 19......

Code	List No.	DISEASES	ADMISSIONS			DEATHS		
			Male	Female	Total	Male	Female	Total
		INFECTIVE AND PARASITIC DISEASES—*continued*						
049	A.43d	Food Poisoning (excluding Salmonella Infections A.13)						
071	A.43e	Relapsing Fever						
072	A.43f	Leptospirosis (Weil's Disease)						
073	A.43g	Yaws						
086	A.43h	Rubella						
087	A.43i	Chicken-pox						
088	A.43j	Herpes Zoster						
089	A.43k	Mumps						
095	A.43l	Trachoma						
120	A.43m	Leishmaniasis						
121	A.43n	Trypanosomiasis						
131–	A.43o	Dermatophytosis (Tinea)						
135	A.43p	Scabies						
N.O.S. 054–138	A.43q	All other Infective and Parasitic Diseases						
	–	NEW GROWTHS						
140–148	A.44	Malignant Neoplasm of Mouth and Pharynx						
150	A.45	Malignant Neoplasm of Oesophagus						
151	A.46	Malignant Neoplasm of Stomach						
152, 153	A.47	Malignant Neoplasm of Intestine						
154	A.48	Malignant Neoplasm of Rectum						
161	A.49	Malignant Neoplasm of Larynx						
162, 163	A.50	Malignant Neoplasm of Trachea Bronchus and Lung (not secondary)						
170	A.51	Malignant Neoplasm of Breast						
171	A.52	Malignant Neoplasm of Cervix Uteri						
172–174	A.53	Malignant Neoplasm of other parts of Uterus						
177	A.54	Malignant Neoplasm of Prostate						
190·7, 191·7	A.55a	Malignant Neoplasm of Skin of Leg						
N.O.S. 190, 191	A.55b	Malignant Neoplasm of Skin other than Leg						
196	A.56a	Malignant Neoplasm of Jaw						
196, 197	A.56b	Malignant Neoplasm of other Bone and Connective Tissue						
155·0	A.57a	Malignant Neoplasm of Liver (Primary)						
175·0	A.57b	Malignant Neoplasm of Ovary						
179·0	A.57c	Malignant Neoplasm of Penis						
N.O.S. 155–199	A.57d	Malignant Neoplasm of other Unspecified Sites						
204	A.58	Leukaemia and Aleukaemia						
200, 203, 205	A.59	Lymphosarcoma and other Neoplasm of Lymphatic and Haematopoietic Systems						
213	A.60a	Benign Neoplasm of Breast						
214	A.60b	Uterine Fibromyoma						
216	A.60c	Benign Neoplasm of Ovary						
N.O.S. 210–239	A.60d	Other Benign and Unspecified Neoplasms						
	:	ALLERGIC METABOLIC AND BLOOD DISEASES						
250, 251	A.61	Non-toxic Goitre						
252	A.62	Thyrotoxicosis with or without Goitre						
260	A.63	Diabetes Mellitus						
280	A.64a	Beriberi						
281	A.64b	Pellagra						
282	A.64c	Scurvy						
286·6	A.64d	Kwashiorkor						
283–286	A.64e	Other Deficiency States						
290	A.65a	Pernicious and other Hyperchromic Anaemias						
291	A.65b	Iron Deficiency Anaemias (Hypochromic)						
292·6	A.65c	Sickle-Cell Anaemia						
292, 293	A.65d	Other Unspecified Anaemias						
241	A.66a	Asthma						
296	A.66b	Purpura and other Haemorrhagic Conditions						
N.O.S. 240–299	A.66c	Other Allergic Endocrine Metabolic and Blood Diseases						
		DISEASES OF NERVOUS SYSTEM AND SENSE ORGANS						
300–309	A.67	Psychoses						
310, 324, 326	A.68	Psychoneuroses and Disorders of Personality						
325	A.69	Mental Deficiency						
330–334	A.70	Vascular Lesions affecting Central Nervous System						
340·0	A.71a	Meningitis due to H. Influenzae						
340·1	A.71b	Meningitis due to Pneumococcus						
340	A.71c	Other Meningitis (except Meningococcal A.23 and TB-A.21)						
345	A.72	Multiple (Disseminated) Sclerosis						
		TOTAL PAGE 2 ..						

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RETURN OF DISEASES (IN-PATIENTS) .... HOSPITAL

For the month of .... 19......

Code	List No.	DISEASES	ADMISSIONS Male	ADMISSIONS Female	ADMISSIONS Total	DEATHS Male	DEATHS Female	DEATHS Total
		DISEASES OF NERVOUS SYSTEM AND SENSE ORGANS—*continued*						
353	A.73	Epilepsy						
370–379	A.74	Inflammatory Diseases of Eye (except Trachoma A.43f)						
385	A.75	Cataract						
387	A.76	Glaucoma						
391–393	A.77	Otitis Media and Mastoiditis						
390	A.78a	Otitis Externa						
394–398	A.78b	Other Diseases and Conditions of the Ear						
N.O.S. 380–389	A.78c	Other Diseases and Conditions of the Eye						
N.O.S. 341–369	A.78d	All other Diseases of the Nervous System						
		CIRCULATORY DISEASES						
400–402	A.79	Rheumatic Fever						
410–416	A.80	Chronic Rheumatic Heart Disease						
420–422	A.81	Arteriosclerotic and Degenerative Heart Disease						
430·0	A.82a	Acute and Subacute Bacterial Endocarditis						
431	A.82b	Endomyocardial Fibrosis						
N.O.S. 430–434	A.82c	Other Diseases of Heart						
440–443	A.83	Hypertension with Heart Disease						
444–447	A.84	Hypertension without Mention of Heart						
450–456	A.85	Diseases of Arteries						
460–468	A.86	Other Diseases of Circulatory System						
		RESPIRATORY DISEASES						
470–475	A.87	Acute Upper Respiratory Infections						
480–483	A.88	Influenza						
490	A.89	Lobar Pneumonia						
491	A.90	Bronchopneumonia						
492, 493	A.91	Primary Atypical other and Unspecified Pneumonia						
500	A.92	Acute Bronchitis						
501, 502	A.93	Bronchitis Chronic and Unqualified						
510	A.94	Hypertrophy of Tonsils and Adenoids						
518, 521	A.95	Empyema and Abscess of Lung						
519·0	A.96a	Pleurisy without Effusion						
519·1, 519·2	A.96b	Pleurisy with Effusion without mention of T.B.						
523	A.97a	Pneumoconiosis						
N.O.S. 511–527	A.97b	All other Respiratory Diseases						
		ALIMENTARY DISEASES						
530	A.98a	Dental Caries						
531–535	A.98b	All other Diseases of Teeth and Gums						
540	A.99	Ulcer of Stomach						
541	A.100	Ulcer of Duodenum						
543	A.101	Gastritis						
550–553	A.102	Appendicitis						
560	A.103a	Hernia of Abdominal Cavity without Obstruction						
561	A.103b	Hernia of Abdominal Cavity with Obstruction						
570·0	A.103c	Intussusception						
570·2	A.103d	Volvulus						
N.O.S. 570	A.103e	Other Intestinal Obstruction without Hernia						
571·0	A.104a	Gastro Enteritis and Colitis (Age 4 weeks to 2 years)						
571·1	A.104b	Gastro Enteritis and Colitis (Age 2 years and over)						
572	A.104c	Chronic Enteritis and Ulcerative Colitis						
581	A.105	Cirrhosis of Liver						
584, 585	A.106	Cholelithiasis and Cholecystitis						
N.O.S. 536–587	A.107	Other Diseases of Digestive System						
		GENITO-URINARY DISEASES						
590	A.108	Acute Nephritis						
591–594	A.109	Chronic and Unspecified Nephritis						
600	A.110	Pyelitis Pyelonephritis and other Infections of Kidney (except TB-A 5)						
602, 604	A.111	Calculi of Urinary System						
610	A.112	Hyperplasia of Prostate						
620, 621	A.113	Diseases of Breast (except Neoplasms)						
608	A.114a	Stricture of Urethra						
613	A.114b	Hydrocele						
634	A.114c	Disorders of Menstruation						
636	A.114d	Sterility Female						
637·1	A.114e	Vaginal Fistula						
N.O.S. 601–637	A.114f	All other diseases of Genito-Urinary System						
		TOTAL PAGE 3 ..						

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RETURN OF DISEASES (IN-PATIENTS) .... HOSPITAL

For the month of .... 19......

Code	List No.	DISEASES	ADMISSIONS Male	ADMISSIONS Female	ADMISSIONS Total	DEATHS Male	DEATHS Female	DEATHS Total
		DISEASES OF PREGNANCY AND PUERPERIUM						
640–641	A.115	Sepsis of Pregnancy Childbirth and Puerperium						
681/2,4–642·2	A.116a	Pre-eclamptic Toxaemia						
642·3	A.116b	Eclamptic Toxaemia						
642, 652, 685, 686	A.116c	Other Toxaemias of Pregnancy and Puerperium						
670	A.117a	Haemorrhage of Pregnancy and Childbirth (ante-natal)						
671, 672	A.117b	Haemorrhage of Pregnancy and Childbirth (post-natal)						
650	A.118	Abortion without Sepsis or Toxaemia						
651	A.119	Abortion with Sepsis						
645	A.120a	Ectopic Pregnancy						
674	A.120b	Abnormal Labour due to Disproportion						
674	A.120c	Abnormal Labour due to Malposition						
677	A.120d	Ruptured Uterus						
N.O.S. 646–689	A.120e	Other Complications of Pregnancy Childbirth and Puerperium						
660	A.120f	Delivery without Complication						
		SKIN AND MUSCULO-SKELETAL DISEASES						
690–698	A.121	Infection of Skin and Subcutaneous Tissue						
720–725	A.122	Arthritis and Spondylitis						
726, 727	A.123	Muscular and Unspecified Rheumatism						
730	A.124	Osteomyelitis and Periostitis						
737, 745–749	A.125	Ankylosis and Acquired Musculo Skeletal Deformities (except A.30)						
715	A.126a	Ulcer of Leg						
N.O.S. 700–716	A.126b	All other Diseases of Skin						
743	A.126c	Pyomyositis						
731–744	A.126d	All other Diseases of Musculo-Skeletal System						
751	A.127	Spina Bifida and Meningocele						
754	A.128	Congenital Malformations of Circulatory System						
N.O.S. 750–759	A.129	Other Congenital Malformations						
		DISEASES OF NEW-BORN						
760, 761	A.130	Birth Injuries						
762	A.131	Post-natal Asphyxia and Atelectasis						
764	A.132a	Diarrhoea of New-born (under 4 weeks)						
765	A.132b	Ophthalmia Neonatorum						
763, 766–768	A.132c	Other Infections						
770	A.133	Haemolytic Disease of New-born						
771, 772	A.134	All other Defined Diseases of Early Infancy						
774–776	A.135a	Immaturity						
773	A.135b	Ill-defined Diseases of Early Infancy						
		ILL-DEFINED DISEASES						
794	A.136	Senility without mention of Psychosis						
788·8	A.137a	Pyrexia of Unknown Origin						
793	A.137b	Observation without need for further medical care						
N.O.S. 780–795	A.137c	All other Ill-Defined Causes of Morbidity						
		INJURIES						
800–804	AN.138	Fractures of Skull						
805–809	AN.139	Fracture of Spine and Trunk						
810–829	AN.140	Fracture of Limbs						
830–839	AN.141	Dislocation without Fracture						
840–848	AN.142	Sprains and Strains of Joints and Adjacent Muscle						
850–856	AN.143	Head Injury (except Fracture)						
860–869	AN.144	Internal Injury of Chest Abdomen and Pelvis						
870–908	AN.145	Laceration and Open Wounds						
910–929	AN.146	Superficial Injury Contusion and Crushing with Intact Skin						
930–936	AN.147	Effects of Foreign Body entering through Orifice						
940–949	AN.148	Burns and Scalds						
960–979	AN.149	Effects of Poisons						
950–959	AN.150	All other Unspecified Effects of External Causes						
980–999								
		TOTAL PAGE 4 ..						
		TOTAL PAGE 3 ..						
		TOTAL PAGE 2 ..						
		TOTAL PAGE 1 ..						
		GRAND TOTAL						
		TOTAL IN-PATIENT DAYS ..						

N.O.S. means " Not Otherwise Specified ", i.e. N.O.S. 054–138 means all other diseases included between these numbers in the International Classification to be entered in this line if not otherwise specified in any line elsewhere.

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African
or Asian
or European

RETURN OF DISEASES (OUT-PATIENTS) AT .... (UNIT)

For the month of .... 19......

Code	No.	DISEASES	CASES Male	Female	Total
		INFECTIOUS AND PARASITIC DISEASES			
001–008	1	Respiratory Tuberculosis			
010–019	2	Other Tuberculosis			
020–029	3	Syphilis			
030–035	4	Gonorrhoea (excluding Ophthalmia Neonatorum, see 77)			
036–039	5	Other Venereal Diseases			
045	6	Bacillary Dysentery			
046	7	Amoebic Dysentery			
055	8	Diphtheria			
056	9	Whooping-cough			
057, 340	10	Meningitis (excluding Tuberculous, see 2)			
060	11	Leprosy			
062	12	Anthrax			
071	13	Relapsing Fever			
073	14	Yaws			
080	15	Acute Poliomyelitis			
081	16	Acute Poliomyelitis Late Effects			
084	17	Smallpox (Variola Major)			
085	18	Smallpox (Variola Minor)			
085	19	Measles			
086	20	Rubella			
087	21	Chicken-pox			
088	22	Herpes Zoster			
089	23	Mumps			
095	24	Trachoma			
110	25	Malaria B.T.			
111	26	Malaria Q.T.			
112	27	Malaria S.T.			
116, 788·8	28	Fevers not otherwise specified			
121	29	Trypanosomiasis			
123·0	30	Schistosomiasis Vesical			
123·1	31	Schistosomiasis Intestinal			
126	32	Tapeworm (Taeniasis)			
127	33	Onchocerciasis			
129	34	Ankylostomiasis (Hookworm)			
130·0	35	Ascariasis (Roundworm)			
130·3	36	Guinea-worm			
130	37	Other Helminthic Diseases			
131	38	Tinea			
135	39	Scabies			
N.O.S. 036–138	40	Other Infective and Parasitic Diseases			
		NEW GROWTHS			
140–205	41	Malignant Neoplasms (including Leukaemia)			
210–239	42	Benign and Other Neoplasms			
		ALLERGIC METABOLIC AND BLOOD DISEASES			
241	43	Asthma			
260	44	Diabetes			
286·6	45	Kwashiorkor			
280–286	46	Vitamin Deficiency States			
290–293	47	Anaemia			
N.O.S. 240–299	48	Other Allergic Metabolic and Blood Diseases			
		DISEASES OF NERVOUS SYSTEM AND SENSE ORGANS			
300–326	49	Mental Disorders			
353	50	Epilepsy			
330–369	51	Other Diseases of Nervous System			
370–389	52	Diseases of Eye (excluding Trachoma, see 24)			
514–515	53	Diseases of Nose			
390–398	54	Diseases of Ear			
		CIRCULATORY DISEASES			
400–447	55	Heart Disease			
450–468	56	Other Circulatory Diseases			
		RESPIRATORY DISEASES			
490–493	57	Pneumonia			
N.O.S. 470–527	58	Other Diseases of Respiratory System			
		Total Page 1			

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Page 2

African
or Asian
or European

RETURN OF DISEASES (OUT-PATIENTS) AT .... (UNIT)

For the month of .... 19......

Code	No.	DISEASES	CASES		
			Male	Female	Total
		ALIMENTARY DISEASES			
530	59	Dental Caries			
531-535	60	Other Diseases of Teeth and Gums			
560	61	Hernia			
571	62	Gastro Enteritis (Age 4 weeks and over)			
785·2	63	Jaundice			
581	64	Cirrhosis of Liver			
N.O.S. 580-587	65	Other Diseases of Liver and Bile Passages			
N.O.S. 536-579	66	Other Diseases of Alimentary System			
		GENITO-URINARY DISEASES			
590-594	67	Nephritis			
613	68	Hydrocele			
608	69	Urethral Stricture			
N.O.S. 600-637	70	Other Diseases of Genito-Urinary System			
640-689	71	Diseases of Pregnancy, Birth and Puerperium			
		SKIN AND MUSCULO-SKELETAL DISEASES			
720-727	72	Arthritis and Rheumatism			
715	73	Tropical Ulcer			
N.O.S. 690-716	74	Infections of Skin and Subcutaneous Tissues			
730-749	75	Other Diseases of Musculo-Skeletal System			
		DISEASES OF NEW-BORN			
764	76	Diarrhoea of New-born (Age under 4 weeks)			
765	77	Ophthalmia Neonatorum			
774-776	78	Immaturity			
N.O.S. 760-773	79	Other Malformations and Diseases of Infancy			
		INJURIES			
N.800-839	80	Fractures and Dislocations			
N.840-848	81	Sprains			
N.940-949	82	Burns and Scalds			
N.960-979	83	Poisoning			
N.O.S. 850-[illegible]	84	All other Injuries and Wounds			
		ILL-DEFINED DISEASES			
780-795	85	Ill-defined Diseases and Conditions			
		EXAMINATIONS AND INOCULATIONS			
Y.06	86	Ante-Natal			
Y.005	87	Child Welfare			
Y.00	88	Other Examinations			
	89	Immediate Admissions			
Y.02	90	Smallpox Vaccinations			
Y.02	91	Prophylactic Injections			
		TOTAL PAGE 2 ..			
		TOTAL PAGE 1 ..			
		TOTAL RE-ATTENDANCES ..			
		GRAND TOTAL... ..			

N.O.S. means "Not Otherwise Specified", i.e. N.O.S. 054-138 means all other diseases included between these numbers in the International Classification to be entered on this line if not otherwise specified in any line elsewhere.

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UGANDA MINISTRY OF HEALTH

NAME OF UNIT .... DISTRICT ....

REPORT FOR THE MONTH OF .... 19......

1. New Cases (six and over) .. Male.............. Female.............. Total ....

New Cases (five and under) .. Male.............. Female.............. Total ....

Re-attendances .. .. Male.............. Female.............. Total ....

Admissions .. .. .. Male.............. Female.............. Total ....

Transferred to Hospital .. .. Male.............. Female.............. Total ....

Deaths (*six and over*) .. Male.............. Female.............. Total ....

Deaths (*five and under, excluding those given in section 6*) .. Male.............. Female.............. Total ....

AID POSTS:

Number .... Number of Visits ....

Number of new patients .... Re-attendances ....

2. RETURN OF ALL NEW CASES, BOTH IN AND OUT PATIENTS (*excluding Aid Posts*):

Clinical Malaria with Fever .... Malnutrition (*five and under*) ....

Upper Respiratory Infection .... Burns and Scalds ....

Pneumonia .... Fractures ....

Tuberculosis of Lung .... Wounds ....

Early Syphilis .... Measles ....

Early Yaws .... Whooping Cough ....

Late Syphilis or Yaws .... Chicken Pox ....

Gonorrhoea .... Scabies ....

Leprosy .... Stricture of Ureter ....

Diarrhoea (*over five*) .... Hernia (*inguinal or femoral*) ....

Diarrhoea (*five and under*) .... Other Diseases ....

Intestinal Worm Disease ....

Conjunctivitis and Trachoma ....

Other Eye Diseases ....

Discharging Ear ....

Tropical Ulcer ....

3. SMALLPOX VACCINATION:

Six and over .... five and under .... Total ....

4. OTHER PREVENTIVE INOCULATIONS (*Whooping cough, T.A.B., etc.*):

5. MINOR OPERATIONS:

Dental Extractions .... Other operations ....

6. MATERNITY:

Antenatal new cases .... Re-attendances ....

Deliveries .... Maternity cases sent to Hospital ....

Maternal Deaths .... Death of Babies .... Stillbirths ....

7. CHILD WELFARE—CHILDREN'S CLINIC:

New Cases .... Re-attendances ....

(P.T.O.

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