Small Applied
Research Paper No. 12

Operating Efficiency in Public Sector Health Facilities in Sri Lanka: Measurement and Institutional Determinants of Performance

August 2000

Prepared by:

Aparnaa Somanathan, M.Sc.
Health Policy Programme,
Institute of Policy Studies of Sri Lanka

Kara Hanson, S.D.
Health Policy Unit,
London School of Hygiene and
Tropical Medicine,

Tamara Dorabawila, B.A.
Health Policy Programme,
Institute of Policy Studies of Sri Lanka

Bilesha Perera, M.Sc.
Department of Community Medicine,
Faculty of Medicine, Galle, Sri Lanka

Partnerships for Health Reform
PHR

Abt Associates Inc. ■ 4800 Montgomery Lane, Suite 600
Bethesda, Maryland 20814 ■ Tel: 301/913-0500 ■ Fax: 301/652-3916

In collaboration with:
Development Associates, Inc. ■ Harvard School of Public Health ■
Howard University International Affairs Center ■ University Research Co., LLC

Funded by:
U.S. Agency for International Development

Partnerships for Health Reform

PHR

Mission

The Partnerships for Health Reform (PHR) Project seeks to improve people's health in low- and middle-income countries by supporting health sector reforms that ensure equitable access to efficient, sustainable, quality health care services. In partnership with local stakeholders, PHR promotes an integrated approach to health reform and builds capacity in the following key areas:

- *better informed and more participatory policy processes in health sector reform;*
- *more equitable and sustainable health financing systems;*
- *improved incentives within health systems to encourage agents to use and deliver efficient and quality health services; and*
- *enhanced organization and management of health care systems and institutions to support specific health sector reforms.*

PHR advances knowledge and methodologies to develop, implement, and monitor health reforms and their impact, and promotes the exchange of information on critical health reform issues.

August 2000

Recommended Citation

Somanathan, Aparnaa, Kara Hanson, Tamara Dorabawila, Bilesha Perera. August 2000. *Operating Efficiency in Public Sector Health Facilities in Sri Lanka: Measurement and Institutional Determinants of Performance.* Small Applied Research Paper No.12. Bethesda, MD: Partnerships for Health Reform Project, Abt Associates Inc.

For additional copies of this report, contact the PHR Resource Center at PHR-InfoCenter@abtassoc.com or visit our website at www.phrproject.com.

Contract No.: HRN-C-00-95-00024
Project No.: 936-5974.13

Submitted to: Robert Emrey, COTR
Policy and Sector Reform Division
Office of Health and Nutrition
Center for Population, Health and Nutrition
Bureau for Global Programs, Field Support and Research
United States Agency for International Development

The opinions stated in this document are solely those of the authors and do not necessarily reflect the views of USAID

Abstract

Sri Lanka is well known for having achieved very good health outcomes at low cost. Analysis of a survey of health facilities in 1991 found that average costs of care in public sector health facilities were very low by international standards. Nonetheless, considerable variation was identified among facilities offering similar services, suggesting that there is potential for improving efficiency. The objectives of the this study were to (i) to explore different methods for quantifying the magnitude of technical and economic inefficiency in service provision by public sector providers and (ii) to identify institutional and behavioural factors which explain differences in efficiency.

A variety of techniques were used to quantify the extent of inefficiency in service provision, including standard service indicators (length of stay, occupancy rate, turnover rate), average costs, and econometric cost and production functions. The results of the different methods were compared using rank correlation coefficients. Lasso diagrams were used to compare the relative performance of facilities. Other potential correlates of facility performance studied included a series of management indicators, which describe the characteristics of the facility manager, the systems used for managing key inputs such as drugs and staff, and the characteristics of the environment.

The study found that average costs of care in 1997 continued to be below international norms, but that there remained an important degree of variation among similar facilities, with ratios of high:low cost facilities ranging from 4.3 (for cost per patient day in complex inpatient facilities) to almost 30 (for outpatient visits in basic inpatient facilities). Differences in average length of stay and occupancy rate explain only a small proportion of the variation in facility cost. Indicators of management characteristics do not seem to explain much of the variation in costs either.

The findings of this study led us to question the adequacy of microeconomic approaches to efficiency for understanding the way in which public hospitals in Sri Lanka operate. The neo-classical production model relies on several assumptions such as perfect information and choice over inputs and outputs that do not necessarily hold in the context of Sri Lankan public hospitals. In a situation where budgets are fixed and demand is exogenous, unit costs are mainly demand driven and are unlikely to be adequate measures of economic efficiency at the hospital level. A macroeconomic perspective of efficiency that takes into account the equity and efficiency objectives of health planners who are responsible for resource allocation would be more effective at explaining the huge variation in unit costs and performance indicators between the same types of facilities.

Table of Contents

List of Tables

List of Figures

Acronyms

A/RMO	Assistant/Registered Medical Officer
ALOS	Average Length of Stay
CD	Central Dispensary
CD&MH	Central Dispensary and Maternity Home
CSSD	Central Sterile Supplies Division
DDHS	Divisional Director of Health Services
ECG	Electrocardiogram
ENT	Ear, Nose and Throat
GDP	Gross Domestic Product
IP	Inpatient
MCH	Maternity and Child Health
MH	Maternity Home
MLT	Medical Laboratory Technician
MOHIM	Ministry of Health and Indigenous Medicine
MOHWA	Ministry of Health and Women's Affairs
MOOH	Medical Officers of Health
MSD	Medical Supplies Division
Obs/gyne	Obstetrics and Gynaecology
OP	Outpatient
OPD	Outpatient Department
PC	Provincial Councils
PDHS	Provincial Director of Health Services
PHR	Partnerships for Health Reform Project (USAID)
R	Rupee (Sri Lankan)
RDHS	Regional Director of Health Services
SPC	State Pharmaceutical Company
USAID	United States Agency for International Development

Currency Conversion: Rs 78.15 = US$ 1

Acknowledgments

Special mention should be made of Dr. Saman Kelegama (Executive Director, Institute for Policy Studies [IPS]) for his continuing support and interest. The study, which was carried out in collaboration with the Ministry of Health and Indigenous Medicine, would not have been a success if not for the invaluable and prompt support mainly on institutional matters by Dr. K.C.S. Dalpadatu (Deputy Director General, Planning), Dr. K.K.W. Karandgoda (Director, Policy Analysis and Development) and Dr. S.M. Samarage (Director, Organization Development). The Steering Committee members, especially Dr. Patricia Alailima (Director General, National Planning Department), Mrs. Soma Mahawewa (Deputy Director, National Planning Department), Dr. Shelton Wanasinghe (Senior Visiting Fellow, IPS) provided useful inputs to the survey and study. We would also like to give a special thank to Charita Ratwatte, Ms. Rohanthi Perera, and Udayana Seneviratna of Research International (Pte) Ltd for carrying out the survey and data entry.

We acknowledge, with gratitude, the support shown towards us by all the hospital directors and other staff members, especially those of Sri Lanka National Hospital and the hospitals the IPS staff members visited to do the spot checks. We are grateful not only for the support provided at the data collection level, but also for the assistance at the numerous occasions we disturbed them for additional information and clarifications.

To all those who attended our Workshop on "Operating Efficiency in Public Health Facilities in Sri Lanka" on February 24, 2000, despite their busy schedules, we wish to express our sincere gratitude. All suggestions and criticisms by the participants made the discussion fruitful and provided useful feedback to our study.

We sincerely acknowledge the vital contribution made by Easha Ramachandran (Research Assistant) at the early stages of the study. We are grateful to Varuni Sumathiratne (Research Assistant) for graciously providing her assistance during the course of the study. We thank Dilshan Muhajarine (Programme Manager through 1999) and his successor, Shermal Karunaratne, for providing overall administrative support. Nishan de Mel (Research Officer) and Dr. Saroj Jayasinghe (Department of Medicine, University of Colombo) provided useful insight to the study. Many thanks are due to Mr. D.D.M. Waidyasekara, for editing the report at such short notice.

Finally, special mention must be made of two individuals for their contribution to this study. We admire and acknowledge, with a deep sense of gratitude, the supervision, constant guidance, and expert advice offered by Dr. Ravi Rannan-Eliya in all stages of the study. The overall support and research advice by Dr. Daya Samarasinghe was invaluable.

Any views expressed in this document are solely those of the authors and do not necessarily represent those of the Ministry of Health or the Institute of Policy Studies

Foreword

Part of the mission of the Partnerships for Health Reform Project (PHR) is to advance "knowledge and methodologies to develop, implement, and monitor health reforms and their impact." This goal is addressed not only through PHR's technical assistance work but also through its Applied Research program, designed to complement and support technical assistance activities. The main objective of the Applied Research program is to prepare and implement an agenda of research that will advance the knowledge about health sector reform at the global and individual country levels.

An important component of PHR's applied research is the Small Applied Research (SAR) program. SAR grants are awarded, on a competitive basis, to developing-country research institutions, individuals, and non-profit organizations to study policy-relevant issues in the realm of health sector reform. The SAR program has twin objectives: to provide data and analyses relevant to policy concerns in the researcher's own country, and to help strengthen the health policy research capacity of developing country organizations. While PHR provides technical advice and support to the SAR grantees, the content and conclusions in the final research reports are the responsibility of the grantees. They do not necessarily reflect the views of USAID or PHR.

A total of 16 small research grants have been awarded to researchers throughout the developing world. Topics studied include health financing strategies, the role of the private sector in health care delivery, and the efficiency of public health facilities.

SAR grant recipients are encouraged to disseminate the findings of their work locally. In addition, final reports of the SAR research studies are available from the PHR Resource Center and via the PHR website. A summary of the findings of each study are also disseminated through the PHR "in brief" series.

Small Applied Research Grants

Dr. Joseph K. Konde-Lule (Institute of Public Health, Makerere University). "User Fees in Government Health Units in Uganda: Implementation, Impact and Scope."

Dr. R. Neil Soderlund (University of Witswatersrand). "The Design of a Low Cost Insurance Package."

Pedro Francke (Independent). "Targeting Public Health Expenditures in Peru: Evaluation of Ministry of Health Services and Procedures and Proposal of a Targeting System."

Alfred Obuobi (School of Public Health, University of Ghana). "Assessing the Contribution of Private Health Care Providers to Public Health Care Delivery in the Greater Accra Region."

V.R. Muraleedharan (Indian Institute of Technology, Department of Humanities and Social Sciences). "Competition, Incentives and the Structure of Private Hospital Markets in Urban India: A Study of Madras."

Dr. George Gotsadze (Curatio International Foundation). “Developing Recommendations for Policy and Regulatory Decisions for Hospital Care Financing in Georgia.”

Dr. Aldrie Henry-Lee (The University of West Indies, Institute of Social and Economic Research). “Protecting the Poor, High Risk and Medically Indingent under Health Insurance: A Case Study of Jamaica.”

Dr. Maria C.G. Bautista (The Institute for Development Policy and Management Research Foundation, Inc.). “Local Governments’ Health Financing Initiatives: Evaluation, Synthesis and Prospects for the National Health Insurance Program in the Philippines.”

Oliver Mudyarabikwa (University of Zimbabwe). “Regulation and Incentive Setting for Participation of Private-for-Profit Health Care Providers in Zimbabwe.”

Easha Ramachandran (Institute of Policy Studies, Health Policy Programme). “Operating Efficiency in Public Sector Health Facilities in Sri Lanka: Measurement and Institutional Determinants of Performance.”

Dr. M. Mahmud Khan (Public Health Sciences Division, Center for Health and Population Research). “Costing the Integrated Management of Childhood Illnesses (IMCI) Module: A Case Study in Bangladesh.”

Dr. Arlette Beltrán Barco (Universidad Del Pacífico). “Determinants of Women’s Health Services Usage and Its Importance in Policy Design: The Peruvian Case.”

Frederick Mwesigye (Makerere University, Makerere Institute of Social Research). “Priority Service Provision Under Decentralization: A Case Study of Maternal and Child Health Care in Uganda.”

Dr. Gaspar K. Munishi (Faculty of Arts and Social Sciences, University of Dar Es Salaam). “The Growth of the Private Health Sector and Challenges to Quality of Health Care Delivery in Tanzania.”

Mathias L. Kamugisha (National Institute for Medical Research- Amani Research Center). “Health Financing Reform in Tanzania: Appropriate Payment Mechanism for the Poor and Vulnerable Groups in Korogwe District, Northeastern Tanzania.”

Dr. Joses Kirigia, Dr. Di McIntyre (University of Cape Town Health Economics Unit, Department of Community Health). “A Cost-Effectiveness Analysis of AIDS Patient Care in Western Cape Province.”

1. Introduction

In 1991 the Ministry of Health and Women's Affairs (MOHWA)[1] undertook a Health Facility Survey, with support from the World Bank. The study covered all public health facilities and a sample of private facilities in four districts (Colombo, Galle, Matale, and Polonnaruwa). The primary goal of the study was to provide information about the costs of providing health services in public and private health facilities. The data from this survey were re-analysed by the Institute of Policy Studies (IPS) during 1994/5 during which two main findings became apparent. First, average costs in Sri Lankan public health facilities were very low in comparison with other developing countries. Second, although the average costs were low, there was tremendous variation in costs even among fairly similar public sector facilities, with the range from the lowest to the highest being nearly Rs.400 for costs per bed-day at lower-level inpatient facilities. While there was a relationship between costs and factors known to influence costs, such as levels of utilisation, bed occupancy rate, and average length of stay, these factors could not explain all of the observed variation. Thus, while overall the sector was found to be very efficient, particularly when Sri Lanka's achievements in health outcomes are considered, there appeared to be considerable scope for improvements in efficiency.

The Sri Lankan government is currently considering major reforms to the health sector which aim to restructure the Ministry of Health and Indigenous Medicine (MOHIM), devolve greater responsibility for managing public institutions to the provincial level, modernise the management of public institutions, and upgrade certain public hospitals (Hsiao 2000). Up-to-date information about health facility erformance is needed to inform the reform strategies. Before measures can be taken to improve the efficiency of public service delivery there is a need for valid measures of efficiency. They must be measures that can be collected easily in an operational setting and used both to monitor overall trends in health sector performance and assess relative efficiency between facilities. The latter implies that efficiency measures must be available and accessible for use by health facility managers. An important focus of this study is to examine different approaches to measuring efficiency and to assess the congruence of the different approaches.

In addition to simply measuring efficiency, it was felt that a better understanding of the factors that underlie the variations in performance was needed. Given that public institutions in Sri Lanka face a common set of formal rules and regulations, it was hypothesised that other factors must underlie these differences in efficiency. One hypothesis was that differences in efficiency were related to differences in the way that these facilities were managed. Characteristics of the managers (their training and experience), of the systems they use to manage their key inputs (staff and drugs), and of the organisational environment (their location, the extent to which they are accessible, the support they enjoy in the community, and the level of competition they face in the local health care market) were identified as potential variables influencing the efficiency of public facilities. An examination of these factors, together with the conventional factors believed to underpin cost differences, was therefore an

[1] In 1994, the Ministry of Health and Women's Affairs was split into the MOHWA and Ministry of Health and Indigenous Medicine.

important focus of the study. An understanding of such issues will also provide an insight into why unit costs of Sri Lankan public hospitals lie well below those of most other and lower- and middle-income countries..

2. Objectives

The objectives of the study are as follows:

a) To explore different methods for quantifying the magnitude of technical and economic inefficiency in service provision by public sector providers

b) To identify institutional and behavioural factors which explain differences in efficiency

c) To develop and evaluate policy options at different levels of the health care system to improve the performance of public sector providers

d) To identify factors that explain why unit costs in Sri Lanka's MOHIM facilities are lower than in other comparable developing countries

The study asked the following specific research questions:

I. What are the incentives and constraints facing public sector health care providers (formal institutions structuring behaviour of facilities).

II. How can efficiency be operationalised for measurement, analysis and use in health sector planning and evaluation?

- How much technical and economic inefficiency, distribution of inefficiency?
- Efficiency of maternal and child health (MCH) services compared with others?
- How much cost savings/output increase from improvements in efficiency?
- What indicators can be constructed from routinely available data?

III. What characteristics of managers, of organisational environment, of production are associated with efficiency differences?

IV. How can this information be used to develop a strategy for reforming the public sector to improve efficiency in health service provision

V. ?

3. The Sri Lankan Health System

3.1 General Country Background

Sri Lanka is a lower-middle-income economy with a per capita income of US$900, which grows at 3.5–5 percent per year. One of the first countries to initiate economic liberalisation, in 1977, Sri Lanka experienced a rapid growth in export oriented, labour intensive manufacturing industries. Manufactured exports, mainly garments, now account for three-quarters of export earnings (Central Bank of Sri Lanka 1999). Greater market and outward orientation underlies the economy's resilient GDP growth performance despite 17 years of internal conflict and external shocks related to the Asian economic crisis (Table 1). Sri Lanka is a democracy with a two-party dominated political system that has existed since the 1950s. Sri Lanka's modern health care system is a product of that democratic system. Health policy is an area that has always been decided by bipartisan consensus. Social sectors including health care tend to have high priority, as is evidenced by their relative protection in the annual budget provisions.

Table 1. Selected economic indicators

	1978-83	1984-89	1990-93	1994-99
Population (period annual growth rate)	1.7	1.4	1.2	1.1
Per capita GNP (Rs.)	4825	10595	20752	39852
GDP (Rs. million)	73400	176910	367026	750537
Rate of inflation (period average)	15.2	9.8	13.8	9.5
Government expenditures (% of GDP)				
Total expenditures	36.1	32.9	29.7	28.2
Defence expenditures	0.67	2.15	2.74	4.28
Health	1.59	1.5	1.47	1.46
Education	2.55	2.69	2.8	2.67
Other social services	0.59	3.66	4.64	4.39

Sources: Hsiao 2000; Central Bank of Sri Lanka Annual Report, various years.

Although the privileged position of the health sector in the budgetary process is likely to remain, it is unlikely that the government can allocate a significantly higher portion of its budget to health care in the medium term (Hsiao 2000). Despite generally positive economic trends, the fiscal situation of the government is likely to remain tight in the medium term. Total government revenue, which was equivalent to 20 percent of GDP in 1995, has fallen to 17 percent in 1998, while the tax service ratio has fallen from 17.8 percent to 14.5 percent for the same period. Nearly half of the budget is spent on defence and interest payments on public debt. With little prospect of an early end to the military conflict, defence expenditures cannot be realistically cut in the next two years. In this fiscal and economic context, Sri Lanka's general revenue financed public health sector is likely to be increasingly resource constrained.

3.2 Health Status

Sri Lanka has always been regarded as a high performer in health status terms, whose health indicators rival those of even middle-income countries. By 1997 Sri Lanka had reduced its infant mortality rate to 15 and its total fertility rate to below replacement level at 2.0. Its life expectancy had increased to 75 and 71 years at birth for women and men respectively (Table 2). The epidemiological transition is well underway, yet the country remains free of a major HIV/AIDS epidemic and of the resurgence of old diseases such as tuberculosis. With life expectancy projected to reach current U.S. levels by 2020, the country faces a rapid ageing process with an increasing portion of the population suffering from chronic diseases such as ischaemic heart disease, cerebrovascular disease, and diabetes. Moreover, rapid economic development has given rise to a growing incidence of mental disorders, drug addiction and suicides.

Table 2. Trends in health indicators

	1950	1970	1990	1997
Birth rate	40	29	21	16
Death rate	13	7	5	6
Infant mortality rate	82	47	22	15
Maternal mortality rate	6	2	1	<1
Life expectancy at birth (years)				
Female	55	67	73	75
Male	56	64	69	71
Total fertility rate	5.3	4.2	2.2	2

Source: Hsiao 2000

The public sector has generally been known for its success in ensuring universal and equitable access to good quality health services but at apparently very low unit costs. Nevertheless, it may find it increasingly difficult to sustain itself in view of the resource constraints it faces in the medium term, and the growing population, changing epidemiology, and medical progress. The need to assess the relative efficiency of public health facilities and how resources are allocated within that sector is therefore vital.

3.3 Sri Lankan Health Care System

3.3.1 Organisation of Health Services

Health care in Sri Lanka is delivered through a network of hospitals and outpatient care centres throughout the country. Public services are the responsibility of the central Ministry of Health and eight provincial councils. Major municipalities also provide services of a limited nature. The public sector delivers inpatient and outpatient services as well as carrying out preventive and promotional health activities. It provides more than 95 percent of inpatient services. There is a small, but growing private hospital sector. Private health care services consist mainly of ambulatory services provided by full-time private practitioners, government medical staff working privately and pharmacies. As elsewhere in South Asia, there is now little demand for non-western medicine.

The public sector runs an extensive network of facilities throughout the island. These are organised into a multi-tiered referral system of facilities ranging from maternity homes and dispensaries upwards to teaching hospitals and other national hospitals. (Table 3) They provide mostly modern western type care, but ayurvedic care is also provided by separate government facilities under the responsibility of the MOHIM. Outpatient care is mostly provided through outpatient departments attached to the inpatient facilities, although there are also free-standing outpatient facilities.

Table 3. Public health facilities in 1997

	Number	Total beds
MOOH* units	238	n/a
Central dispensaries	387	n/a
CDs&MHs*	67	672
Rural hospitals	133	3481
Peripheral units	104	4745
District hospitals	149	13162
Base hospitals	31	8375
Provincial hospitals	5	4281
Teaching hospitals	15	13815

Source: MOHIM 1997.

* MOOH = medical officer of health, CD = central dispensary, MH = maternity home

The public health sector employed 6,109 doctors in 1997. In general they work as full-time employees, although most are also permitted private practice during their non-working time. In addition, the MOHIM employs 1,384 assistant/registered medical officers (A/RMO's) who have received basic medical training during a three-year medical programme, are permitted to diagnose and prescribe, and often work unsupervised in lower-level hospitals such as peripheral units. Ambulatory private care is mainly provided by full-time private general practitioners and supplemented by private practice of government doctors, who work from clinics, homes, or private hospitals.

3.3.2 Financing

Health care is equally financed by the government and by households' direct out-of-pocket payments. Public financing covered entirely by general tax revenue, declined as a share of total during the 1980s, but appears to have stabilised at approximately 50 percent of overall financing. Private financing predominantly takes the form of household out-of-pocket payments with little contribution from private insurance or employer-sponsored prepayment plans.

Approximately three-fourths of the government health budget for recurrent expenses goes to public hospitals, where care is free at the point of use. Overcrowding and long waiting lines have created incentives for patients to seek health care from the private sector whenever they can afford to pay. However, since most of the population cannot afford the high private hospital charges, they continue to rely on the public sector for inpatient care services

4. Literature Review

An efficient health service is one that achieves its objectives at the least cost. Ultimately, these objectives might be couched in terms of maximizing health or individual utility, or the pursuit of other social goals such as equity or poverty alleviation (Hammer and Berman 1995). Making such a broad social definition of inefficiency operational is, unfortunately, extremely difficult. Instead, most of the existing literature focuses on efficiency in the pursuit of an intermediate objective—the delivery of health services. The efficient production of health services is necessary, though not sufficient, for achieving broader social efficiency.

Technical efficiency, economic efficiency

Technical efficiency implies producing maximum output with given inputs; or equivalently, using minimum inputs to produce a given output. Technically efficient production units are located on the production isoquant.

Production units that are *economically efficient* are located on the production isoquant and use the minimum cost combination of inputs. In other words, the marginal rate of technical substitution is equal to the ratio of input prices. Technical efficiency is necessary but not sufficient for economic efficiency.

Absolute and relative efficiency

As noted above, the low average costs of providing health services in Sri Lanka suggest that the public health system is highly efficient in a "macro" sense: large quantities of health services are produced with a minimum allocation of resources. However, the evidence from the 1991 Health Facility Survey suggests that there are considerable variations in the performance of individual facilities, and that it is possible to identify facilities that are "relatively inefficient" in relation to other comparable health facilities.

Behavioural implications of being "efficient": structural models and cost-minimisation

The idea of an "efficient" health facility is derived from the neoclassical production model in which agents choose inputs to minimise cost, given exogenous demand. Under certain circumstances this is a reasonable characterisation of the behaviour of some privately owned firms. However, cost-minimisation is only one among many possible objectives of the public sector.[2] The existence of multiple goals may lead to compromises between, for example, improving access and minimising cost. This may produce outcomes that are observationally equivalent to, but nonetheless different from, "inefficient." Furthermore, the specific incentives and constraints facing the public sector may lead to managerial behaviour that is actually inconsistent with cost-minimisation, for example, satisfaction. Thus, in the context of the particular institutions within which public providers operate, "efficient" production is not a realistic policy goal. Rather, the objective should be to *improve efficiency*. One way to do this is to identify those facilities that are performing better than others. The

[2] Lovell (1993) cites the argument made by Pestieau and Tulkens (1990) that, due to differences in objectives, public and private providers should only be compared on the criterion of productive (i.e., technical) efficiency because it is "the only objective shared by both types of producer and the only objective not in conflict with other goals of the public producer" (p. 7).

factors that are associated with these performance differentials can then be identified, and interventions developed which can help bring the performance of the "worst" facilities closer to that of the "best" ones.

Efficiency and the locus of decision making

Different efficiency concepts may apply to different levels of the decision-making process. For example, where input choices are made at the central (or district) level, it is of little interest to evaluate *facility* performance by means of the criterion of economic efficiency, which implies choosing the minimum cost combination of inputs. Technical efficiency is, however, a relevant measure of facility performance in this context, since it is concerned with the use that is made of a given quantity of inputs. Identifying the appropriate efficiency concept requires a thorough understanding of the institutional context.

4.1 Measuring Efficiency

4.1.1 Ratio Measures

The simplest way of measuring efficiency is through the use of simple ratios, such as the number of visits per health worker and consumption of drugs and supplies per health worker. Inpatient service efficiency is often expressed through the use of three service indicators: average length of stay, bed occupancy rate, and turnover rate. Pabon Lasso (1986) describes a method for simultaneously presenting length of stay, occupancy rate and turnover rate in a way that allows the relative performance of similar groups of facilities. Using the sample means, four quadrants can be defined, which divide facilities into four groups (Barnum and Kutzin 1993):

I. Low turnover and low occupancy: facilities characterised by excess bed availability in relation to demand;

II. High turnover and low occupancy: facilities where there is excess bed availability, unnecessary hospitalisation, many beds used for patient observation, predominance of normal (vs. complicated) deliveries;

III. High turnover, high occupancy: Facilities that are performing well on average, with a relatively small proportion of unused beds;

IV. Low turnover, high occupancy: Facilities with high proportion of severely ill patients, predominance of chronic cases, unnecessarily long inpatient stays.

Such analysis can help quick identification of those facilities that perform relatively poorly and also point to potential explanatory factors.

Such ratio indicators have the advantage that they are easily calculated using routinely available data. However, they have certain disadvantages. In particular, because of the lack of appropriate weights for aggregating different types of outputs, they tend to focus on a single type of hospital activity and fail to reflect the multi-product nature of hospitals.

4.1.2 Accounting-based Costs

Two types of studies using accounting costs can be distinguished in the literature (Barnum and Kutzin 1993). The first uses detailed step-down analyses of accounting. Step-down costing is time consuming and invariably such studies include only a small number of facilities. The second approach uses aggregated accounting data together with assumptions about the relative resource intensity of different activities (e.g., outpatient visits and inpatient days) to arrive at an estimate of average costs. There is clearly a trade-off between the number of facilities for which data can feasibly be collected, and the level of detail in which the allocation of resources among different activities can be measured. A further disadvantage of such studies is that they produce estimates of average costs, not marginal costs, limiting the extent to which the results can be used to make inferences about conventional measures of economic efficiency such as economies of scale and scope.

4.1.3 Statistical Methods

Within the group of statistical methods for measuring efficiency, two main approaches can be distinguished: those which use residuals from cost or production functions that are fitted through the "middle" of the data; and frontier methods. Both have been extensively used in the study of U.S. health facilities and, to a lesser degree, European ones. Each approach has its limitations, which are discussed below.

4.1.3.1 Cost and Production Functions

Using estimated residuals calculated from cost or production functions is the traditional way to measure inefficiency. This approach is used in Feldstein's (1967) study of National Health Service hospitals, and in studies of U.S. facilities by Goldman and Grossman (1983) and Frank and Taube (1987). Economic inefficiency can be accommodated by estimating non-minimum cost functions. For example, Wouters' (1993) cost functions for Nigerian health centres include an economic inefficiency variable estimated from a production function. Eakin and Kneisner (1988) estimate a non-minimum cost function to calculate the extent of economic inefficiency in U.S. hospitals.

There are three main disadvantages of this method. First, the approach is deterministic in the sense that the entire deviation from predicted cost (or output) is measured as inefficiency. Second, there is an assumption that the technology (or cost function) is the same at the frontier as in the middle of the data (Lovell 1993). Finally, the estimated residuals may be sensitive to the econometric specification, particularly the choice of functional form.

4.1.3.2 Frontier Approaches

Stochastic frontiers

Stochastic frontier approaches attempt to take account of the fact that deviation from optimal performance may be due either to random factors outside the control of managers, or to systematic inefficiency (Forsund, Lovell and Schmidt 1980; Lovell 1993). Both are captured in a composed error that can be broken down into its stochastic and systematic components. Stochastic cost functions for health facilities are estimated by Zuckerman, Hadley, and Iezzoni (1994) and Vitaliano and Toren (1994). The method has also been used to study township clinics in China (Liu 1995). The key limitation of this method is that it relies

on untestable assumptions about the distribution of the error components (Newhouse 1994). It shares the risk of specification error associated with other parametric approaches to efficiency measurement.

Linear programming (Data Envelopment Analysis)

Data Envelopment Analysis has now been quite extensively used in the health literature to study technical inefficiency (Banker, Conrad and Strauss 1986; Burgess and Wilson forthcoming, July 1995, and August 1995; Byrnes and Valdmanis 1989; Grosskopf and Valdmanis 1987; Kooreman 1994; Nyman and Bricker 1989). An empirical production frontier is estimated by setting out the relationship between inputs and outputs as a linear programming problem. The solution (a distance function) indicates either the amount by which output could be expanded using the same inputs, or the amount by which inputs could be reduced while maintaining the same level of output. Its main advantage is that being nonparametric, it is not subject to specification error in the same way as either the stochastic frontier model or the cost function approach. However, like the cost function approach, it is deterministic and attributes the entire residual to inefficiency.

4.2 Studies of Efficiency in Developing Countries

4.2.1 Existing Studies

A large number of studies of hospital costs report information about inpatient service indicators (Barnum and Kutzin 1992, Mahapatra and Berman 1994). A common finding is that tertiary hospitals have significantly higher occupancy rates (i.e., make greater use of existing capacity) than first- and second-level referral hospitals.

The published and "grey" literature contains a large number of accounting cost studies (for example, Berman and Sakai 1993, Gilson 1995, Hanson and Chindele 1992, Mitchell et al. 1988, Purohit and Rai 1992). Typically these studies identify significant levels of inefficiency in the production of health services in government facilities, inferred from variation in the level of unit costs across similar facilities. These studies highlight a number of features of the institutional environment which influence resource use and are likely to affect provider behaviour. However the quantitative importance of these features is not evaluated.

Two recent accounting cost studies look explicitly at the relative efficiency of public and private providers. Gilson (1995) compares the costs of government and mission dispensaries in one district of Tanzania, and finds that costs are higher and process quality generally lower in the mission facilities. Higher costs are attributed at least in part to lower levels of utilisation. Bitran (1995) looks at a sample of public and private dispensaries in Senegal. He notes that there is considerable heterogeneity in the costs and quality of services provided in the private sector. Comparing the facilities that are most alike—Catholic dispensaries and government dispensaries—he finds that relative performance depends on the level of output. At lower levels of utilisation, government facilities have somewhat lower average cost, while at higher levels of output, the mission dispensaries appear to be more efficient. Drug availability is unambiguously better in the mission facilities, but process quality is quite variable in all ownership groups

The second group of studies uses statistical cost functions estimated from cross-section data to examine efficiency (Anderson 1980; Bitran-Dicowsky and Dunlop 1993, Barnum and

Kutzin 1993, Wouters 1993, Donaldson 1995). Whilst recognizing that the structural model they adopt may be too restrictive, most of these studies nonetheless estimate neoclassical cost functions. An exception is the approach taken by Wouters (1993), which estimates a non-minimum cost function for Nigerian health centres and includes an economic inefficiency index as a regressor. Donaldson (1995) tests for and rejects cost-minimisation in a set of health facilities in Papua New Guinea. None of the cost function studies explore alternative behavioural assumptions, or use specifications which integrate the qualitative information from accounting studies about institutional constraints and incentives facing decision makers.

4.2.2 A Framework for Understanding the Causes of Inefficiency

A body of literature now exists which describes the institutional features of public sector production and their effect on efficiency (see, for example, Barnum and Kutzin 1992, Berman and Sakai 1993, Bitran and Block 1993, Gilson 1995, Harrison et al. 1993, Mills 1990a, 1990b, and 1997). One way of organising these factors into a useful conceptual framework is to distinguish between the absence of *incentives* for efficient behaviour, and structural *constraints* on decision makers' freedom to make efficient choices. These features form the building blocks with which more appropriate models of public sector behaviour can be developed.

Table 4 integrates the findings of the descriptive literature on public sector inefficiency into an overall framework for understanding the context within which public sector health service production occurs.

Table 4. Characteristics of public sector production

Feature	Effect	Behavioural implication
Public ownership	No claim on residual profit.	Without "reward" for cost saving, there is no incentive to chose minimum cost input combination, or to minimise waste; may be latitude for expense preference.
Paid by salary	Remuneration unaffected by performance.	As above.
Lack of resources	Low salaries; dependence on donors; shortage of inputs; limited supervision.	Problems of motivation and incentives (see above); may be constrained to use a technically or economically inefficient input mix; inappropriate donor-funded inputs leading to technical and economic inefficiency.
Input indivisibilities	High fixed costs because of mismatch of optimal and actual scale of operation (e.g., equipment, staffing independent of workload).	May be constrained (e.g., by demand) to operate at sub-optimal level of output leading to high fixed costs. Using inputs efficiently may require incentive/motivation to avoid waste (e.g., by more creative use of available staff).
Demand factors	High fixed costs because of sparse population (i.e., input indivisibilities); patients may have preferences for inefficient input mixes.	Indivisibility constraint (related to incentives as above); responsiveness to consumer preference (e.g., for specific drugs or for care from physician, may lead to expense preference).
Financing/ payment mechanism	Variation in payment mechanism and	Incentives for treatment patterns (under-prescription, over-prescription, induced

	arrangements governing the retention and use of revenue (e.g., fee per episode, fee per drug, pre-payment, capitation; retention of funds at facility or returned to centre, use of revenue for bonus payments).	demand) and for cost of production and efficiency; where fees are used for staff bonuses may encourage over-treatment and higher costs; may affect the overall behavioural objective.
Information availability	Absence of price information (donor-funded inputs, inputs which are centrally provided and not against a known budget constraint).	Without price information it is impossible for decision makers to choose minimum cost input combination.
Civil service structure, procedures, policies	Centralised decision making, lack of knowledge or responsiveness to local conditions, inflexible budgeting and transfer procedures; human resources policies resulting in shortages of skills or knowledge; wrong staff input combinations; weak planning and management; dominance of medical professionals, lack of consistency and uniformity in supply, lack of maintenance.	Constrained to inefficient input mix; difficulty in making adjustments to achieve efficient input use; poor training leads to inefficient input use; poor planning and management may lead to poor choices in the use of other inputs; regulations concerning staff combinations may lead to inefficiencies associated with indivisibilities of staff; medical professional dominance may be associated with more expense preference; lack of uniformity of supply, lack of maintenance can lead to waste, excess downtime.
Multiple objectives	The goals of public sector activity include efficiency but also equity, access, quality, redistribution, accountability, etc.	With mangers trading off these objectives, might expect a "constrained maximised" solution (i.e., given requirements of access, production is efficient; might also see satisfying behaviour).
Market structure	No competitive "benchmark" against which to measure managerial performance.	As in the case of regulated industries or monopoly power, managers may be able to exercise discretion and expense preference in their input choice; or deviate from maximising behaviour (i.e., x-inefficiency).
Medical profession dominance	Doctors' specialised medical knowledge reinforces clinical autonomy, with implications for resource use. Exacerbated by absence of clear "bottom line" for performance measurement, termination mechanisms.	Managers may be less able to influence doctors' decisions; may also imply greater ability to use public employment to generate private income, increasing public sector costs; doctors' emphasis on quality may lead to higher cost medicine, which is harder to control in public sector because of bottom line and termination mechanism issues.

Source: Barnum and Kutzin 1993; Berman and Sakai 1993; Gilson 1995; Harrison et al. 1993; Mills 1997, Wolf 1993.

4.3 Allocation and Management of Resources in the Sri Lankan Public Health Sector

The numbers of public health facilities at each level of care and the number of beds in each facility are largely determined by a population formula. The level of service and the number of beds determine staffing patterns. The allocation of drugs is based on both historical factors and an estimation of needs. The population formula does not take into account actual demand, which means that this method of resource allocation often leads to over- or under-supply of services. The central and provincial ministries of health allocate their recurrent cost budgets for each hospital based on the hospital's historical budget, which in turn is closely related to the number of beds and staffing of the hospital. The budgetary allocation mechanisms described above, which also leave no claims on residual cost savings to hospitals, do very little to provide incentives to choose the minimum cost combination of inputs or to minimise waste.

Provincial councils (PCs) are responsible for the management of all facilities below base hospital level. There exist no procedures to ensure transparency and accountability in the operations of the PCs. Requirements for independent audit of PC financial operations are limited, while systems for the reporting of their health expenditures on a standardised basis do not exist. PCs are not required to maintain accounting systems allowing them to track expenditures according to functional use. As a result, very little data are available on how health expenditures are allocated by program and function at provincial level. Without expenditure information it is impossible for the central health ministry to assess the financial activities of the provincial departments of health or for provincial-level health administrators to allocate resources efficiently.

Hospitals are organised into wards with 20-80 beds per ward. Clinical services are the responsibility of physicians, who typically see 50-70 patients a day. A sister who supervises nurses and attendants manages patient care in the ward. The Ministry of Health holds the power to assign physicians to their posts and to promote them. The provincial government has the power to assign and promote other health professionals. Under devolution, the MOHIM decentralised a major portion of financial resources and responsibilities to provinces, but continues to control physician assignments and promotion, which severely limits what provinces can do. No facility except for Sri Jayawardnepura Hospital has autonomy over staff allocation. With regard to health worker motivation, all health workers including doctors are paid primarily by salary with some extra allowances, which are very rarely related to performance. Problems of motivation and incentives combined with shortages of key inputs such as drugs and supplies mean that hospitals are constrained to use a technically or economically inefficient mix of inputs.

Human resource planning for the health sector is shared between the Ministry of Education and the Ministry of Health. The absence of a coordinated human resource strategy has meant that the supply and demand for medical personnel are not well matched. Sri Lanka currently has a severe shortage of nurses and an inadequate number of specialists. Meanwhile, in year 2000, the expected number of medical school graduates will exceed internship slots available (Hsiao 2000). This over- or under-supply of necessary staff will thus compromise the choice of an efficient mix of inputs at facility level.

In summary, the MOHIM uses the command and control approach in planning and management of the financial and human resources. The current system runs on rules, norms,

and procedures (Hsiao 2000) that do not necessarily lead to an efficient allocation and use of available resources.

5. Methodology

To investigate issues of efficiency in Sri Lankan health facilities, two approaches were adopted: a quantitative analysis of health facility efficiency and its determinants; and a qualitative study, which would provide more in-depth information about factors that influence health facility performance.

5.1 Health Facility Survey

For the quantitative analysis, a health facility survey was conducted. It collected information on the activities provided by the health facility, the resources available (infrastructure, equipment, staff, drugs, and supplies), utilisation levels, and recurrent expenditures. The survey, which took place during 1998, collected information for the 1997 financial year. The questionnaire was based on the 1991 Health Facility Survey but modified in order to collect more accurate and comprehensive information about health facility activities and more reliable information about the allocation of resources between inpatient and outpatient activity. A total of 218 facilities were surveyed in seven districts, representing one district from each of seven provinces. Because of security concerns it was not possible to survey facilities in the Northern Province, though supplementary funds are currently being sought to extend the data collection to the Jaffna district.

At the time of data cleaning and preliminary analysis it was found that the questions about the allocation of staff time (particularly doctors' time) between outpatient and inpatient duties had been answered inconsistently by respondents. Moreover, the original questionnaire as designed was not sufficient to capture the varied work hours of the doctors. To improve the reliability of this variable, a supplementary survey of staff time use was undertaken in a sample of 20 facilities representing the different levels of health facility in the survey.

This study adopts three approaches to the quantitative measurement of efficiency. First, ratio measures are calculated, such as visits/staff member, drug expenditure per patient, and the three hospital service indicators (average length of stay, bed occupancy rate, turnover rate). Second, average costs are calculated. Finally, cost and production functions are estimated, with the residuals used as measures of relative efficiency. The cost function results are used to evaluate the existence of economies of scale and scope.

Average costs were calculated using the direct allocation method. In facilities that provide both inpatient and outpatient services, total recurrent costs were allocated between the inpatient and outpatient departments using the following procedures:

Staff costs: The questionnaire identified the total number of staff in the facility, and the staffing level of the outpatient department (OPD). For categories of staff that are generally allocated specifically to the OPD (i.e., all categories other than doctors), information from the MOHIM about average salary costs for each category were used to weight the allocation of total staff costs to the OPD. Total staff costs to the inpatient departments were assumed to be equal to the total staff costs less the outpatient staff costs. For doctors, who typically provide both inpatient and outpatient care, a supplementary survey was administered in a sample of 20

facilities chosen to be representative of the types of facility in the sample. In the survey instrument the medical officer in charge was asked to report the total hours worked by doctors and the hours spent in the OPD. The proportions from this survey were applied to the total salary costs of doctors and used to apportion this item between the inpatient and outpatient departments.

Drug costs: Quantities of drugs issued to the inpatient and outpatient departments were sampled for a selection of 50 drugs for a period of one month. These quantities were valued using prices from Medical Supplies Division (MSD), and this proportion was used to apportion the total drugs and supplies costs between inpatient and outpatient departments.

Other recurrent costs: These include overhead costs such as utilities and maintenance. The costs of other recurrent cost items were apportioned between the inpatient and outpatient departments in the same proportions as the total salary and drug costs.

Average costs were calculated by dividing the total recurrent costs of the outpatient and inpatient department by the output of those departments (outpatient visits, inpatient admission, and inpatient days).

5.2 Case Studies

A medical sociologist from Ruhuna Medical School was hired as a consultant to undertake the case studies. The aim of the case studies was to identify organisational features that contribute to a facility's performance. Data collection was oriented towards three sets of characteristics that were hypothesised to influence facility performance: the characteristics of the person in charge (including their training, work experience, and other responsibilities); the organisational goals of the facility and systems for managing key inputs such as staff and drugs; and the characteristics of the environment, such as the facility location and the extent of community support for the facility.

In total, 20 case studies of health facilities were undertaken.[3]

The facilities were selected to represent 10 "more efficient" and 10 "least efficient" health units, stratified by type of facility, so that facilities of different sizes and levels of complexity would be represented. Because of delays in finalising the cost allocation data, the selection was made before the analysis of average costs could be undertaken. Case study facilities were chosen on the basis of a combination of average length of stay, turnover rate, and bed occupancy rate. The case study sample is shown in Table 5.

In order to avoid bias, the researcher was "blinded" to the efficiency status of the facilities.

A semi-structured questionnaire was used, covering the following topics:

- Description of the setting

[3] Additionally, there were 20 case studies of MCH units. These will be reported on in a separate report to UNICEF.

- Individual characteristics of the facility manager
- Organisational goal and management of the facility
- Characteristics of the environment

Table 5. Case study sample: Facility efficiency

	"More efficient"	**"Least efficient"**
Teaching hospitals	3	1
Base hospitals	1	1
District hospitals	2	2
Peripheral units	3	4
Rural hospitals	1	2
Total	10	10

In most cases the interviews were conducted with the health facility manager. In two cases the medical officer in charge could not be interviewed. For one, the discussion was held with the regional director of health services (RDHS); and for the other, the deputy director was interviewed.

Content analysis was used to identify the characteristics of the management of the different facilities, and the researcher was asked to classify each facility as being "better managed" or "worse managed."

6. Data

6.1 Sample

6.1.1 Survey

The sample of facilities for this survey built on the sample from the 1991 Health Facility Survey, which covered all the public facilities in four districts, one each from four provinces (Colombo, Galle, Matale, and Polonnaruwa districts). In order to achieve greater national representativeness, the 1997 survey covered three additional districts (Kurunegala, Badulla, and Ratnapura). In these three districts, all facilities higher than central dispensary level were surveyed. Finally, a total of 30 MOOH/MCH units were randomly selected from the seven districts.

Table 6. Final sample

Type of facility	Number of facilities
MOOH	35
MCH	15
Central dispensary	19
Maternity home	-
CD&MH	7
Rural hospital	33
Peripheral unit	49
District hospital	52
Base hospital	10
Provincial hospital	2
Teaching hospital	9
Special teaching	3
TOTAL	234

6.1.2 Case Studies

The case studies covered two different types of facilities. First, a total of 10 MOOH/MCH clinics were purposively chosen with the assistance of the Family Health Bureau to represent five that were recognised to be functioning “well” and five functioning “poorly.” The second round of case studies covered curative health facilities above central dispensary level, that is, those providing inpatient services. The aim was to identify 10 among the “most efficient” and 10 “least efficient” facilities, stratified by facility type so that the proportions of facilities in the case studies were representative of the types in the overall

sample. The following criteria were used to identify their relative efficiency: average length of stay, turnover rate, and bed occupancy rate.

6.2 Data Collection, Entry, and Verification

Data collection and entry were contracted to a private research firm, Research International, which has considerable experience in undertaking surveys. The data collection team was made up of 17 interviewers together with a field supervisor.

6.2.1 Quality Checks

In order to ensure high quality of the data collected, a number of different checks on the data were performed as they were collected.

First, a one-day training session was held in which the questionnaire was reviewed question by question, and the type and source of information discussed. This was followed by two days of pilot testing of the questionnaire by the interviewers, following which the completed questionnaires were reviewed with the interviewers and field supervisors and any data collection errors corrected.

Second, the research team met with groups of interviewers twice during the data collection period to discuss specific problems that were arising with data collection.

Third, a series of random checks were undertaken in eight facilities. These were undertaken by telephoning the facility and cross-checking the responses for specific questions. Few discrepancies were identified, but where there were problems, interviewers were asked to return to the facility to re-collect the data.

Fourth, the data collected by the interviewers was cross-checked against a number of other information sources. Provincial directorates of health services (PDHS) covering four of the survey districts were able to provide expenditure data for drugs and personnel. Where differences were identified these were discussed with the MOHIM Director for Policy Analysis, and it was determined that the survey data was likely to be more accurate than the routine accounts data. For two of the provinces (Galle and Polonnaruwa), the PDHS was unable to provide expenditure data. For Colombo district, data for the facilities not managed by the Colombo Municipal Council or the Ministry of Health (i.e., teaching facilities) were provided by the Colombo Divisional Director of Health Services (DDHS) office and survey results were found to be consistent with data from this source. Expenditure data for teaching hospitals were cross-checked against MOHIM accounts data. Drug expenditure data were cross-checked against both MOHIM accounts and data from the Medical Supplies Division, and the survey data were found to be generally in agreement with data from MSD. Service indicators (occupancy rate and average length of stay) were verified against the numbers produced in the 1997 Annual Health Bulletin, and where discrepancies were found, the facility was consulted to determine which figures were correct.

Finally, once data entry was complete, spotchecks of the raw data from the questionnaires against the data set were undertaken, and major data entry problems were identified. Research International was asked to re-enter the data to rectify these errors. The re-entered dataset was then checked using data entry staff hired by IPS. Data from Sections 4, 5, 6, and 10 were

verified for all 218 questionnaires; for other sections, random checks were undertaken for every tenth questionnaire.

6.3 Data Cleaning

The survey targeted 231 facilities. Eleven of those facilities had to be excluded from the analysis as those in charge of the hospitals refused to or were unable to provide the data.

IPS research staff cleaned the final data set used for analysis. In spite of all the above quality checks, expenditure data could not be obtained for a significant number of health facilities, in particular the lower-level facilities for which data could not be collected at the PDHS office or elsewhere. Where expenditure data are entirely incomplete, the facilities have been excluded from the unit cost analysis (Table 7); however data for other variables have been included in the analysis on the assumption that the main problem lies with the expenditure data.

Table 7. Facilities with expenditure data by level of facility and district

	Complex	Intermediate	Basic	Outpatient	MOOH/ MCH	TOTAL
Colombo	9	2	6	2	1	20
Galle	2	0	1	0	0	3
Matale		2	12	5	0	19
Polonnaruwa		2	1	2	1	6
Badulla	1	3	17		0	21
Kurunegala	1	4	29		3	37
Ratnapura	1	3	20		0	24
TOTAL	14	16	86	9	5	130

7. Description of Facilities

7.1 Categorisation of Facilities

Given the wide mix of facilities in the public sector, analysis of the survey results required a classification system that would reduce the sample into sub-groups that are as homogeneous as possible in terms of outputs and inputs. It was also necessary to keep the size of the sub-groups large enough to allow meaningful statistical inferences to be drawn. The categorisation is as follows. Teaching hospitals and specialist hospitals are classified as *complex* inpatient facilities. Facilities are classified as *intermediate* inpatient facilities if they are base hospitals or have one or more of the following four facilities or equipment: radiology unit, intensive care unit, blood bank, and central sterile supplies division (CSSD). Facilities are classified as *basic* inpatient if they provide inpatient care but have none of the above. All facilities providing solely outpatient care are classified as *outpatient* unless they are *MOOH units* or *MCH centres*, which form a fifth group. Inputs and outputs of each of the above groups were compared with each other to ensure that the groups were statistically distinguishable and represented the different levels of health care delivery. Tables 8 and 9 show the distribution of the new categories within the sample by public sector facility type and by district. Table 10 shows the population covered at each level of facility.

Table 8. Categorisation of facilities

MOHIM Type/ IPS Type	Complex	Intermediate	Basic	Outpatient	MOOH/ MCH	TOTAL
MOOH					29	29
MCH					11	11
CD			1	16		17
MH			2			2
CD&MH			5	1		6
Rural		1	28	2		31
Peripheral unit		1	46			47
District		10	41			51
Base		10				10
Provincial	2					2
Teaching	9					9
Special teaching	3					3
TOTAL	14	22	123	19	40	218

Table 9. Categorisation of facilities by district

District	Complex	Intermediate	Basic	Outpatient	MOOH/ MCH	TOTAL
Colombo	9	2	10	10	18	49
Galle	2	4	20	2	4	32
Matale		2	13	5	4	24
Polannaruwa		3	9	2	2	16
Badulla	1	3	20	-	3	27
Kurunegala	1	5	31	-	6	43
Ratnapura	1	3	20	-	3	27
TOTAL	14	22	123	19	40	218

Table 10. Population coverage, by type of facility

Type of facility	Mean size of population covered by the facility
Complex	Over 50,000
Intermediate	20,000 - 50,000
Basic	1,000 - 5,000
Outpatient	5,000 - 20,000
MOOH/MCH	20,000 - 50,000

7.2 Availability of Infrastructure and Equipment

Average bed numbers increase with the level of complexity of inpatient facilities. However, it can be seen from Table 11 that bed size varies greatly between districts within the same facility group.

Table 11. Average number of beds available, by district and type of facility

District	Complex	Intermediate	Basic
Colombo	753	270	64
Galle	768	135	41
Matale	-	376	45
Polannaruwa	-	172	79
Badulla	788	115	55
Kurunegala	1140	181	63
Ratnapura	816	169	54
TOTAL	790	186	56
	(662)	(131)	(123)

Note: Standard deviation, where shown in parentheses.

As expected the availability of infrastructure and physical facilities improves with the level of facility as shown in Table 12. Over 80 percent of all facilities, excluding MCH/MOOH units, have a functional pharmacy. Notably, basic inpatient facilities are less

likely to have a pharmacy that functions than outpatient units. Only 64 percent of intermediate and 19 percent of basic inpatient facilities have a functional laboratory. While 64 percent of intermediate and 12 percent of basic inpatient facilities report having operating theatres, they are functional only in 59 percent and 10 percent of the cases. Intensive care unit facilities are only available in complex and intermediate inpatient units.

Table 12. Availability of functional physical facilities (percentage of facilities)

	Complex	Intermediate	Basic	Outpatient	MCH/ MOOH
Pharmacy	93	95	84	89	3
Medical record office	93	73	20	0	0
Kitchen	100	95	87	0	0
Laundry	29	18	1	0	0
Emergency room/ consultancy room	64	36	16	0	0
Dental clinic facility	57	86	39	5	3
CSSD	71	41	0	0	0
Medical laboratory	93	64	19	5	0
Radiology/X-ray	64	32	0	0	0
Operating theatre	93	59	10	0	0
Blood bank	71	45	0	0	0
Intensive care unit	79	14	0	0	0

Complex facilities have on average three ambulances and/or three other vehicles. Intermediate and basic facilities are likely to have two and one ambulances respectively (Table 13).

Table 13. Mean number of vehicles available

	Complex	Intermediate	Basic	Outpatient	MCH/MOOH
Ambulance	2.8	1.5	0.9	0.1	0.2
Other	2.6	0.1	0.0	1.1	0.2

Access of the different levels of facilities to at least one functional source of water and electricity are compared in Table 14. At least 94 percent of intermediate and basic facilities have functional water and electricity supplies. Ten percent of outpatient facilities and 50 percent of MOOH/MCH centres have no functional water supplies. This is reflected in a similar non-availability of functional toilets at these facilities. Eighty percent or more of all inpatient facilities have telephones that function. Fifteen percent of MOOH/MCH centres report having freezers, while only 5 percent or less of lower-level inpatient facilities do so. This may be attributed to vaccine storage needs at those facilities.

Table 14. Availability of functional equipment (percentage of facilities)

	Complex	Intermediate	Basic	Outpatient	MCH/ MOOH
Electricity and/or generator	100	94	95	96	53
Water (piped, bowzer, and/or well-pump)	100	95	98	90	50
Toilets (water seal/flush and/or bucket)	100	100	94	89	50
Telephone	100	95	80	47	43
Refrigerator	100	100	94	79	48
Deep freezer	79	5	5	0	15
Clinical waste disposal-incinerator	50	18	3	0	0
Clinical waste disposal-pit	29	77	57	37	20
Morgue	93	100	78	5	3
Morgue refrigeration	93	32	2	5	3

Ultrasound scanners, cardiac monitors and radiology facilities are only available at complex and intermediate facilities (Table 15). Twelve percent of basic inpatient facilities and 5 percent of outpatient facilities have ECG equipment available.

Table 15. Availability of functional technology (percentage of facilities)

	Complex	Intermediate	Basic	Outpatient	MCH/ MOOH
Ultrasound scanning	81	35	0	0	0
X-ray unit (plain)	75	20	0	0	0
X-ray unit: contrast radiology	44	5	0	0	0
Mobile X-ray unit	50	15	0	0	0
ECG	81	50	12	5	0
EEG	25	0	2	0	0
Radiotherapy	31	0	0	0	0
CT scanner	19	5	0	0	0
Cardiac monitor	56	15	1	0	0

7.3 Staffing

Personnel have been grouped into four categories:

- "Doctors" include specialists, medical officers, interns, assistant/registered medical officers, and dental surgeons;
- "Nurses" include nurses, midwives, public health nurses, and midwives;
- "Paramedical" staff include pharmacists, occupational therapists, and health inspectors;

> "Non-technical" staff include attendants and labourers.

The average number of each type of staff available decreases with the level of facility complexity (Table 16). Comparing availability of doctors, nurses, paramedical, and non-technical staff among the different levels, complex facilities have 7-8 times the number of those staff than intermediate facilities, and intermediate facilities 4-5 times the number of those staff than basic inpatient facilities. Complex hospitals have three times more specialists per medical officer than intermediate facilities; basic facilities have none. The nurse-doctor ratio is the same at complex and intermediate levels and slightly lower at basic inpatient facilities. The ratio of other staff (paramedical and non-technical) to doctors and nurses increases as level of complexity decreases.

Table 16. Staffing availability and mix

	Complex	Intermediate	Basic	Outpatient	MCH/ MOOH
Doctors: mean	173	21	4	1	2
Std. Deviation	(214)	(23)	(2)	(0)	(2)
N	14	22	123	19	40
Nurses: mean	393	53	10	0	1
Std. Deviation	(349)	(50)	(9)	(0)	(3)
N	14	22	123	19	40
MOOH staff: mean	0.00	0.05	0.02	0.00	17.80
Std. Deviation	(0)	(0)	(0)	(0)	(14)
N	14	22	123	19	40
Paramedical staff: mean	67	8	2	0	0
Std. Deviation	(70)	(8)	(2)	(0)	(0)
N	14	22	123	19	40
Administrative staff: mean	15	3	1	0	0
Std. Deviation	(11)	(2)	(0)	(0)	(0)
N	14	22	123	19	40
Non-technical staff: mean	463	65	20	3	16
Std. Deviation	(323)	(57)	(11)	(1)	(29)
N	14	22	123	19	40
Nurses/doctor : mean	3.0	3.0	2.7	0.0	0.0
Std. Deviation	(1.5)	(1.4)	(1.7)	(0.0)	(0.0)
N	14	22	123	19	40
Specialists / Medical officers	0.3	0.1	0.0	0.0	0.0
Std. Deviation	(0.4)	(0.1)	(0.0)	(0.0)	(0.0)
N	14	22	123	19	40
Paramedics and non-technical staff / Nurses and doctors: mean	1.1	1.3	2.4	3.3	19.2
Std. Deviation	(0.4)	(0.9)	(2.0)	(1.4)	(31.6)
N	14	22	123	19	40

7.4 Services Offered

Outpatient units are typically open 6-7 days a week. OPD clinics at inpatient facilities are open the entire week with hours of operation ranging from an average of 16 hours at complex hospitals to six hours at basic inpatient facilities. Inpatient facilities are open to emergency cases 24 hours throughout the week (Table 17).

Table 17. Hours and days of operation

	Complex	Intermediate	Basic	Outpatient
OPD - days per week	7	7	7	6
	(0.0)	(0.0)	(0.0)	(1.0)
	11	22	123	19
OPD - hours per day	15.6	8.0	6.2	7.1
	(8.3)	(5.3)	(0.6)	(2.0)
	11	22	123	19
Emergency - hours per day	23.7	20.5	21.8	n/a
	(0.8)	(8.0)	(6.9)	n/a
	8	10	23	n/a

Notes: Excludes specialist hospitals.
Mean, standard deviation (in parentheses) and sample size reported in each case.

Over 90 percent of MOOH/MCH centres and complex and intermediate inpatient facilities carry out preventive services such as health education and control of communicable diseases (Table 18). Less than 75 percent of basic inpatient facilities and outpatient units provide the same preventive services. MOOH/MCH centres apart, basic and intermediate facilities are most likely to provide MCH services.

Table 18. Preventive and MCH services provided (percentage)

	Complex	Intermediate	Basic	Outpatient	MOOH/ MCH
Health education	100	91	72	63	100
Control of communicable diseases	93	91	71	42	93
Environmental sanitation	64	73	44	26	85
Prenatal care	57	100	89	47	93
Postnatal care	57	86	77	21	93
Family planning	64	86	85	42	98
Immunization	79	91	90	47	100
Supplementary feeding	57	45	50	21	88
Well-baby clinic	64	82	79	42	93

Complex facilities differ from one another in what services they provide, depending on their specialty. Lady Ridgeway Hospital is the national hospital for children and provides all the most complex curative services for children, all of which was classified as paediatric. Of the two teaching hospitals in Galle, Mahamodara Hospital deals only with obstetrics/ gynaecological services, while Karapitiya Hospital deals with all other complex cases. These

differences explain why only 65-80 percent of complex facilities provide each of the curative services listed in Table 19. The only exception is "curative medical services," which are provided by all complex facilities.

Intermediate and basic facilities dominate in the provision of basic curative care, with over 85 percent providing obstetric, paediatric and general medical care (Table 19). This is in keeping with their role as first-level referral centres. Major surgery is mainly available at complex facilities. Minor surgery appears to be underprovided at lower-level inpatient facilities. Sixty-eight percent of intermediate facilities and 37 percent of basic facilities are designated to provide minor surgery, but only 45 percent and 16 percent actually provide it.

Table 19. Curative services actually provided, by facility type (percent)

Service	Special hospitals	Complex (excluding special hospitals)	Intermediate	Basic	Outpatient	MOOH/ MCH
Obstetrics	67	73	100	94	32	18
Gyneacology	67	73	82	68	37	5
Paediatrics	67	82	95	88	68	15
Medicine	100	73	95	98	84	8
Minor surgery	67	91	45	16	0	0
Major surgery	67	73	18	1	0	0

7.5 Quality and Resource Availability Indicators

Two aspects of health facility quality were assessed: physical and structural.

Physical quality was assessed on the basis of whether the hospital was "clean and in good state of repair." As shown in Table 20, overall physical quality is highest at intermediate facilities, with 75 percent or more having clean floor, walls, and smell and 65 percent having good furniture.

Table 20. Physical quality indicators, by facility type (percent)

Indicator	Complex	Intermediate	Basic	Outpatient	MCH/MOOH
Floor	62.5	80	65.85	57.89	17.5
Walls	43.75	75	57.72	59.89	17.5
Furniture	75	65	71	57.89	17.5
Smell	75	85	90.24	73.68	25

Note: percent of facilities of each type where physical conditions were reported as "clean and in good state of repair"

Structural quality was assessed on the basis of the availability of equipment or technology required to deliver specific types of curative and preventive services ("tracer conditions"). This is based on the principle that a number of essential inputs can be identified without which it is not possible to provide a service of an acceptable quality. The components of the indices were decided upon in collaboration with medical personnel from the Ministry of

Health. (See Annex A for list of tracer conditions and the minimum input requirements defined for each case).

Scores out of 12 for the structural quality index for minor surgery decline with facility complexity (Table 21). There is considerable variation between districts at each facility level. For instance, complex facilities in Badulla achieve the maximum score of 12 while those in Ratnapura on average score only 7 out of 12. Basic inpatient facilities have relatively low scores, confirming the earlier finding that only half of those designated to provide minor surgery actually provide it. Similarly, scores out of 24 for major surgery also decline with facility level and show considerable variation between districts. Complex and intermediate facilities in Badulla are relatively well equipped for major surgery while Ratnapura and Polonnaruwa inpatient facilities are the least well equipped.

Table 21. Structural quality indicators by facility type

	Maximum score	Complex	Intermediate	Basic
Minor surgery	12	9.4	8.5	6.7
		(2.50)	(2.34)	(1.86)
		14	22	123
Major surgery	24	20.4	16.6	12.2
		(4.31)	(5.08)	(3.01)
		14	22	123
Cardiac resuscitation	12	9.7	7.6	4.6
		(2.92)	(3.61)	(2.07)
		14	22	123
Caesarian section	31	24.5	22.3	17.3
		(5.54)	(5.66)	(4.41)
		14	22	123
Normal delivery	19	15.1	15.5	13.1
		(3.08)	(3.19)	(3.21)
		14	22	123
Vaccination, well-baby care	8	5.5	6.0	5.4
		(2.31)	(1.02)	(1.71)
		14	22	132
Prenatal care	9	4.9	6.5	4.8
		(3.22)	(1.18)	(1.20)
		14	22	123

Note: Mean, standard deviation (in parentheses), and sample size are reported.

Structural quality scores for normal and Caesarean deliveries reveal that basic inpatient facilities are relatively poorly equipped for child delivery. Complex and intermediate facilities have similar average scores for normal delivery, which are low due to poor scores in Galle, Polonnaruwa, and Ratnapura districts. The Caesarean section scores provide cause for concern in that all complex and intermediate facilities alike score less than 25 out of 33, with the

exception of three districts: Colombo (intermediate), and Badulla and Kurunegala (complex). However, the better structural quality of intermediate relative to basic facilities is reassuring since women are likely to be referred to the former when complications in delivery arise.

Intermediate hospitals are best equipped to provide vaccinations, well-baby, and prenatal care. Basic and complex facilities have roughly the same average scores, while outpatient units perform the worst. There are district-level variations, with facilities in Badulla having the highest scores.

Drug availability scores (Table 22) were calculated based on MOHIM basic requirements for drugs that must be available at each level of facility (see Annex B). Large inpatient hospitals in Level 4 group are relatively well stocked with drugs, with average scores of 28 out of 30. The lower scores obtained by lower-level inpatient facilities and central dispensaries are of some concern. As with structural quality indicators, there is significant variation between the scores of different districts at the same facility level. The maximum score in each case provides some indication of this variation.

Table 22. Drug availability indicators

Index	Types of facilities	Score out of	Max. Score	Mean Score
Level 1	CD, MH, CD&MH	25	23	18.5
Level 3	Rural, peripheral, district	30	30	25.1
Level 4	Base, provincial, teaching, special	30	30	27.8

Note: Levels 1 – four are MOHIM classifications.

7.6 Utilisation

Complex, intermediate, and basic facilities all provide both inpatient and outpatient services, although outpatient services predominate at lower levels (Table 23). Relative to complex facilities, the ratio of outpatient visits per bed-day is twice as high in intermediate facilities and six times as high in basic facilities. Numbers of lab tests and radiology examinations are higher at the more complex facilities.

Table 23. Average annual number of outpatient visits and investigations

	Special hospitals	Complex (excluding special hospitals)	Intermediate	Basic	Outpatient	MCH/ MOOH
Outpatient visits	18,304	323,682	108,992	54,762	37,411	821
	(23,812)	(203,395)	(67,894)	(74,172)	(66,525)	(1,999)
	3	11	22	121	18	40
Dental visits	650	24,751	9,107	2,333	0	0
	(1,126)	(35,826)	(8,364)	(3,587)	(00)	(00)
	3	11	22	123	0	0
Specialist visits	81,560	39,424	2,409	1,324	1,229	18,409
	(115,344)	(48,448)	(5,345)	(3,195)	(3,509)	(44,200)
	2	6	15	104	11	20
Lab tests	298,542	266,929	136,786	853	0	0
	(375,119)	(303,724)	(533,210)	(3,883)	(0)	(0)
	3	11	22	123	19	40
Radiology examinations	20,263	52,579	812	0	0	0
	(24,796)	(91,025)	(3,807)	(0)	(0)	(0)
	3	11	22	123	19	40
Outpatient per bed-day	0.72	2	5	23	n/a	24
	(0.13)	(1)	(3)	(57)		(6)
	2	6	9	79		2

Note: Mean, standard deviation (in parentheses), and sample size reported.

In basic and intermediate facilities, obs/gyne, medical, and surgical services make up the bulk of inpatient services (Table 24), with intermediate facilities providing a relatively greater share of surgical admissions. Obs/gyne cases make up a greater share of output in basic inpatient facilities. More specialised inpatient services such as psychiatry and eye services are only provided in complex inpatient facilities. The proportion of Caesarean sections to total deliveries is 21 percent at complex facilities and 10 percent at basic facilities (Table 25). The former is probably due to the fact that mothers at risk are transferred to the teaching hospitals. The district-level caesarean rate is highest for Colombo and Galle, where the majority of teaching hospitals are located.

Table 24. Distribution of admissions by category and type of facility (percentage of total admissions)

Type of Admission	Complex	Intermediate	Basic
Obstetric/Gynaecological	31	19	28
Medical	20	52	61
Surgical	17	24	14
Paediatric	10	13	15
Psychiatry	1	0	n/a
Eye	1	0	n/a

Table 25. Inpatient statistics by type of facility

	Complex	Intermediate	Basic
Admissions	54,870	14,328	4,856
	(39,420)	(11,693)	(9,038)
	14	21	122
Bed-day	242,605	49,362	9,813
	(193,935)	(55,115)	(11,173)
	11	14	96
Transfers	5,859	844	295
	(16,864)	(684)	(393)
	10	16	97
Intensive care admissions	2,888	72	0
	(8,705)	(239)	(0)
	11	21	123
Deliveries	5,685	1,145	255
	(5,807)	(1,402)	(994)
	12	22	122
Caesarian section rate	21%	10%	0%
Operative intervention rate	31%	11%	1%

Note: Mean, standard deviation (in parentheses), and sample size recorded.

8. Measuring Efficiency

Three different approaches to measuring efficiency are presented below.

8.1 Ratio Measures

8.1.1 Staffing Ratios

Complex facilities have the highest number of staff per bed, while the total number of staff bed is roughly similar at basic and intermediate facilities (Table 26). Basic facilities have lower numbers of skilled staff per bed but have relatively more paramedical and non-technical staff. In complex facilities doctors on average see 167 outpatients per month, compared to 1364 at basic facilities (Table 27).

Table 26. Mean staff per bed ratios, by type of facility

	Complex	Intermediate	Basic
Doctors per bed	0.2	0.1	0.1
	(0.1)	(0.1)	(0.0)
Nurses per bed	0.5	0.3	0.2
	(0.2)	(0.1)	(0.1)
Total staff per bed	1.4	0.7	0.8
	(0.5)	(0.2)	(0.3)

Note: Std. deviation in parentheses

Table 27. Outpatient visits and admissions per doctor

	Complex	Intermediate	Basic	Outpatient
Outpatient visits per doctor				
N	14	22	121	18
Mean/annum	2003	8431	16369	35259
Minimum	13	234	3133	8447
Maximum	5387	20051	159993	300000
Mean/month	167	703	1364	2938
Admissions per doctor				
N	14	21	122	n/a
Mean/annum	429	1020	996	n/a
Minimum	149	486	30	n/a
Maximum	991	1735	3736	n/a
Mean/month	36	85	83	n/a

Admissions per nurse				
N	14	21	113	-
Mean/annum	148	420	409	-
Minimum	87	180	15	-
Maximum	300	1996	2005	-
Mean/month	12	35	34	-

8.1.2 Expenditure Ratios

Drug expenditures per outpatient visit are highest in complex facilities and lowest at basic inpatient facilities (Table 28). Drug expenditure per admission is higher at basic facilities than at intermediate facilities, reflecting lower levels of utilisation at the former.

Table 28. Drug expenditure by type of facility (rupees)

		Complex	Intermediate	Basic	Outpatient
Per admission	N	14	15	82	n/a
	Mean	1074	101	118	n/a
Per outpatient visit	N	14	16	81	5
	Mean	113	72	15	4

8.1.3 Service Indicators

For facilities which admit inpatients, the three inpatient service indicators (average length of stay, bed occupancy rate, and bed turnover rate) were calculated. These are shown in Table 29. Average length of stay increases with facility complexity, which is expected, as more complex facilities should be seeing more severely ill patients. Excluding the three special hospitals (cancer, fever, and eye) slightly reduces the average length of stay in the complex inpatient category. The occupancy rate in complex inpatient facilities is slightly higher than international norms would suggest (80-85 percent), and a number of facilities have occupancy rates in excess of 100 percent. Under these circumstances overcrowding is likely to be an important factor undermining perceived, if not technical, quality. The average occupancy rate for basic inpatient facilities is less than 50 percent, suggesting substantial underutilisation of capacity, though there are four facilities with occupancy rates greater than 100 percent. The turnover rate measures the admissions per bed per year, and is fairly similar across all three types of facility.

Table 29. Service indicators

		Complex	Intermediate	Basic
N		11	14	96
ALOS	Mean	4.8	3.0	2.8
	Range	(3.4 –7.4)	(1.2 – 5.8)	(1.1 – 15.5)
ALOS excluding special hospitals	Mean	4.5	n/a	n/a
	Range	(3.4 – 5.9)		
Bed occupancy rate	Mean	84.8	58.2	47.9
	Range	(32.1 – 109.3)	(21.1 – 94.6)	(1.1 – 197.8)
Turnover rate	Mean	72.17	78.26	67.4
	Range	(22.2 – 152.6)	(39.8 – 124.3)	(1.5 – 548.6)

Notes: Excludes Eye Hospital and Angoda Fever Hospital.
Number of observations for turnover rate: Complex = 14, Intermediate = 21, Basic = 122. The number is lower for ALOS and bed occupancy because the data on patient days was more often unavailable.

8.1.4 Comparative Assessment of Facility Performance: Lasso Indicators

A rapid assessment of the relative efficiency of facilities can be made by simultaneously representing occupancy rates, turnover rates, and average lengths of stay on a single graph (Barnum and Kutzin 1993, Lasso 1986). The occupancy rate is plotted on the x-axis of the graph, and the turnover rate on the y-axis. Any ray drawn from the origin represents a constant average length of stay, and this measure increases monotonically from left to right. It is conventional to show the distribution of individual facilities according to four regions in the graph, defined by drawing intersecting lines through the mean values of occupancy rate and turnover rate.

An interpretation of the reasons for a facility falling in each region is given by Barnum and Kutzin (1993). Hospitals in Region 1 have low occupancy and turnover rates relative to the rest of the sample. This may be attributable to excess capacity, low demand for hospitalisation in relation to installed capacity, and reduced demand due to patients being diverted to other institutions. The low occupancy despite high turnover rates for hospitals in Region 2 may be due to unnecessary hospitalisations and a predominance of normal (as opposed to complicated) deliveries. Hospitals in Region 3 are performing well on average, relative to all the other facilities in the group, with high occupancy rates and turnover rates. Region 4 hospitals may be characterised by a high proportion of severely ill patients, a predominance of chronic cases, and unnecessarily long inpatient stays.

Figures 1-3 plot facilities according to these indicators for each of the three facility types.

Basic inpatient facilities (Figure 1) are predominantly found in Regions 1 and 3, with a significant number of them in Region 1. It is important to recognize that the regions in this graph are defined by the sample averages, not international norms. If the “average” bed occupancy line were drawn at 80-85 percent, then a considerably higher proportion of facilities would fall into the “relatively inefficient” Region 1. The latter consists of small peripheral units or rural hospitals, which provide mainly outpatient services but have beds available for basic inpatient obstetric services. Such hospitals, although set up to provide medical and obs/gyne services, are often bypassed by patients who prefer the quality of services offered at more complex hospitals. The authors’ visits to these facilities revealed several empty beds,

unused wards, and badly maintained equipment. Hence the low turnover and low occupancy rates found in the basic hospitals in Region 1.

Figure 1. Lasso diagram – Basic inpatient facilities

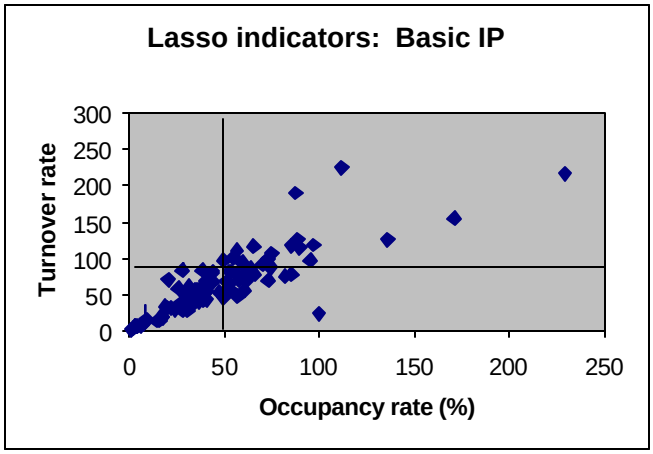


Figure 2 presents the same performance indicators for intermediate inpatient facilities. Again facilities are found to be distributed mainly in Regions 1 and 3.

Figure 2. Lasso diagram – Intermediate inpatient facilities

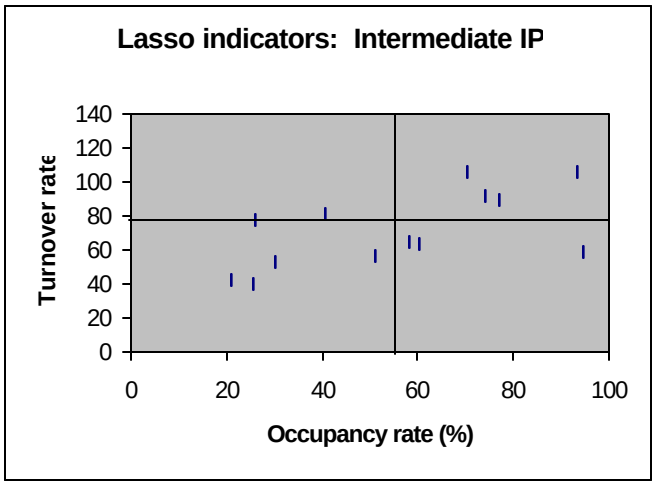
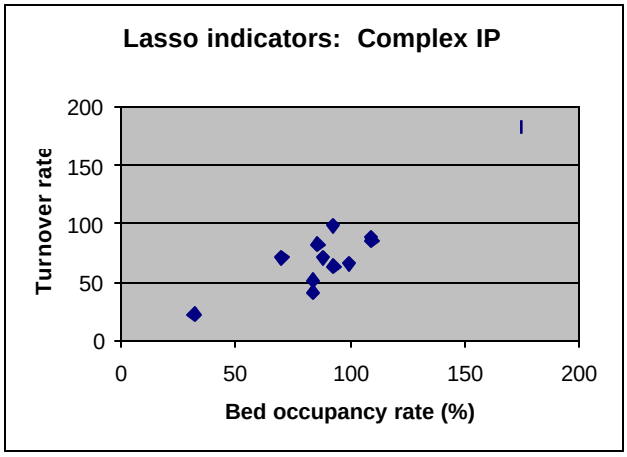


Figure 3 for complex facilities shows that while the majority of the complex facilities are in Region 3, a few lie in Region 4. These include long-stay specialist hospitals such as the Eye Hospital and Angoda Fever Hospital. The mean for complex hospitals of 93 percent occupancy is unusually high by international standards. If international norms were to be used instead, the "mean" occupancy line would be a lower lever of 80 percent, and more complex facilities would be in the relatively well-performing Region 3. Meanwhile, the hospital with the extremely high occupancy of over 140 percent may be seriously compromising on process

quality and should not be regarded as 'relatively efficient' on the basis of its location in Region 3.

Figure 3. Lasso diagram – Complex inpatient facilities



8.2 Average Costs

Table 30 shows the mean cost of each type of activity by facility type, together with the ratio of the highest to lowest cost in the sample. From the table it can be seen that while complex inpatient facilities have the highest mean cost per inpatient admission, basic inpatient facilities have higher costs than intermediate facilities. This is probably due to the lower occupancy rates in the basic inpatient facilities, which has the effect of increasing the average cost. A similar pattern holds for the cost per patient day, with complex inpatient facilities having the highest cost per patient day, followed by basic inpatient facilities.

For cost per outpatient visit, the highest costs are observed in the complex inpatient facilities, followed by intermediate inpatient facilities. Costs are similar in the basic inpatient facilities and outpatient facilities, and are considerably lower than those in the higher-level facilities.

Of particular interest is the range of costs observed in all facilities for all types of service. As in 1991, the ratio of highest to lowest cost is very large for inpatient costs in complex and intermediate inpatient facilities. The variation is even greater, however, for basic inpatient facilities. The variation in the cost per outpatient visit is considerable for all types of outpatient facility, but only moderate for facilities that provide only outpatient services.

Table 30. Average costs (rupees)

	Cost per admission			Cost per patient day			Cost per outpatient visit		
	n	Mean	High/ low	n	Mean	High/ low	n	Mean	High/ low
Complex	15	3446	8.5	12	635	6.4	16	153	21.5
Intermediate	13	900	5.8	9	394	5.8	12*	26	4.1
Basic	80	1545	82.4	64	627	119.8	79	32	37.8
Outpatient		N/a			N/a		3	35	4.6

* One intermediate inpatient facility excluded from calculation of cost per outpatient visit because the number of visits was unreasonably low (facility ID 702).

Cost per admission is very high for very small facilities because of low utilisation (e.g., one rural hospital has 57 admission/year and only 27 deliveries/year. This means that the fixed costs of running the inpatient facility are spread over a very small number of units of output, thus raising average costs.

The breakdown of total costs by department and by inputs is shown in Tables 31 and 32. The share of costs attributable to inpatient costs declines with facility complexity. The shares of staff and drugs in total costs are comparable with international norms, with drugs and staff accounting for more than 80 percent of total costs. This implies that efforts to manage costs should focus on these two major cost items. The share of drugs in inpatient and outpatient costs is highest for complex inpatient facilities, which is consistent with the essential drugs list which provides for more expensive products to be available in Level 3 and Level 4 facilities, as well as with more severely ill patients being hospitalised in these facilities. There is little difference between intermediate and complex facilities in the proportions of costs attributable to drugs.

Table 31. Cost breakdowns (1): Percent of total recurrent cost attributable to inpatient and outpatient care

	Inpatient (percent)	Outpatient (percent)
Complex	85.8	14.2
Intermediate	76.3	23.7
Basic	67.4	32.6

Table 32. Cost breakdowns (2): Percent of total cost by input

	Total cost (percent)			Inpatient cost (percent)			Outpatient cost (percent)		
	Staff	Drugs	Other	Staff	Drugs	Other	Staff	Drugs	Other
Complex	53.5	30.7	15.5	60.1	23.5	16.4	31.1	57.0	11.9
Interme-diate	60	21.2	17.8	67.4	11.9	20.7	47.0	42.5	10.5
Basic	59.7	20.8	19.5	66.6	8.8	24.6	45.9	45.3	8.8
Outpatient	75.5	12.7	11.8				71.0	12.7	16.3

8.2.1 Explaining cost differences

Average length of stay

Average length of stay should be positively related to the cost per admission. This is both because cumulative costs should be higher for higher length of stay, and because length of stay is expected to be correlated with severity. Figure 4 graphs average cost per admission against average length of stay for basic inpatient facilities. Surprisingly, there appears to be no relationship between these two variables. There is relatively little variation in average length of stay in these facilities, with clustering of facilities between two and four days. However, there is considerable variation in costs for similar length of stay. The pattern is similar for the other two types of inpatient facility. The R2 from a simple bivariate regression of cost per admission and length of stay shows that average length of stay explains a very small proportion of total cost per admission, particularly for intermediate and basic inpatient facilities (Table 33).

Figure 4. Average cost per Admission and Average Length of Stay for Basic Inpatient Facilities

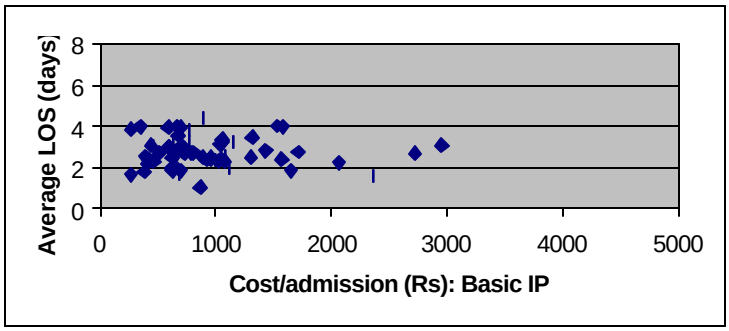


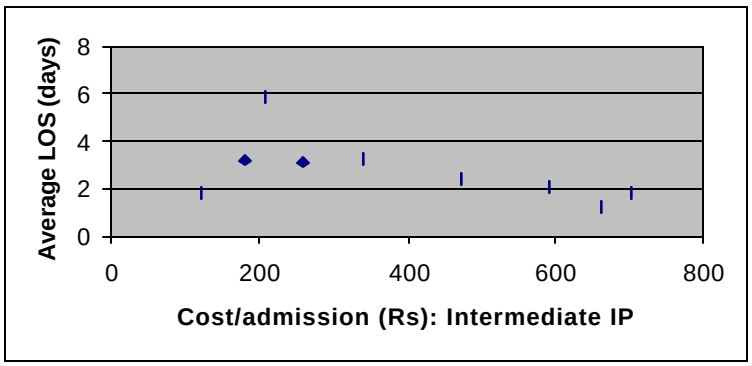
Table 33. R-squared values from a simple bivariate regression of cost per admission cost on average length of stay

	R2 from regression of cost per admission on ALOS
Complex inpatient	.31
Intermediate inpatient	.13
Basic inpatient	.00

Notes: Regressed by each type of facility using function '*admcost = f(alos)*'.

To the extent that higher costs are incurred in earlier days of a hospital admission, we would expect average cost per inpatient day to be negatively related to average length of stay. Figure 5 graphs cost per day against length of stay for intermediate inpatient facilities, and indicates that the expected relationship holds for intermediate-level facilities. However, the picture is less clear for both basic and complex intermediate facilities.

Figure 5. Average cost per admission and average length of stay for intermediate inpatient facilities



8.2.1.1 Occupancy rate and costs

A higher occupancy rate should be associated with lower costs per inpatient day and per admission, due to the higher utilisation of fixed capacity and the consequent spreading out of fixed costs over a larger number of units of output. Figure 6 graphs cost per admission against occupancy rate for basic inpatient facilities, and reveals the expected negative relationship. Figure 7 shows the cost per day against occupancy rate for complex facilities and also shows a negative association. Table 34 shows the R2 from a regression of cost per day on occupancy rate, and indicates that a significant proportion of total variation is explained by this factor, particularly for intermediate and basic facilities. Because the complex facilities are so heterogeneous, it may be that differences in case mix are responsible for some of the cost variation.

Figure 6. Cost per admission and occupancy rate for basic inpatient facilities

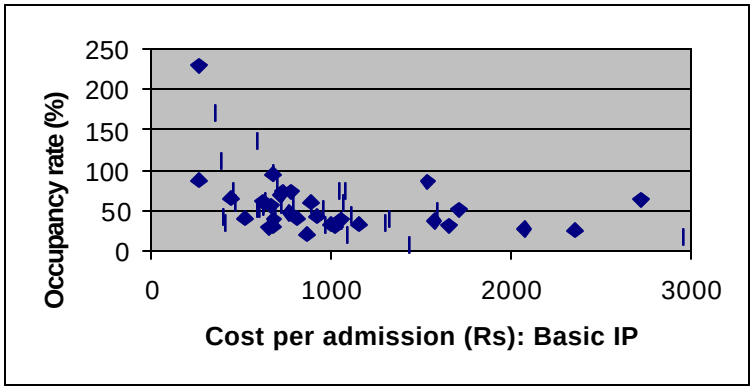


Figure 7. Cost per bed-day and occupancy rate for complex inpatient facilities

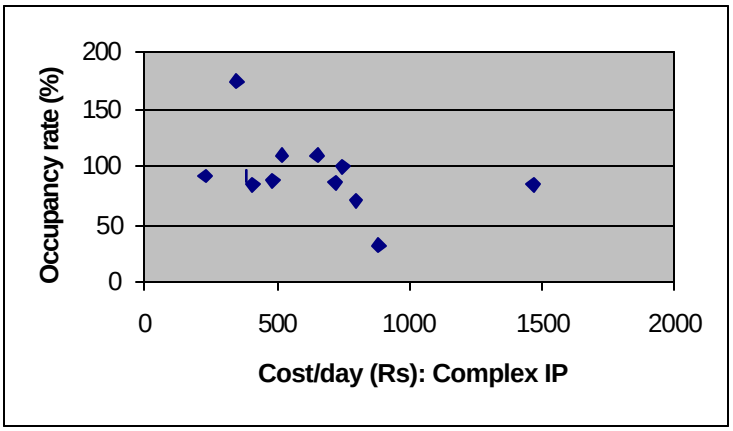


Table 34. R-squared values from regressing cost per day on occupancy rate

	R2 Occupancy rate	R2 Occupancy rate + occupancy-squared
Complex	0.17	0.17
Intermediate	0.52	0.58
Basic	0.15	0.34

Notes: Regression equations: 'Cost per bed-day=α+β(occupancy rate),' 'Cost per bed-day=α+β(occupancy rate) + γ(occupancy rate)'

8.2.2 Comparison of Sri Lankan Performance Indicators Over Time

The analysis and findings of the 1991 public health facility survey provided the motivation for this current study. The 1991 survey showed that the facilities operated at very low average costs, and had high bed occupancy rates and low lengths of stay by international standards. Combined, such indicators suggested that Sri Lankan public hospitals were performing extremely efficiently, relative to other low- and middle-income countries. Before moving on to assess factors underlying hospital performance, the results of the 1991 and 1997 surveys are compared, both with each other and with results from other countries to see if the "relative performance" indicators in 1997 point to the same trends as in 1991.

Table 35 compares inpatient and outpatient unit costs for 1991 and 1997, at 1997 prices, for a selection of hospital types. In order that the comparisons be valid, the averages for 1997 were calculated for the four districts that the 1991 survey covered. Table 36 compares performance indicators for the two years.

Table 35. Unit costs in 1991 and 1997

MOOH type	Cost per admission		Cost per bed-day occupied		Cost per outpatient visit	
	1991	1997	1991	1997	1991	1997
Rural hospital	1,050	1,384	316	501	31	32
Peripheral unit	880	1,611	437	561	32	20
District hospital	1,764	818	215	278	54	35
Base hospital	846	946	235	295	153	22
Teaching hospital	4,413	2,681	742	597	222	152

Note: 1991 costs have been inflated to 1997 prices using GDP deflators.

Table 36. Service indicators in 1991 and 1997

MOOH type	Bed-occupancy rate		Turnover rate		Average length of stay	
	1991	1997	1991	1997	1991	1997
Rural hospital	55	37	65	53	3.5	2.8
Peripheral unit	57	45	76	88	3.0	2.6
District hospital	105	48	60	158	10.3	4.1
Base hospital	99	86	90	100	4.1	3.7
Teaching hospital	97	105	63	87	6.0	4.7

Inpatient unit costs have increased at the lower-level rural hospitals and peripheral units and also at base hospitals. Bed occupancy and turnover rates have fallen between 1991 and 1997 at all three levels of hospitals, explaining a large part of the increase in inpatient unit costs. At district hospitals, costs per admission have fallen while costs per bed-day have increased. The huge increase in turnover rates at district hospitals lies behind the fall in costs per admission, while the decline in occupancy rates explains the fall in bed-day costs. At teaching hospitals, utilisation increased significantly between 1991 and 1997 as evidenced by the lower inpatient unit costs. Outpatient unit costs have fallen at all levels. The fall in average lengths of stay across all hospital types is part of a general downward trend over the last 25 years in all government hospitals in Sri Lanka (MOHIM 1997). While part of it may be due to increasing cost pressures, the long-term decline suggests that technological improvements and consequent productivity increases may have been largely responsible for the change.

8.2.3 Cross-country Comparison of Performance Indicators

Tables 37 and 38 show unit costs as a percentage of GDP per capita and performance indicators for a selection of countries where such data were available. Level 1 hospitals correspond to the complex facilities and Level 2 to the intermediate and basic hospitals in this study. It must be noted that the facility types are only roughly comparable internationally as there may be very large variations in the way in which facilities were categorized into Levels 1 and 2 in each of the countries.

Sri Lankan Level 1 facilities both in 1991 and 1997 had the lowest inpatient unit costs as a percentage of GDP per capita relative to all other countries shown here. This may partly be

explained by the fact that Sri Lankan occupancy and turnover rates are the highest in the group and average lengths of stay the lowest. Unit costs at Level 2 facilities, although not the lowest internationally, certainly rank at the lower end of the scale. Occupancy rates at these hospitals are fairly low by international standards. However, high turnover rates and very low average lengths of stay are able to explain the relatively low unit costs.

Table 37. Unit costs as a percentage of per capita GNP for selected of countries

Country	Year	Cost per patient day	Cost per admission	Cost per bed	Cost per outpatient visit
Level I hospitals (Complex)					
Sri Lanka	**1991**	**1.4**	**9.3**	**437.2**	**1.0**
Sri Lanka	**1997**	**1.4**	**7.4**	**410.0**	**0.3**
Bangladesh	1997	3.3	68.2	1030.7	1.9
China	1986	3.2	90.0	1119.0	N/a
China	1989	3.0	76.0	1039.0	0.8
Colombia	1978	3.4	25.0	985.0	0.8
Indonesia	1985	2.8	26.0	756.0	0.7
Jamaica	1985-86	3.7	40.0	1148.0	1.5
Niger	1986-87	2.2	32.0	710.0	5.4
Papua New Guinea	1988	3.3	33.0	962.0	0.7
Rwanda	1984	5.2	N/a	1667.0	1.3
Zimbabwe	1987	4.3	33.0	1393.0	1.6
Level II & III hospitals (Intermediate & Basic)					
Sri Lanka	**1991**	**1.7**	**5.3**	**172.3**	**0.1**
Sri Lanka	**1997**	**1.2**	**3.0**	**130.7**	**0.1**
Bangladesh	1997	4.4	16.0	1000.2	0.6
Belize	1985	3.7	12.9	505.9	N/a
China	1986	1.8	29.8	584.2	0.5
China	1986	1.5	30.0	502.0	N/a
Indonesia I	1987	2.0	n/a	n/a	0.6
Indonesia	1985	1.1	6.6	221.2	0.3
Jamaica	1985-86	2.7	18.3	812.3	1.1
Malawi	1987-88	1.9	17.0	806.0	0.4
Papua New Guinea	1988	3.1	38.7	734.0	0.5
Rwanda	1984	2.6	n/a	556.6	0.6
St.Lucia	1986-87	3.0	21.0	808	1.3
Zimbabwe	1987		17.0	667.0	0.3

Sources: Barnum and Kutzin 1993, Rannana-Eliya and Somanathon 1999, and survey for current study.

Table 38. Service indicators for selected of countries

Country	Year	Occupancy rate	Turnover rate	Average length of stay
Level I hospitals (Complex)				
Sri Lanka	**1991**	**96.3**	**65.0**	**6.9**
Sri Lanka	**1997**	**93.5**	**74.4**	**4.7**
Bangladesh	1997	92.9	30.5	25.2
China	1986	94.0	13.7	25.1
Colombia	1980	73.0	37.8	7.2
Ethiopia	1983-85	47.0	14.7	11.8
Fiji	1987	83.0	42.5	7.2
Indonesia	1985	75.0	29.2	9.4
Jamaica	1985	79.0	35.2	8.2
Niger	1986-87	87.0	22.5	14.1
Papua New Guinea	1988	80.0	29.4	9.9
Rwanda	1984	88.0	n/a	n/a
Tunisia	1989	76.0	27.6	10.1
Zimbabwe	1987	89.0	41.7	7.8
Level II & III hospitals (Intermediate and Basic)				
Sri Lanka	**1991**	**63.9**	**57.1**	**6.0**
Sri Lanka	**1997**	**49.8**	**80.9**	**2.8**
Bangladesh	1997	78.8	21.1	4.0
Belize	1985	36.3	37.8	3.4
China	1986	89.5	20.9	16.1
Colombia	1980	56.9	41.5	5.5
Ethiopia	1983-85	59.0	29.7	7.2
Fiji	1987	46.0	47.9	4.2
Indonesia	1985	54.7	33.4	6.0
Jamaica	1985	66.4	32.0	7.6
Lesotho	1985	129.0	54.9	8.6
Malawi	1987-88	116.0	47.4	9.0
Papua New Guinea	1988	66.7	20.6	12.1
Rwanda	1984	58.4	n/a	n/a
St. Lucia	1986-87	74.0	38.8	7.0
Zimbabwe	1987	79.1	43.6	6.7

8.3 Econometric Analysis

8.3.1 Production Functions

In order to investigate facility performance, a bi-product production function has been estimated. The dependent variable is inpatient admissions, but the number of outpatient visits appears on the right-hand side of the function in order to fix the point on the production frontier. This allows the technical relationship between different types of input and the number of admissions to be investigated while holding constant the number of outpatient visits.

The inputs that are included are the numbers of doctors, nurses, paramedics, and other health workers. Other explanatory variables included in the model are the number of beds, average length of stay, and dummy variables for facility type. This latter is expected to control for some of the variation due to differences in case mix between the different facility types.

In order to control for quality, a summary indicator has been included that is the mean of the structural quality score (expressed as a percentage of the maximum score) for minor surgery, normal deliveries and prenatal care. These interventions were chosen because they represent types of care that should be available in all types of inpatient facility.

The double-logged form of the Cobb-Douglas production function is used. While it would be desirable to use the more flexible full transcendental logarithmic form (which places fewer restrictions on the estimated technology parameters), multicollinearity between the levels and squares of the different inputs was problematic. Other hospital production function studies have shown that the Cobb-Douglas model performs almost as well as the translog (Frank and Taube 1987). While the Lagrange Multiplier test for heteroskedasticity using a fully specified model (regressing squared residuals against the levels and squares of all the dependent variables) did not lead to rejection of the null hypothesis of homoskedasticity, this can be a low powered test. Further investigation suggested that the residuals did vary systematically with a smaller number of the independent variables. To address this problem, the final model was estimated using White's heteroskedasticity corrected errors.

Regression diagnostics also included investigation of influential observations using dfbetas. This procedure involves re-estimating the model while sequentially excluding individual observations from the model, and investigating whether this produces significant changes in the coefficient estimates. No influential observations were found which suggests that outliers are not a significant factor affecting the estimated parameters.

Table 39 shows the means of the model variables, by facility type. The results of the production function estimation appear in Table 41.

Table 39. Means of variables by facility type

	Complex	Intermediate	Basic
Admissions	57474 (47678)	13147 (10632.8)	4856 (9038.0)
Outpatient visits	250878 (206784)	99960 (64147.8)	54762 (74171.5)
Doctors	160 (202.7)	16 (19.3)	3.5 (2.2)
Nurses	365 (333.5)	41 (32.9)	9.9 (8.6)
Paramedics	62 (67.0)	7 (7.3)	2.2 (1.8)
Other staff	439 (327.7)	58 (49.3)	20.6 (11.4)
Beds	374 (464.4)	61 (56.8)	19.8 (17.0)
ALOS	4.8 (1.2)	2.84 (1.14)	2.84 (1.5)
Quality score	0.71 (0.19)	0.75 (0.14)	0.60 (0.14)

Note: Mean and standard deviation (in parenthesis) are recorded.

Table 40. Definitions of model variables

Variable	Definition
Ln outpatient visits	Natural log of total outpatient visits
Ln doctors	Natural log of total doctors (including AMOs/RMOs)
Ln nurses	Natural log of total nurses
Ln paramedics	Natural log of total paramedical workers
Ln others	Natural log of other workers (administrative + non-technical)
Ln beds	Natural log of total beds
Alos	Average length of stay (days)
Type 2	Dummy variable, = 1 if intermediate inpatient facility, 0 otherwise
Type 3	Dummy variable, = 1 if basic inpatient facility, 0 otherwise
Quality	Mean of score (measured as percent of maximum) on structural quality indices for minor surgery, normal delivery, prenatal care

Table 41. Results of production function estimation

Variable	Coefficient	Std. Error*	T	p-value	95 percent Confidence Interval	
Ln outpatient visits	-0.034	0.101	-0.341	0.734	-0.235	0.166
Ln doctors	0.181	0.206	0.877	0.383	-0.230	0.591
Ln nurses	0.676	0.217	3.110	0.003	0.243	1.109
Ln paramedics	-0.339	0.181	-1.871	0.065	-0.701	0.022
Ln others	0.203	0.251	0.808	0.422	-0.297	0.702
Ln beds	0.547	0.189	2.903	0.005	0.172	0.923
Alos	-0.062	0.033	-1.884	0.064	-0.127	0.004
Type2	0.959	0.321	2.992	0.004	0.320	1.598
Type3	1.137	0.393	2.895	0.005	0.354	1.919
Quality	-0.301	0.671	-0.448	0.655	-1.639	1.037
Constant	3.893	1.114	3.495	0.001	1.674	6.113
N	85					
R2	0.80					

* Uses White's heteroskedasticity-corrected standard errors.

The model appears to fit the data reasonably well, with a R^2 of 0.80. Most of the coefficients are of the expected sign, indicating positive marginal products of the different types of staff. The exception is paramedic staff, which is negative but not quite significant at the 5 percent level. The coefficient on the number of outpatient visits is negative, indicating that inpatient admissions and outpatient visits are substitutes in output; however it is not statistically significantly different from zero.

Average length of stay has the expected negative relationship with output. The two type dummy variables are both positive and significantly different from zero, with the basic inpatient facilities having a larger coefficient than the intermediate facilities. This is consistent with having a more complex case mix, requiring more intensive staff time, as we move from basic to intermediate and to complex inpatient facilities.

The quality variable is not significantly different from zero, suggesting that higher structural quality is not associated with the level of output produced (in other words, there is no tradeoff between quantity and quality, where quality is measured this way). It has, nonetheless, been retained in the model for theoretical consistency.

In this double-log functional form, the estimated coefficients on the different types of staff represent the elasticity of output with respect to the particular input. Marginal products are calculated by multiplying the output elasticity by the average product. These are shown in Table 42. The marginal product of doctors is lower than that of nurses for all facility types; and for both nurses and doctors the marginal product is higher at lower levels of facility complexity.

Table 42. Marginal products (measured in inpatient days)

	Complex	Intermediate	Basic
Doctors	64.8	148.4	250.5
Nurses	106.4	216.6	331.4
Others	26.5	45.9	47.8

Note: Evaluated at the mean levels of output and inputs for each facility type.

Following Wouters (1993) and Goldman and Grossman (1983), the economic efficiency of the input mix has been assessed by comparing the ratio of the marginal products of different types of staff with the ratio of their wages. Economic theory suggests that costs are minimised when the ratio of marginal products is equal to the wage ratio:

$MP\ (X_1)/W(X_1) = MP(X_2)/W(X_2)$.

This relationship has been used to calculate the efficiency index:

$[MP(X_1)/MP(X_2)]/[Wage(X_1)/Wage(X_2)]$.

Where this index takes the value of one, the cost-minimising input combination is used. Deviations from unity indicate the extent of a facility's deviation from the cost-minimising choice of inputs, with a larger index signifying a higher level of economic inefficiency.

$E = |[MP(X_1)/MP(X_2)]/[Wage(X_1)/Wage(X_2)] - 1|$

Practically, the index has been calculated using facility-specific marginal products (estimated output elasticity X facility-specific average product); and type-specific wage ratios, where the weighted average salary cost for each type of staff (X1 = doctors, X2 = nurses) has been calculated for each of the three facility types. Results are shown in Table 43. The mean ratio of the marginal productivities to wages of doctors compared with nurses is less than one for all types of facility, suggesting that too many doctors are employed relative to nurses. In other words, reducing the ratio of doctors to nurses could provide additional output.

Table 43. Efficiency index by facility type (doctors vs. nurses)

	Complex	Intermediate	Basic
Mean	0.57	0.50	0.52
(Std. Deviation)	(0.15)	(0.21)	(0.25)

Note: E = |[MP(X1)/MP(X2)]/[Wage(X1)/Wage(X2)] –1|

8.3.2 Cost Functions

An econometric cost function has been estimated in order to explore a variety of other measures of economic efficiency. The dependent variable is total recurrent costs, and two outputs (inpatient admissions and outpatient visits) have been included. Input prices have not been included as they are fixed centrally through Ministry of Health salary scales and do not vary across facilities. As in the case of the production function, quality has been controlled for through the inclusion of a structural quality summary measure, and dummy variables for facility type should partly control for case mix differences among the facility types.

In order to be consistent with the production function, a Cobb-Douglas functional form has been used. Visual inspection of residuals and the Lagrange Multiplier test were used to investigate heteroskedasticity. As in the case with the production function, the fully specified Lagrange Multiplier test could not reject the null of homoskedastic errors, but there was evidence of some association between the residuals and the number of admissions and number of beds. For this reason, White's heteroskedasticity-adjusted errors are used for the hypothesis testing.

Table 44 shows the regression results. In general the model is well behaved, with an R2 of 0.92. The estimated coefficients on the two outputs imply a positive elasticity of total cost with respect to both, although the coefficient on outpatient visits is not statistically significant. The two type dummy variables are both negative and highly significant, and suggest that costs fall as facility complexity decreases. The level of capital is controlled for by including the number of beds. The coefficient on beds is small but statistically significant. Bed occupancy was included as an explanatory variable because of the descriptive results which suggest that for some facility types, cost decreases with bed occupancy. This relationship is also borne out in the multivariate analysis.

Table 44. Results of cost function estimation

Variable	Coefficient	Std. Error*	T value	p-value	95% Confidence Interval	
Ln admissions	0.485	0.080	6.04	0.000	0.325	0.645
Ln outpatient visits	0.131	0.096	1.37	0.176	-0.060	0.321
Type 2	-1.273	0,223	-5.70	0.000	-1.717	-0.828
Type 3	-1.542	0.168	-9.20	0.000	-1.877	-1.21
Beds	0.0007	0.0001	5.09	0.000	0.0004	0.001
Quality	0.621	0.347	1.79	0.078	-0.071	1.313
Bed occupancy	-0.004	0.001	-3.18	0.002	-0.006	-0.001
Constant	11.28	0.879	12.85	0.000	9.540	13.04
N	84					
R2	0.92					

* Uses White's heteroskedasticity-corrected standard errors.

The cost measures presented in Wouters (1993) are also calculated (Table 45).

Table 45. Definitions of cost measures

Cost measure	Formula
Marginal cost	
Outpatient visits – MC(OP)	dC/dOP
Inpatient days – MC(IP)	dC/dIP
Average incremental cost	
Outpatient visits – AIC(OP)	[C(OP,IP) – C(0,IP)]/OP
Inpatient days – AIC (IP)	[C(OP,IP) – C(OP,0)]/IP
Short run product-specific returns to the variable factor	
Outpatient visits – SPRVF(OP)	AIC(OP)/MC(OP)
Inpatient days – SPRVF(IP)	AIC(IP)/MC(IP)
Ray-specific economies of scale – RSE	C(OP,IP) ÷ [IP * MC(IP) + OP * MC(OP)]
Economies of Scope – SC	{[C(0,IP) + C(IP,0)] – C(OP,IP)}÷C(OP,IP)}

Sources: Wouters 1993, Barnum and Kutzin 1993

As would be expected, both the marginal and average costs of providing inpatient services are considerably higher than for outpatient services. Marginal and average costs of both outputs decrease as the facility complexity declines, with the highest costs observed at the complex inpatient facilities and lowest in basic inpatient facilities.

Evaluating these at the sample means for each of the facility types, it is seen that on average the facilities are operating on the downwards sloping part of the average cost curve, as the marginal costs are less than the average costs. Additional support is provided by the measures of product-specific returns to the variable factor which are all greater than 1. These are most pronounced for outpatient visits. Complex facilities are operating closer to their minimum average cost level than the other two types of facility.

The ray-specific economies of scale measure indicates that complex facilities are operating at near constant returns, while there are increasing returns for the two types of lower-level facility. This is consistent with the low bed occupancy rates observed in intermediate and basic inpatient facilities, indicating substantial under use of existing capacity.

The negative estimates on the economies of scope measure suggest that there are diseconomies of scope. This means that facilities with larger numbers of inpatients also have higher costs of outpatient visits. This may be because the larger facilities also tend to see more complex outpatient cases, for instance patients who are referred to specialist outpatient clinics. It may also be because the input mix in the larger facilities may be more costly, for example, using more doctors rather than A/RMOs, or more specialists compared with medical officers.

Table 46. Efficiency indicators using cost function estimates

	Complex	Intermediate	Basic
MC (IP)	1670	564	498
MC (OP)	103	20	12
AIC (IP)	2055	922	722
AIC (OP)	372	94	49
SPRVF(IP)	1.23	1.63	1.45
SPRVF(OP)	3.61	4.72	4.13
Ray-specific scale economies	0.97	1.30	1.17
Economies of scope	-0.77	-0.75	-0.72

It is also useful to compare the estimated average incremental costs from the cost function with the average costs calculated using the accounting cost method. Table 47 shows that, while the orders of magnitude are broadly consistent between the two methods, there are some important differences between the results of the two methods. Generally the accounting costs are higher for the inpatient services and lower for the outpatient services. This no doubt reflects some of the problems that arise in the apportionment of costs between inpatient and outpatient services in the accounting cost methods. In particular, it suggests that the method adopted for the allocation of staff time (that is, estimate the total staff time available and the amount going directly to the outpatient department, and calculating the inpatient share as a residual) may have overestimated the share attributable to inpatient activities.

Table 47. Comparison of estimated average costs, accounting, and econometric methods

	Cost per admission		Cost per outpatient visit	
	Accounting	Econometric	Accounting	Econometric
Complex	3446	2055	153	372
Intermediate	900	922	26	94
Basic	1545	722	32	49

8.3.3 Predicting the Effects of Efficiency Improvements

A further use for the econometric estimates is to simulate the effects of efficiency improvements. In the case of production, we have estimated what the effects are of improving the performance of the facilities that are currently producing a lower level of output than predicted by the production function.

The production function was estimated for 85 facilities. Thirty-seven of these have negative residuals. Together, these 37 facilities are currently producing 446,082 inpatient admissions, or just over 12,000 admissions per facility per year. If they were producing at the level of the average facility given their staffing levels and infrastructure, an additional 197,164 inpatient admissions could be produced, or an average of 5328 admissions per facility. This represents an average increase of 44 percent of output for these “relatively inefficient” facilities. The average increase would be 25 percent for complex inpatient facilities, 41 percent for intermediate inpatient facilities, and more than 100 percent for the basic inpatient facilities. This is consistent with the patterns of bed occupancy described earlier.

A similar exercise was undertaken for the cost function, where the cost savings from producing at the average level represented in the data can be calculated. A total of 84 facilities were included in the cost function, of which 40 have positive residuals (i.e. are producing at a higher level of total recurrent cost than predicted by their output levels). Together, the total recurrent cost of the 40 facilities is Rs. 896,000,000. Savings from producing at the average level of cost would amount to Rs. 374,000,000, or Rs. 9,350,432 per facility, an average level of savings of 42 percent. In this case, there is less difference among the different facility types in the average level of cost savings possible, with complex inpatient facilities saving 26 percent of recurrent cost, intermediate facilities saving 21 percent and basic facilities saving 24 percent. (Note that the "overall" average is unweighted and overstates the cost savings because of a small number of very high cost facilities in the average).

Obviously, the accuracy of these estimates is limited by the extent to which the econometric estimates control adequately for case mix. However, they do give an indication of the effects on production and costs of the high levels of variability in efficiency that have been identified.

8.4 Comparison of Different Indicators

One objective of the study was to compare the results of the different ways of measuring efficiency and assess their congruence. The underlying notion is that the Ministry of Health is unlikely to have the capacity to use econometric methods to assess facility performance, but that they could conceivably undertake analysis of accounting costs. To the extent that the econometric results are more reliable measures of relative performance, a high correlation between the rankings using the two methods would reinforce the reliability of the accounting cost method adopted.

The analysis of the association between the different indicators has been done by treating the residuals from the production and cost functions as "efficiency scores" and comparing the ranking of facilities using these scores and that from the accounting cost estimates. This has been done both by examining the linear correlation coefficients between the different measures, and by using Spearman's rank correlation coefficient.

For the production function, a negative residual means that the facility is producing less output than the sample average. Therefore, we would expect a negative correlation between the residuals and the accounting cost estimates. Tables 48 and 49 show that the correlations are negative for all the pairwise comparisons other than for outpatient costs in basic inpatient facilities. The linear correlation coefficients are all fairly high, with the exception of intermediate and basic inpatient facilities for outpatient visits. The same holds true for the Spearman rank correlation coefficients, and the hypothesis that the two rankings are independent is rejected in most cases. Exceptions are the cost per outpatient visit. If we consider the econometric estimates to be the "gold standard," then it appears that the relative magnitudes of accounting costs provide a reasonable approximation of the relative efficiency of facilities, at least for inpatient costs. Cost per outpatient visit seems to be much more variable and less related to the econometric estimates.

Table 48. Linear correlation coefficients for association between accounting costs and "output scores" from production function

	Complex	Intermediate	Basic
Cost/admission	-0.94	-0.81	-0.75
Cost/day	-0.83	-0.61	-0.76
Cost/outpatient visit	-0.75	-0.06	0.23

Table 49. Spearman rank correlation coefficients for association between accounting costs and "output scores" from production function (p-value in parentheses)

	Complex	Intermediate	Basic
Cost/admission	-0.90 (0.03)	-0.85 (0.004)	-0.57 (0.000)
Cost/day	-0.90 (0.04)	-0.60 (0.09)	-0.58 (0.000)
Cost/outpatient visit	-0.70 (0.19)	-0.12 (0.77)	0.48 (0.0005)

Notes: p-value of test of independence; p<.05 means that there is a significant relationship.

In the case of cost functions, a positive residual means that a facility has higher than average costs, so the correlation coefficients with the accounting cost measures should be positive. Both linear correlation coefficients and rank correlation coefficients are positive in most cases, with the exceptions being again for the cost per outpatient visit (Tables 50 and 51). In this case the correlations for cost/outpatient visit in basic inpatient facilities are stronger and of the expected direction. However, the correlations are generally lower than for the production function estimates and there are more statistically insignificant rank correlations.

One explanation for this difference between the production and cost functions is that there is likely to be more error in the reporting of costs than of physical quantities (e.g., of visits and staff inputs). Generally speaking, the complex facilities had better accounting information because their budgets were individually set (in contrast to, for example, some of the smaller units whose budgets are held at the DDHS level). This is reflected in the generally higher correlations for the complex inpatient facilities (although even here, the correlations for cost/outpatient visit are of the wrong sign).

Table 50. Linear correlation coefficients for association between accounting costs and "cost scores" from production function

	Complex	Intermediate	Basic
Cost/admission	0.83	0.76	0.49
Cost/day	0.85	0.03	0.48
Cost/outpatient visit	-0.17	-0.44	0.24

Table 51. Spearman rank correlation coefficients for association between accounting costs and "output scores" from production function (p-value in parentheses)

	Complex	Intermediate	Basic
Cost/admission	0.55 (0.07)	0.52 (0.15)	0.55 (0.000)
Cost/day	0.56 (0.05)	0.08 (0.83)	0.55 (0.000)
Cost/outpatient visit	-0.04 (0.90)	-0.42 (0.29)	0.14 (0.29)

Notes: p-value of test of independence; p<.05 means that there is a significant relationship.

9. Explaining Efficiency by Management Processes

One aim of the study (Research Question C) was to examine whether differences in facility efficiency can be explained by a variety of characteristics of the manager, of the organisational environment, and of management systems in the facility. Two approaches have been taken to investigate these relationships. In the quantitative approach, a special section of the facility questionnaire was developed, which asked the person in charge about a range of management-related issues at the facility. From the responses to these questions a range of indicators were developed, and the association between these indicators and summary measures of facility performance (cost/admission, cost/day and occupancy rate) was evaluated. The qualitative approach used a series of case studies to investigate these issues using a structured interview with the facility manager. The results of both are discussed below.

9.1 Quantitative Analysis

A series of statistical tests (t-tests) of differences in means was used to investigate the association between management indicators and performance measures for different types of facilities. Table 52 below shows the results for those variables for which a significant difference was detected. Because of the small sample sizes (particularly for the complex and intermediate inpatient facilities), the power of the t-test is quite low, so the criterion for designating a relationship as significant has been set which is more generous than standard tests of significance ($p<0.12$).

The first main observation from Table 52 is the large number of variables for which no association was found. This may be due in part to the small cell sizes for the complex and intermediate inpatient facilities (and consequently low statistical power of the t-test). However, it may also be due to the crudeness of some of the indicators that merely report the presence of a system/characteristic, and not the effectiveness with which it functions (e.g., incentives for staff performance, the regularity of meetings with staff).

Some of the results actually move in the opposite direction to what would be expected. For instance, distance from the referral facility was hypothesized to be negatively associated with performance. However, for basic inpatient facilities the cost per admission and per bed day were actually lower if the facility was more distant from the referral facility. Basic inpatient facilities located further from the referral facility had higher bed occupancy rate (which could be explained by less opportunities to by-pass the facility); however, for intermediate facilities, more distant location was associated with a lower occupancy rate.

Some exposure of the facility in-charge to training in management was expected to be associated with greater efficiency; however, for the intermediate inpatient facilities costs per admission and per bed-day were actually higher with management training.

Similarly, the use of some system of incentives to improve the performance of doctors was anticipated to have a positive impact on efficiency, but in basic inpatient facilities it was associated with higher costs per admission and per day.

Table 52. Summary of relationships between management indicators and facility efficiency measures

	Complex	Intermediate	Basic
>15 km from referral facility		Occupancy rate *lower* if further away (p=.11)	Cost/admission *lower* if further away (p=.09) Cost/day *lower* if further away (p=.04) Occupancy *higher* if further away (p=.01)
Rural			
Management training		Cost/admission *higher* if in-charge has management training (p=.11) Cost/day *higher* if in-charge has management training (p=.02) Occupancy rate *lower* if in-charge has management training (p=.08)	
Comm. Health training			
Experience			
Incentives for improving doctors performance			Cost/admission *higher* if there is a system (p=.04) Cost/day *higher* if there is a system (p=.09)
Incentives for improving other staff performance			
Performance evaluation for doctors	Cost/admission lower if there is a system (p=.08)	Occupancy rate higher if there is a system (p=.08)	
Performance evaluation for other staff	Cost/admission lower if there is a system (p=.04)	Cost/admission lower if there is a system (p=.01)	
Regular meetings with doctors			Cost/admission lower if meetings held (p=.03) Cost/bed lower if meetings held (p=.05) Occupancy higher if meetings held (p=.02)
Regular meeting with other staff			Cost/admission lower if meetings held (p=.02) Cost/day lower if meetings held (p=.03)

Management committee			
Hospital committee			
Drug review committee		Cost/admission lower if committee exists (p=.09) Cost/day lower if committee exists (p=.002) Occupancy higher if committee exists (p=.08)	
Organised in-service training			
Plans to expand services		Cost/day lower if plans exist (p=.09) Occupancy rate higher if plans exist (p=.12)	

The remaining significant relationships operate in the expected direction, with the use of different systems for managing the key inputs (staff, drugs) being associated with relatively better performance.

Finally, an index of management systems was constructed which is made up of all the different variables which take the value of 1 if they are present and 0 otherwise. Table 53 summarizes the average level of the index by facility type. As would be expected, the mean and median values of the index are higher for the more complex facilities. This is entirely consistent with the observation that more attention has been paid to strengthening the quality of management at the higher-level facilities.

Table 53. Average values of the "management index" by facility type

	Mean	Median
Complex	8.8	10
Intermediate	6.1	6
Basic	3.9	4

Note: Index constructed by creating indicator variables for the presence of each characteristic (excluding characteristics of the environment) and summing them, so that higher values imply more comprehensive use of management systems.

9.2 Qualitative Analysis

There were two main aims of the qualitative analysis of facility performance. The first was to investigate features of facility management that could not easily be collected through the quantitative survey, and to characterise some of the elements of "good management" which might contribute towards more efficient production of hospital services and better overall facility performance. The second was to investigate whether these characteristics are good predictors of facility performance, as measured through more quantitative and objectively verifiable measures of efficiency. This may help to identify the types of procedures and characteristics of managers that contribute to more effective facility management, and thereby suggest areas where the Ministry should focus its efforts to improve the management of its facilities.

The characteristics of "well-organised" and "poorly organised" facilities [4]

The data were analyzed and the health facilities were categorised broadly into two groups: teaching and base hospitals were considered in the first category. The second category of health facilities included district hospitals, peripheral units and rural hospitals.

From the discussions with facility managers and using the data gathered it was possible to formulate some indicators/criteria to classify facilities into "best organised" and "worst organised."

The best organised/managed facilities generally exhibit the following characteristics:

- The facility is basically run by a management committee although the officer in charge is mainly responsible for its administration and services.
- The facility is evaluated (regularly or at least in ad hoc manner) formally or informally by the facility manager or by the community or by the higher levels of officials.
- The facility manager has correct attitudes[5] and skills for managing the facility.
- The facility has a well-educated and experienced staff.
- The facility has adequate infrastructure and supplies of basic equipment and drugs.
- The facility has a quality assurance scheme.

The worst organised/managed facilities generally exhibit the following characteristics:

- The facility does not have a proper management committee.
- The facility functions in isolation.
- The manager's contribution to enhance the effectiveness of the facility is comparatively poor, mainly due to his/her engagement in private practice and family circumstances.
- The facility has somewhat inadequate structural quality.
- The facility receives inadequate formal and informal supervision and feedback.

Using the above basic indicators, which are generated from the data, it was possible to identify specific features which could influence the performance of the different health facilities, into three categories, which are presented in Table 54.

[4] This section was written by Bilesha Perera.

[5] This concept is based upon the extent of health facility manager's involvement in the promotion of overall health of people by making use of the available resources and, in particular, community support and political support.

Table 54. Comparison of the characteristics of "best organised" and "worst organised" facilities

Best organised	Worst organised
Manager characteristics: > Higher education/ management – experience/qualifications > Understanding of the mission > Less economic pressure > Able to cope up with changes in the environment > Good communication skills	Manager characteristics: > Inadequate management – qualifications/experience > Family responsibilities > Economic problems > Resistance to change > Work in isolation > Poor interpersonal skills
Facility organisation: > Decentralization of work > Having clear responsibilities for different units/departments > Decisions are taken collectively > Adequate equipment and supplies > Adequate staff > Support from the voluntary and community organisations > Formal and informal feedback on performance	Facility organisation > Centralized management system > Inadequate equipment and supplies > Inadequate staff > Inadequate public facilities > Lack of support from voluntary organisations
Environmental factors > Having opportunity to discuss work problems with peers > Authorities > Community and political interest of the facility > Demand from the community	Environmental factors > Lack of opportunities to get feedback from peers > No challenges from other facilities > Less demand from the community

9.2.1 Results

The in-depth interviews with heath facility managers revealed that their behavioural factors and the environmental characteristics of their respective areas have had a profound effect on level of operation of the facility.

9.2.1.1 Characteristics of the Manager

The health facility manager's personal attitudes, beliefs, educational qualifications, working experience and immediate family responsibilities play a vital role in explaining the performance of the facility.

Those who have done postgraduate studies or who have shown some interest in higher studies had in fact tried to increase the efficiency of the facility. Moreover, those who had some management qualifications or experience performed better in improving the effectiveness of the management of the facility.

The qualification and management experience described by "best" organised tertiary health care facility manager/s and their attitudes are as follows:

"….have been working here for nearly five years. …did a masters degree in medical administration at the Postgraduate Institute of Medicine, Colombo. ….am working full time as the director and …not involved in any other social or private activity at present. …am very keen in doing research work to improve the quality of the care given by the hospital. I have identified that lack of management skills of managing staff as a major constraint to the development of the hospital."

"My firm belief is that everybody who is engaged in administration and management and giving leadership to others should have developed some kind of management skills. People who are giving leadership in various units in this hospital have not had those skills. For example, the chief MLT (medical laboratory technician) in our hospital is the leader in his unit but he is just another MLT. The nurse in charge of the ward has to look after the work of nurses, midwifes, minor staff, etc., but she has not had any training in management."

"I am not doing private practice. My husband is a doctor and he is doing full time private practice. I am very keen in doing research to improve the quality of the care given by the hospital."

" ...has done an M.Sc. in Community Medicine. …five-month course in health systems management at Boston…in our set up, this is one of the few hospitals where there is a proper management committee that functions…we prepare agenda and circulate minutes. Frankly speaking all the senior consultants are in the management committee."

Following are the qualifications and experience described by a "worst" organised tertiary health care facility manager:

"… am planning to sit for M.Sc. in medical administration. …have joined the facility very recently. I worked at a base hospital as an administrator. But there were problems. There was no hospital committee there. I could have solved much problems easily if there was a committee, because of the fact that there are politicians involved in such committees."

" My wife is a housewife. I have to do private practice and I am doing it after 4.00 pm. I am also involved in judicial work...I have to do at least one postmortem a day."

The qualifications and management experience described by the managers of "best" organised primary health care facilities were as follows:

" I am a little strict. It is difficult to manage the staff. Some of my friends advised me not to come to this centre because of these staff problems. I told the staff when I assumed duties that I am a person who likes to work and they also should work hard. I like preventive medicine also. I do have some leaflets etc at the office. I am hoping to start a library at the hospital."

"Even though we do curative medicine, I started a health education unit. I employed a nurse for this. She is now delivering health talks to in-ward patients. Now, other hospitals also have started health education units…"

The qualifications and management experience described by the managers of "worst" organised primary health care facilities were as follows:

"… 30 years of age… have been working here for two years. No children...there seems to be no proper management system here. ...am not interested in doing management work. I am interested in doing family medicine. Here there are lots of administrative problems. Nurses and labourers are going on leave without prior approval. There is no use in punishing them…"

"Our salaries are not adequate. So I have to do private practice. If the government can double our salary and gives us a vehicle we can stop private practice and can concentrate more on this work."

9.2.1.2 Organisation of the facility

It is observed that the performance of the facility depends on the decision–making process, collaborative work, utilisation of available resources, and the feedback received by the manager about the facility from the authorities and community.

In a "best" organised tertiary health care facility:

"This hospital is managed by a management committee. Policy decisions are taken by this committee."

"There was a big problem of babies dying. Lots of babies were dying of infections. Everyday it appeared in the newspapers. They criticized us. So I did a personal investigation…now it has been reduced to a very low level."

"We are planning to change the present OPD system. According to the present system if a patient comes, he has to get a number and has to wait in a queue to reach an OPD doctor. There the OPD doctor refers him to a relevant unit, then he has to wait at another queue at the special units. If he is to get a laboratory test then the lab is closed from 12.00–2.00pm. By the time he gets the results it will be 4.00 pm and sometimes he will have to come again. If a patient comes and say he is having an ear discharge, which a nurse can easily identify, straight-a-way this patient can be referred to ENT unit within five minutes."

In a "worst" organised tertiary health care facility:

"We do not have a management committee. Consultants are looking after their wards …"

"After Dr …assumed duties he said he will have regular meetings once in two months for hospital directors. We sent monthly reports …"

In a "best" *organis*ed primary health care facility:

" There is an administrative nursing sister, and she is responsible for management of nurses and the minor staff. If there is a problem which she cannot solve then only it comes to me. However, the driver and dispenser are under my supervision."

"There is a good support from the community. Recently they donated a TV. Many people donate things privately. …tomorrow there is a hospital committee meeting. Once a month we meet and discuss problems. Now we have a bank account and it has Rs. 11,000."

"These days less number of people are coming to get treatment. There was a shortage of drugs. I put up a notice saying that patients have to get drugs from outside due to a shortage…now we have received our drugs; no problem…The doctor who worked here before I came had not ordered an adequate amount of drugs. So I went and met RDHS and explained the situation and he gave more than we estimated."

"When RDHS came for regular check ups, since some labourers are not coming to work on time, I got the blame. So what I did was I drew lines on the attendance register at 7.00 am and at 7.30 am."

In a "worst" organised primary health care facility:

"The RDHS office wanted to hold monthly meetings and to discuss the problems and send them a report. But it won't work here. I have a different system. It is difficult to have a meeting. I give advise and possible solutions as and when necessary….. no hospital committee… I do not like these committees, they try to influence the administrative work of the hospital."

"There is no community support. There was a committee earlier. But now it is not functioning properly. People are not interested in developing the centre."

"I am responsible for DDHS.. there is no proper supervision from RDHS office…"

9.2.1.3 Environmental Factors

There are certain environmental factors that affect the performance of the health facility. Community interest of the facility, work in isolation, easy access to relevant authorities are some of these factors.

In a "best" organised tertiary health care facility:

"This hospital receives support from outside *organis*ations. Hospital committee consist of some Rotary Club and Lions Club members. … Lions Club donated the hospital Rs. 600,000 worth of laundry machine."

"Last year our annual estimates for local purchases was 4 million but due to unknown reasons, there is a circular and they have asked us to limit it to a million. So I spoke to Prof… at SPC and got special allocation to purchase drugs."

In a " worst" organised tertiary health care facility:

"People in this area are very busy and very diverse...do not care about others. There is some outside support. Lions Club and some other volunteer *organis*ations support us… But not a significant support…"

In a " best" organised primary health care facility:

"If there is any problem, I do not take action. I have to refer problems to the RDHS office; he takes necessary action. Now we can work smoothly."

"If there is an emergency we can send the patients to a National Hospital."

"People donate various things...recently Lions Club gave us a fridge."

"I believe we can develop this facility to a very satisfactory level mainly because people in the village have correct attitudes and feelings for the centre."

In a " worst" organised primary health care facility:

"…no significant support from the community. People have no intention of improving this; they go to …(a teaching hospital) if the work is found not adequate."

"…no community support. Simply they are not interested."

9.2.2 Discussion

The level of economic support for health care appears to be seriously below the level required to meet the health needs of the population. Weaknesses in national planning and budgeting for health care also contribute to such deficiencies.

In order to improve the effectiveness of health care facilities, its operational system should work smoothly, without interruptions. Administration of health facilities requires special professional training that includes management knowledge and skills, executive leadership, and a relationship established by the hospital with the community.

The location, size, type of the community, and design of the facility are important features of health facilities and have a major influence on their effectiveness.

Health facility mangers express needs for many types of medical instruments and drugs. Much of this equipment, however, is expensive and health officials in recent years have become skeptical about the relative value of such " new technologies."

In Sri Lanka the provincial health ministries run almost all hospitals except teaching hospitals. Even though decentralisation of health services was aimed at improving the quality and effectiveness of the health care delivery system, the decision-making processes that require substantial analysis and judgement at the central level are often weak. Some of the

reasons for these failures are lack of political initiative, shortage of well-educated or experienced management staff, lack of statistical information, and top-down policymaking without sufficient clarification at lower levels.

There is little cooperation between the health sector and other relevant sectors. As a consequence intersectoral policies, strategies or plans of action cannot be implemented.

It is said that management is a process whereby resources in terms of people, finances, equipment, and facilities are mobilized, ideally in an efficient and effective manner to serve the purposes of an institution. Key factors for successful management include the appointment of a manager who has leadership qualities and is good at working with a team. Equally important are availability of resources and a suitable organisational structure.

Proper planning is also a key factor for effective management. It is essential to decide in advance what is to be done and how it is to be done. Management meetings play a vital role in planning the future activities of the facility. The main aim of proper planning is to maintain the services of the facility at a satisfactory level and to maintain the level of satisfaction of the hospital staff.

9.2.2.1 Association between management characteristics and facility efficiency

Some "validation" of the importance of the characteristics identified above can be carried out by comparing the categorisation of facilities provided by the sociologist with the categorisation based on the performance indicators of turnover, average length of stay, and bed occupancy rate (the indicators which were used to structure the sample for the case studies).

The sample for the qualitative work was chosen to include 10 "relatively efficient" and 10 "relatively inefficient" facilities. According to the categorisation that emerged from the case studies, seven facilities were categorised by the sociologist as "best organised" and 13 as "worst organised." The level of agreement between the two categorisations is shown in Table 55.

Table 55. Composition of case studies by efficiency indicators

Case Studies	Efficiency indicators		Total
	More efficient	Less efficient	
More efficient	5	2	7
Less efficient	5	8	13
Total	10	10	20

The table suggests that the management indicators that were assessed qualitatively are better able to predict low levels of efficiency than high levels of efficiency. While the case studies "correctly" classified eight of the 10 "less efficient" facilities, they only classified half of the "more efficient" facilities correctly.

A number of explanations and qualifications are needed for this analysis. The most important is that the "gold standard" of classifying facilities according to their hospital indicators may not be accurate. Instead, the hospital indicators may be capturing features that

are outside the immediate control of the hospital management. For instance, a facility might have very low occupancy rate (and therefore be classified as "relatively inefficient"), because it is located in a sparsely populated area, or is near to a higher-level facility and is therefore bypassed in favour of the higher level. Overall facility management may therefore be effective and competent as measured through the qualitative indicators, but the manager may be constrained in increasing the use of their inpatient facilities. Similarly, facilities may be busy and well-used, but still have very ineffective management.

Secondly, it is possible that managers overstate or exaggerate the effectiveness of their management procedures. Therefore, they may be falsely categorised using the qualitative indicators as being "efficient." The ability to overstate the quality of management may be greater among those who have had some management training.

Further analysis could possibly identify the degree of association between the qualitative categorisation of facilities and some of the other measures of efficiency, such as having above- or below-average costs.

One observation from the categorisation based on the qualitative indicators is that the lower-level facilities are poorly represented among those that were identified as being "better managed." This is consistent with the view expressed at the workshop[6] at which the results were discussed, when the absence of activities to strengthen management at the lower levels of the health system was extensively discussed.

Although the level of association between the qualitative indicators of performance and the efficiency measures is disappointing, the case studies do present a vivid picture of a range of problems facing hospitals, and of the weak management systems. They have also generated a number of indicators of facility management, which can be investigated in more depth in future research activities.

[6] "Operating Efficiency in Public Health Facilities in Sri Lanka," February 24, 2000. Annex C contains list of workshop participants.

10. Management Issues

In addition to the indicators of facility management presented in the previous chapter, the management section of the questionnaire elicited managers' views about a range of other issues relating to the constraints they face in providing health services, and features of the overall organisational and policy environment. The responses to these questions are discussed below.

In total, 95 percent of managers of the hospitals surveyed responded to questions regarding administrative and other system-level constraints they face. Tables in this chapter show their responses to those questions.

The lack of financial resources was mentioned as the most important constraint to improving performance by 90 percent of hospital managers surveyed (Table 56). Management issues were also mentioned as "important" or "very important" constraints to improving performance. These include insufficient training in management or administration (74 percent), lack of authority over other (non-medical) personnel (63 percent), and financial and administrative regulations (76 percent). Interestingly, the lack of authority over doctors' discipline and lack of control over personnel appointments were rated as less important factors. Inadequate nursing, administrative, and managerial staff were considered important by 69 percent and 66 percent of doctors respectively, reflecting the human resource constraints faced by the public health sector as explained earlier in this report. When asked (in a separate question) who would be the most capable of managing public health facilities most efficiently, 88 percent of responses stated medical doctors with specialised management training. All of the responses listed above point to a critical need for enhanced management training of medical doctors. Given funding shortages that are likely to persist for the foreseeable future, management training appears to be an effective solution to improve efficiency and thus loosen prevailing resource constraints. With regard to other specific resource constraints, 76 percent of managers replied that pilferage of drugs and medical supplies from government health facilities was a widespread problem requiring priority attention. Information inadequacies were mentioned by 50-60 percent of respondents as important factors in constraining performance. The inability to generate revenues and mobilise additional resources were rated as the least important.

Table 56. Important constraints and issues

"In your opinion, how important are the following constraints and issues to improving the performance (both volume and quality) of your facility?"

	Very important	Important	Not important	Irrelevant/ inapplicable
Lack of financial resources	58	32	6	3
Inadequate number of nursing staff	40	29	17	15
Insufficient training in management or administration for facility directors	31	43	10	15
Lack of authority over other personnel/staff indiscipline	27	36	22	14
Political interference	27	26	25	22
Inadequate number of administrative/management staff	26	40	19	15
Financial and administrative regulations	25	51	13	11
Inadequate number of doctors	25	32	25	19
Insufficient control of spending of medical supplies budget	21	39	21	19
Insufficient or inadequate information on workload and delivery	19	56	14	11
Insufficient or inadequate information on costs and use of resources	17	49	17	16
Lack of authority over doctors/indiscipline	16	34	28	22
Lack of control over personnel appointments	15	41	22	21
Inability to transfer funds between budget headings	14	36	22	28
Inability to charge fees from patients	11	17	39	33
Inability to mobilise additional resources other than charging fees	9	32	27	32

Just under 50 percent of managers felt that their level of facility was best administered by the central MOHIM in terms of improving the performance of that facility (Table 57). While 33 percent approved of DDHS administration (below PDHS level), only 19 percent felt that provincial-level administration was appropriate. This response is consistent with responses to questions regarding the level of control that should or should not be vested in the hands of PDHS. The appointment and allocation of medical doctors is currently controlled by the MOHIM. When asked if they would approve of this authority being exercised by the PDHS, 71 percent responded "No" (Table 58). This is consistent with responses above, in which managers did not rate the lack of control of doctors' appointments, as opposed to the appointment of other personnel as an important constraint to performance. Salary scales and allowances are also currently controlled by MOHIM. Eighty-one percent of respondents replied that they would not want this authority to be exercised by the PDHS, subject to the limitations of their existing budgets (Table 59). Sixty percent of respondents said that they would not want the control and authority of the provincial council administration over health facilities to be increased (Table 60).

Table 57. Level of authority

"In terms of improving the performance of your facility, do you think that your level of facility is best administered by:"

Level of facility	Percentage
DDHS	33
Provincial department of health	19
Central Ministry of Health	48

Table 58. Appointment and allocation of medical doctors (percentage)

"The appointment and allocation of medical doctors is currently controlled by the Ministry of Health. Would you approve of this authority being exercised by the provincial departments of health?"

	Percentage
Yes	29
No	71

Table 59. Setting of salary scales and allowances

"The salary scales and allowances of medical doctors are controlled by the Ministry of Health. Would you approve this authority being exercised by the provincial departments of health subject to the limitations of their existing budgets?"

	Percentage
Yes	19
No	81

Table 60. Provincial council authority

"In your opinion, should the authority and control of the provincial council administration over health facilities and the provincial departments of health be increased?"

	N
Yes	40
No	60

It has been proposed that private practice by government doctors be stopped, in view of the increasing numbers of medical graduates. Sixty-nine percent of the doctors who responded said that they would not approve of such a measure (Table 61). However, 81percent said that they would not oppose it if salaries and allowances were increased sufficiently (Table 62).

Table 61. Stop private practice – Approve or not

	Percentage
Yes	16
No	69

Table 62. Stop private practice with sufficient salary increase – Approve or not

	Percentage
Yes	81
No	19

11. Discussion

11.1 Summary of Analysis Results

Efficiency

> The data confirm that the Sri Lankan health sector is relatively efficient compared with other countries.

> However, there continue to be significant levels of variation in efficiency across facilities.

Ratio measures

> Average length of stay is relatively low compared with international norms. It is higher in the complex facilities, probably because of their more complex case mix.

> Average bed occupancy rates vary considerably among facility types, with highly utilised complex facilities (average occupancy of 93 percent) and underutilised basic and intermediate facilities (averages of 48.6 and 55.6 percent respectively). This is confirmed by the Lasso indicator analysis, which identified large numbers of facilities in the low utilisation quadrant.

Accounting methods: Unit costs

> Inpatient costs are highest in the complex facilities, but surprisingly high in the basic inpatient facilities, due to their low levels of output.

> In complex facilities, over 85 percent of the costs are attributed to inpatient activities, with the share in basic and intermediate levels facilities between 66 and 75 percent.

> Staff and drugs together make up 85 percent of the total recurrent cost.

> Differences in occupancy rates explain a significant proportion of the cost differences in both intermediate and basic facilities.

Econometric methods: Production/cost function analysis

> Production and cost functions were estimated and fit the data relatively well.

> From a comparison of marginal products and wage costs, the production functions suggest that hospitals employ too many doctors relative to nurses. This is consistent with labour market conditions, where there is a shortage of nurses and an excess of doctors.

> Intermediate and basic facilities are operating on the downwards-sloping portion of the average cost curve, suggesting that costs could be reduced by increasing output. This is consistent with the observed under utilisation of facilities at these levels.

- Complex facilities are operating closer to the minimum average cost level.
- There is some evidence of diseconomies of scope between inpatient and outpatient activity.
- Considerable savings could be achieved by improving the performance of the below-average facilities, either in terms of cost savings or output increases.

Comparison of Methods

- The results of the accounting costs and production/cost functions for inpatient costs are relatively similar.
- Accounting costs are therefore a reasonable approximation of costs and could be used to monitor the relative performance of facilities.

11.2 Explaining Efficiency by Management Processes

There were few significant associations between the efficiency indicators and management indicators. The qualitative analysis provides a rich source of information about management in the health facilities. However, the results are not robust enough to identify strong relationships between these qualitative characteristics and actual performance. This is an area that requires more work and should involve exploring appropriate indicators of management that can be related to facility performance.

The management section of the questionnaire also provided a range of opinions about the constraints on facility performance. These include training in management and administration, lack of authority over non-medical personnel (though not medical personnel), financial and administrative regulations, inadequate nursing and administrative staff, problems of drug pilferage, and information inadequacies.

11.3 Explaining Changes in Efficiency Over Time as Measured by Unit Costs

Unit costs from the 1991 and 1997 public facility studies were compared for the four districts that were surveyed in both years. Unit costs per admission and per bed-day have declined sharply at teaching hospitals. Rural hospitals, peripheral units and base hospitals have experienced increases in their inpatient unit costs. Outpatient unit costs have fallen across all types of hospitals, except rural hospitals.

An analysis of performance indicators in 1991 and 1997 showed that the changes in costs, especially inpatient unit costs, between 1991 and 1997 were primarily due to the decline in occupancy rates at lower-level facilities, and the increased utilisation at teaching hospitals. Funding constraints in the public health sector meant that lower-level facilities were more likely to face input shortages than tertiary hospitals. Clearly, this has resulted in patients increasingly bypassing lower-level hospitals to seek better quality care at higher-level teaching hospitals. The decline in outpatient unit costs may be attributed to significantly higher levels of utilisation of government outpatient services in 1997 than in 1991.

Health expenditures as a percentage of GDP have stayed the same from 1991-97 (IPS-HPP 2000) while overall utilisation increased significantly. Admissions per capita and outpatient visits per capita have risen both in the public and private sectors, with the public sector increasing its share overall (Central Bank of Sri Lanka 1997). Given a relatively fixed level of expenditures, unit costs inevitably fell at those facilities that experienced large increases in admissions and/or outpatient visits.

A competing explanation for the decline in costs which is observed for inpatient care in complex facilities, and for outpatient care in all facility types is that an increasing share of costs is being transferred to patients, in the form of out-of-pocket payments for drugs and investigations performed in the private sector.[7] While this argument cannot be dismissed, additional data are needed to investigate it further. Firstly, since out-of-pocket payments for "free" public care were already considerable in 1991 (World Bank 1992), they cannot be entirely responsible for the cost trend observed in 1991-97. Moreover, if cost shifting did increase, the price faced by consumers in the public sector would also have increased to cause a shift in the demand from public to private. Household survey data from the two years show that the trend between 1991 and 1997 has been away from the private sector and towards the public sector. Finally, unit costs in the private hospital sector also appear to have fallen 15-25 percent in the same time period. The most likely explanation is that there is increased utilisation lowering unit costs.

11.4 Limitations of This Study and Future Studies

The study had a number of limitations, which should be borne in mind for future work of this type.

First, it was very difficult to get expenditure data for the lower-level facilities. This in itself is an indication of the low levels of management at those facilities. Evidently, hospital administrators and provincial directors of health have limited financial and budgetary authority. As a result of data non-availability, a significant proportion of intermediate and basic inpatient facilities had to be excluded from the cost analysis. While *a priori* we would expect those facilities lacking expenditure data to be relatively more inefficient, comparisons show that this is not always the case. Table 63 compares the facilities for which expenditure data was available with those for which it was missing, and examines the performance of these two groups according to hospital service indicators. While the excluded basic inpatient facilities appear to be relatively inefficient compared with those for which data are available, the opposite appears to be true for intermediate inpatient facilities, problems of sample size notwithstanding. In summary, the effect of the bias introduced by the missing expenditure data is unknown.

[7] This comment was made at the workshop and the seminar at which the results were presented.

Table 63. Direction of bias caused by non-availability of expenditure data

	Intermediate			Basic		
	All	Available	Not available	All	Available	Not available
No. of observations	14	12	2	96	83	13
Average length of stay	3.01	3.03	2.96	2.83	2.92	3.47
	(1.28)	(1.38)	(0.74)	(1.51)	(1.87)	(3.72)
Bed occupancy rate	58.21	57.04	65.21	47.92	49.42	38.30
	(26.53)	(28.58)	(7.19)	(32.33)	(32.24)	(32.50)
Bed turnover rate	78.26	77.63	84.23	67.42	69.94	47.95
	(25.85)	(26.23)	(30.00)	(57.75)	(59.68)	(35.66)

Note: Mean and standard deviation (in parentheses) reported.

While the procedures adopted for apportioning costs between inpatient and outpatient care were an improvement on those used in the 1991 survey, there were nonetheless difficulties, particularly in the estimation of staff time. In future studies, it would be better to ask questions about allocations to both inpatient and outpatient care, rather than using the total time and outpatient time to derive the inpatient time estimation. Our suspicion that our procedure overestimates the share of time going to inpatient activities is borne out by the comparison of the costs estimated from the cost functions with those from the accounting cost estimations.

On output measurement, there may be a gap in our treatment of transferred patients. Although information was collected in the questionnaire about the number of patients transferred, we ended up excluding this information from the analysis because of the difficulty in knowing how much care was provided before the point when the patient was transferred.

In terms of feasibility, this study has shown that an enormous amount of information can be generated from a study of this type. While there were initial difficulties in data collection and entry, we are confident that the quality of the data itself is generally quite high. Future studies could consider improvements in the way that data on staff time allocations were collected. It would be possible to shorten the questionnaire significantly by reducing the questions on service and infrastructure availability, and concentrating on the measurement of inputs and outputs.

Confidentiality of the data has created an unanticipated problem relating to the use of this information by the MOHIM. Ideally, it would be useful to provide to MOHIM a set of information with individual facility identifiers that would allow them to use the data for routine monitoring (e.g., the production of the Lasso diagrammes with facility names identified). However, in administering the questionnaire, respondents were assured of confidentiality of the data, and experience suggests that this assurance of confidentiality was important for securing the cooperation of the hospitals. Since some of this information is routinely reported by hospitals to MOHIM, an option that should be investigated is to ask MOHIM to provide raw data and to construct the diagrammes for them using their data.

Finally, there is the question of which of the efficiency measures explored in this study could be routinely collected by the Ministry of Health for its use in monitoring the performance of the hospital sector, and by individual facility managers for their own purposes. Certainly, information about service indicators can be routinely collected. In addition,

information about total expenditure could be collected, though in the absence of institutionalised cost accounting systems the detailed information needed for the cost apportionment could not be routinely reported, which would limit the potential for calculating accounting costs. Finally, the econometric analysis is of a sufficient level of technical complexity that it will need to be undertaken by specialist researchers, although the data requirements for doing so are not particularly heavy.

12. Recommendations

The following recommendations emerge from the discussion of the initial findings at a workshop in Colombo attended by officials from MOHIM and the Ministry of Finance, hospital directors and the health policy/research community.

In terms of policy towards hospital management, there are two important findings of this study. First, facilities appear to be relatively under-managed, and the skills necessary for managing complex facilities such as hospitals are not yet in place in most facilities. Second, there is very little performance monitoring of hospitals by MOHIM. Furthermore, the initiatives that are being taken focus primarily on tertiary hospitals; and the basic and intermediate hospitals, where the problems appear to be greatest, are not included in the plans to strengthen hospital management.

- Introduce some monitoring of very basic indicators of management performance. The Lasso diagrammes would be an extremely useful tool for this. They could be produced alongside the health indicators in the Annual Health Bulletin each year. Merely producing comparative information can be an extremely powerful tool for stimulating performance improvements.

- In addition to efficiency, indicators to be regularly monitored should also address quality (both technical and perceived) and equity.

- Improved monitoring of hospital performance needs to be accompanied by political commitment to address the problems which are identified.

- Continue efforts to strengthen the management skills of officers-in-charge. The management components of the pre-service training curriculum might need to be revisited, as those taking up posts in the more peripheral hospitals tend to be relatively junior doctors without postgraduate qualifications.

- Continue to support the introduction of management structures such as management committees in hospitals at all levels.

- Consider ways of improving the levels of utilisation of the lower-level hospitals. This will require measures to improve the perceptions of the population of the quality of the services offered.

- Consider the incentives for efficiency in the system: the rule-based methods of management currently in use provide very little incentives for efficiency, and may in fact discourage risk-taking by those in-charge.

The above recommendations must be considered work in progress. At the time of writing, plans were being made to conduct further workshops to present the results of the analysis to provincial directors of health, hospital managers outside of Colombo, and private doctors. A final set or recommendations based on the study will be made to the Ministry of Health once

the inputs of workshop participants and other health administrators/policymakers have been considered.

13. Conclusions

This study confirmed existing views about public health facilities in Sri Lanka regarding unit costs and performance indicators. Public hospitals in Sri Lanka are characterised by very low unit costs, low average lengths of stay, and high occupancy rates. In cross-country comparisons using these indicators, Sri Lankan hospitals stand out in terms of efficiency. Comparisons with the results of the 1991 survey showed that average lengths of stay have fallen and occupancy rates have increased. Lower-level facilities tend to be underutilised as patients bypass them in favour of higher-level facilities, which have better staff and drug supplies and hence higher level of perceived quality. Significant differences in the level of unit costs and performance indicators amongst facilities providing similar services led to the hypothesis that management-related factors may be responsible for much of the variation. On analysing the qualititative components of the survey with the quantitative data, it was found that there was very little association between the efficiency and management indicators. The findings of this study further reinforce skepticism as to the adequacy of neoclassical microeconomic approaches to efficiency for understanding the way in which public hospitals in Sri Lanka (and elsewhere) operate. Conventional models of efficiency based on the neoclassical production model rely on several assumptions, which do not necessarily hold in the context of Sri Lankan public hospitals. Here, production units do not have choice over their inputs as budgets are fixed and allocations are made by health planners at the MOHIM. Economic efficiency, or use of the minimum cost combination of inputs assumes that managers have full information about prices and choose their inputs accordingly. Neither applies to public hospital managers. Nor do the managers have control over their outputs. Sri Lankan hospitals cannot turn away patients, admit selectively, or even discourage use through monetary mechanisms. Thus, in a situation where budgets are fixed and demand is exogenous, unit costs are mainly demand driven and are unlikely to be adequate measures of economic efficiency at the hospital level. A broader perspective on efficiency that takes into account the equity and efficiency objectives of health planners who are responsible for resource allocation would be more effective at explaining the huge variation in unit costs and performance indicators between the same type of facilities.

Another interesting question, which future work in this area should attempt to answer, is why unit costs in Sri Lankan health facilities are so low. Is it demand-driven and determined by health seeking behaviour by households? Or is it that medical personnel in Sri Lanka are willing to supply a greater quantity of services at a given level of resources? An understanding of such issues is necessary to explain the performance of Sri Lankan public hospitals over time. Economic models of efficiency based on assumptions that are not applicable to the public health sector are far from sufficient for such an analysis.

Annex A: Lists of Inputs for Tracer Conditions

Indices documented

Lists of "minimum" inputs required to perform a range of different tracer interventions were prepared. Depending on the availability of the following equipment and drugs a quality score for each facility that relates to its ability to deliver the intervention was obtained

Minor surgery – (*score: out of 12)*

Needles	Syringes
Swabs	Needle holder
Suture needle	Suturing material
Sponge forceps	Towel clips
Mayo Scissors	Tetanus toxoid
Lignocaine injection	Local anaesthetic

Major surgery – (*score: out of 24)*

Needles	Syringes
Needle holder	Suturing needles
Suturing material	Scalpel blade
Scalpel holder	Tissue forceps
Artery forceps	Sinus forceps
McInde scissors	Mayo scissors
Bowel clamps – crushing	Bowel clamps – non-crushing
Nitrous oxide	Oxygen
Anaesthetic drugs	Penicillin
Cloxacillin	Anaesthetist on call 24 hours
Operating table	Spot lamp
Shadowless lamp	Czerney retractor

Normal delivery – (*score: out of 19)*

Vaginal speculum	Episiotomy scissors
Artery forceps	Cord-cutting forceps
Tooth dissecting forceps	Sponge-holding forceps
Wrigley's forceps	Needle holder
Needle (suture)	Suture material
Cord clamp	Suction catheter and tube
Suction apparatus	Ambubag

Oxygen	Lignocaine 2%
Sintocinon injection	Ergometrine injection
Dextrose or normal saline	
Management of acute severe asthma (medical) – (*score: out of 10)*	
Nebuliser	Syringes
Oxygen cylinder and stand	Suction apparatus
Suction tubes	Oxygen
Hydrocortisone injection	Aminophylllin injection
Salbumatol (ventolin) injection	Ventolin solution & inhaler
Neonatal resuscitation – *(score out of 7)*	
Neonatal resuscitation set	Small endotracheal tube
Infant laryngoscope	Suction apparatus
Suction catheter and tubes	Oxygen
Sodium bicarbonate injection	
Cardiac resuscitation – (*score: out of 12)*	
Laryngoscope	Endotracheal tubes
Suction apparatus	Suction catheter and tubes
Magil's forceps	Ambu resuscitation set
Defibrillator	Cardioscopic monitor
Sodium bicarbonate injection	Adrenaline injection
OxygenHydrocortisone injection	
Vaccination & well-baby care – *(score out of 8)*	
Electric and steam sterilizer	Syringes and needles
Vaccine carrier and ice packs	Cheatle forceps
Dry dressing jar	Clinical thermometer
Scale (infant)	Scale (salter hanging with trousers)
Caesarian section – *(score out of 31)*	
Episiotomy scissors	Artery forceps
Cord-cutting forceps	Tooth dissecting forceps
Sponge-holding forceps	Wrigley's forceps
Needle holder	Needle (suture)
Suture material	Cord clamp
Suction catheter and tube	Suction apparatus
Ambubag	Oxygen
Lignocaine 2%	Dextrose or normal saline
Scalpel handle	Scalpel blade
Mayo scissors	Small artery forceps
Mohiniun tissue forceps	Green armytage forceps
Doyan's blade	Czerney's retractor

Pentathal sodium	Scoline
Syntocinon	Ergometrine
Atropine	Pethidine
Anaesthetist on call 24 hours	
Prenatal care – (score out of 9)	
Tape measure	Scale (adult)
Foetal stethoscope	Benedict solution
Acetic acid	Fersolate
Folic acid	Mebendazole
Vitamin BCo/ Calcium	

Annex B: Lists of Drugs

List of drugs used for drug scores by each level[8] of facility.[9]

Level 1 – (score out of 25)

Aluminium hydroxide tabs	Benzathine penicillin injection
Benzyl benzoate lotion	Chloramphenicol eye ointment
Chlorhexidene + Centramide solution	Chloroquine tabs
Diazepam tab	Diethylcarbamazine tab
Ergometrine tab	Ferros sulphate tab
Folic acid tab	Isorbide denigrate tabs
Mebendazole tab	Metronidazole tab
Oral rehydration solution	Paracetamol tab
Phenoxymethyl penicillin tabs	Prednisolone tabs
Primamquine tabs	Promethazine tabs
Salbutamol tabs	Tetracycline capsules
Acetylsalicylic acid tabs	Normal saline solution
Chlorpheniramine	

Level 2 (score out of 27)

Frusemide	Lignociane injection
Morphine injection	

Level 3 (score out of 30)

Atropine injection	Rifampicin

Level 4 (score out of 30)

Entitled to all the above mentioned drugs.

[8] Categorization used by the Medical Supplies Division.

[9] Institutions at the upper level are entitled to the drugs supplied to the lower levels in addition to those specific to that level.

Annex C: List of Workshop Participants

Dr. Saman Kelegama, Executive Director, Institute of Policy Studies

Dr. S.M. Samarage, Director for Organisation Development, Department of Health Services

Dr. Patricia Alailima, Director General, Department of National Planning.

Mrs. Premaratne, Deputy Director, Economic Research Department, Central Bank of Sri Lanka.

Mrs. Kiruga Fernando, Additional Secretary for Health Services, MOHIM

Dr. P.G. Mahipala, Director, ertiary Services, Department of Health Services

Dr. Harsha de Silva, Director, Private Health Sector Development, Department of Health Services

Dr. Hiranthi Wijemanne , UNICEF

Dr. Lucian Jayasooriya (former Additional Secretary, current Medical Advisor, Glaxo Welcome Ceylon Ltd)

Dr. Kusum Wickramasooriya, Former Head of Family Health Bureau

Dr. Cybil Wijesinghe, Consultant, Family Health Bureau,

Mr. Charita Ratwatte, Managing Director, Sri Lanka Business Development Centre

Ms. Rohanthi Perera, Executive Director, Sri Lanka Business Development Centre

Dr. Lalini Rajapakse, Department of Community Medicine, University of Colombo

Dr. Asita de Silva, Head of Department, Department of Pharmacology, Faculty of Medicine, University of Kelaniya

Dr. Kumar Weerasekera, President, Sri Lanka Medical Association

Prof. A.M, Das, WHO Management Officer

Mr. F.D.C. Wijesinghe, Visiting Lecturer, Open University of Sri Lanka.

Dr. Nimal Attanayake, Department of Economics, University of Colombo

Dr. N.W. Vidyasagara, Consultant, World Bank

Mr. Athula Chandrasiri, Finance Commission

Dr. Hector Weerasinghe, Director, Sri Lanka National Hospital

Dr. K.K. W Karangegoda, Director, Castle Street Hospital for Women

Dr. D.L. De Lanerolle, Director, Sri Jayawardenepura Hospital

Dr. Saroj Jayasinghe, Assistant Professor, Department of Medicine, University of Colombo

Dr. G.W. Kaveendraraja, Japan International Corporation Agency

Dr. L.B.L. Denuwera, Deputy Director of Health Services, Provincial Council, Central

Dr. L. Siyambalagoda, Deputy Director of Health Services, Provincial Council, North Central

Annex D: Bibliography

Alchian, A. A. and H. Demsetz. 1972. "Production, Information Costs, and Economic Organization." *American Economic Review* 62(5):777-795.

Ali, A. I. and L. M. Seiford. 1993. "The Mathematical Programming Approach to Efficiency Analysis." In Fried, H.O., C. A. K. Lovell, and S. S. Schmidt eds. *The Measurement of Productive Efficiency: Techniques and Applications*. New York: Oxford University Press.

Anderson, David L. 1980. "A Statistical Cost Function Study of Public General Hospitals in Kenya." *Journal of Development Areas* 14(2):223-35.

Arrow, K. J. 1963. "Uncertainty and the Welfare Economics of Medical Care." *American Economic Review* 53(5):941-973.

Ashmore, M., M. Mulkay, and T. Pinch. 1989. *Health and Efficiency: A Sociology of Health Economics*. Milton Keynes: Open University Press.

Banker, R. D., R. F. Conrad, and R. P. Strauss. 1986. "A Comparative Application of Data Envelopment Analysis and Translog Methods: An Illustrative Study of Hospital Production." *Management Science* 32(1):30-44.

Barnum, Howard, and Joseph Kutzin. 1993. *Public Hospitals in Developing Countries: Resource Use, Cost, Financing*. Baltimore: Johns Hopkins University Press for the World Bank.

Bartlett, W. and J. Le Grand. 1994. "The Performance of Trusts." In Robinson, R. and J. Le Grand, eds. *Evaluating the National Service Reforms*, 54-73. Berks: Policy Journals.

Berman, P. and S. Sakai. 1993. "The Productivity of Manpower and Supplies in Public Health Services in Java." In Robinson, R. and J. Le Grand, eds. *Health Economics Research in Development Countries*, 54-73. Berks: Policy Journals.

Berman, P. 1995. "Health Sector Reform: Making Health Development Sustainable." *Health Policy* 32:13-28.

Birdsall, N. and E. James. Forthcoming. "Health, Government and the Poor: The Case for the Private Sector." In Gribble, J. and S. Preston, eds. *Policy and Planning Implications of the Epidemiological Transition*.

Bitran, R. 1995. "Efficiency and Quality in the Public and Private Sectors in Senegal." *Health Policy and Planning* 10(3):271-283.

Bitran, R., and S. Block. September 1992. *Provider Incentives and Productive Efficiency in Government Health Services*. Bethesda, Maryland: Abt Associates,.Inc.

Bitran-Dicowsky, R. and D. W. Dunlop. 1993. "The Determinants of Hospital Costs: An Analysis of Ethiopia." In Mills, A. and K. Lee. *Health Economics Research in Developing Countries.* Oxford: Oxford University Press.

Breyer, F. 1987. "The Specification of a Hospital Cost Function: A Comment on the Recent Literature." *Journal of Health Economics* 6:147-157.

Brown, R. S., D. W. Caves, and L. R. Christensen. 1979. "Modelling the Structure of Cost and Production for Multiproduct Firms." *Southern Economic Journal* 256-273.

Burgess, J. F. Jr. and P. W. Wilson. August 1995. "Decomposing Hospital Productivity Changes 1985-88: A Non-Parametric Malmquist Approach."

———. July 1995. "Policy and Inefficiency in the US Hospital Industry."

——. Forthcoming. "Hospital Ownership and Technical Inefficiency." *Management Sciences for Health*. Boston.

———. 1993. "Technical Efficiency in Veterans Administration Hospitals." In. Fried, H.O., C. A. K. Lovell, and S. S. Schmidt. *The Measurement of Productive Efficiency: Techniques and Applications.* New York: Oxford University Press.

Button, K. J. and T. J. Weyman-Jones. 1994. "X-Efficiency and Technical Efficiency." *Public Choice* 80:83-104.

Byrnes, P. and V. Valdmanis. 1989. "Variable Cost Frontiers and Efficiency: An Investigation of Labour Costs in Hospitals." In Gulledge, T. R. and L. A. Litteral, eds. *Cost Analysis Applications of Economics and Operations Research: Proceedings of the Institute of Cost Analysis National Conference*.

Caves, D. H. and L. R. Christenson. 1980. "The Relative Efficiency of Public and Private Firms in a Competitive Environment: The Case of Canadian Railroads." *Journal of Political Economy* 88(5):958-976.

Central Bank of Sri Lanka. Various Years. *Annual Report*. Colombo: Central Bank.

Central Bank of Sri Lanka. 1997. *Consumer Finance Survey 1996/97*. Colombo: Central Bank.

Chambers, R. G. 1988. *Applied Production Analysis.* Cambridge UK: Cambridge University Press.

Chambers, R. 1992. "The Self-Deceiving State." *Bulletin of the Institute of Development Studies* 23(4):31-42.

Cohen, M. D., J. G. March, and J. P Olsen. 1972. "A Garbage Can Model of Organizational Choice." *Administrative Science Quarterly* 17(1):1-25.

Cowing, T. G., A. G. Holtmann, and S. Powers. 1983. "Hospital Cost Analysis: A Survey and Evaluation of Recent Studies." *Advances in Health Economics and Health Services Research* 4:257-303.

Cowing, T. G. and A. G. Holtmann. 1983. “Multiproduct Short-run Hospital Cost Functions: Empirical Evidence and Policy Implications from Cross-section Data.” *Southern Economic Journal* 49:637-653.

DiMaggio, P. J. and W. W. Powell. 1991. “The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organization Fields.” In Powell, W. W. and P. J. DiMaggio, eds. *The New Institutionalism in Organizational Analysis,* 63-82. Chicago: University of Chicago Press.

Donaldson, D. S. 1995. “Application of Econometric Methods to Study of the Costs of Rural Health Facilities in Papua New Guinea.” Ph.D. diss., Harvard School of Public Health, Boston.

Dor, A. 1994. “Non-minimum Cost Functions and the Stochastic Frontier: On Applications to Health Care Providers." *Journal of Health Economics* 13:329-334.

Dunleavy, P. 1991. *Democracy, Bureaucracy and Public Choice*. New York: Harvester Wheatsheaf.

Eakin, B. K. 1991. “Allocative Inefficiency in the Production of Hospital Services.” *Southern Economic Journal* 240-248.

——. 1993. “Do Physicians Minimize Cost?” In Fried, H.O., C. A. K. Lovell, and S. S. Schmidt, eds. *The Measurement of Productive Efficiency: Techniques and Applications*. New York: Oxford University Press.

Eakin, B. K., and T. J. Kniesner. 1988. “Estimating a Non-minimum Cost Function for Hospitals.” *Southern Economic Journal* 54(3):583-597.

Edwards, F. R. 1977. “Managerial Objectives in Regulated Industries: Expense-Preference Behavior in Banking.” *Journal of Political Economy* 85(1):147-162.

Evans, R. G. 1971. “Behavioural Cost Functions for Hospitals.” *Canadian Journal of Economics* 4(2):198-215.

Evans, R. G., and H. D. Walker. 1972. “Information Theory and the Analysis of Hospital Cost Structure.” *Canadian Journal of Economics* 3:398-418.

Felstein, M. 1981. *Hospital Costs and Health Insurance.* Cambridge, MA: Harvard University Press.

Feldstein, M. S. 1967. Economic Analysis for Health Service Efficiency. Amsterdam: North-Holland.

Forsund, F. R., C. A. K. Lovell, and P. Schmidt. 1980. “A Survey of Frontier Production Functions and of their Relationship to Efficiency Measurements.” *Journal of Econometrics* 13:5-25.

Frank, R. G., D. S. Salkever, and J. Mitchell. 1990. “Market Forces and the Public Good: Competition among Hospitals and Provision of Indigent Care.” *Advances in Health Economics and Health Services Research* 11:159-183.

Frank, R. G. and D. S. Salkever. 1991. "The Supply of Charity Services by Non Profit Hospitals: Motives and Market Structure." *Rand Journal of Economics* 22(3):430-445.

Frank, R. G. and C. A. Taube. 1987. "Technical and Allocative Efficiency in Production of Outpatient Mental Health Clinic Services." *Social Science and Medicine* 24(10):843-850.

Frank, R. G. and T. G. McGuire. August 1994. "Health Care Reform and Community Mental Health Systems."

Frank, R., and D. Salkever. 1994. "Nonprofit Organizations in the Health Sector." *Journal of Economic Perspectives* 8(4):129-144.

Fried, H. O., C. A. K. Lovell, and S. S. Schmidt, eds. 1993. *The Measurement of Productive Efficiency: Techniques and Applications.* New York: Oxford University Press.

Friedman, B. and M. Pauly. 1981. "Cost Functions for a Service Firm with Variable Quality and Stochastic Demand: The Case of Hospitals." *Review of Economics and Statistics* 63:620-624.

Gertler, P. J. and D. M. Waldman. 1992. "Quality-adjusted Cost Functions and Policy Evaluation in the Nursing Home Industry." *Journal of Political Economy* 100(6):1232-1256.

Gilson, Lucy. 1995. "Management and Health Care Reform in Sub-Saharan Africa." *Social Science and Medicine* 40(5):695-710.

Gilson, L., and A. Mills. 1995. "Health Sector Reforms in Sub-Saharan Africa: Lessons of the Last 10 Years." *Health Policy* 32:215-243.

Goldman, F., and M. Grossman. 1983. "The Production and Cost of Ambulatory Medical Care in Community Health Centers." *Advances in Health Economics and Health Services Research* 4:1-56.

Golladay, F. L., M. E. Manser, and K. R. Smith. "Scale Economies in the Delivery of Medical Care: A Mixed Integer Programming Analysis of Efficient Manpower Utilization." *Journal of Human Resources* 9(10):50-62.

Granneman, T. W., R. S. Brown, and M. V. Pauly. 1986. "Estimating Hospital Costs: A Multiple-Output Analysis." *Journal of Health Economics* 5:107-127.

Green, A. 1992. *An Introduction to Health Planning in Developing Countries.* Oxford: Oxford University Press.

Grosskopf, S., and K. Hayes. 1993. "Local Public Sector Bureaucrats and their Input Choices." *Journal of Urban Economics* 33:151-166.

Grosskopf, S., and V. Valdmanis. 1987. "Measuring Hospital Performance: A Non-Parametric Approach." *Journal of Health Economics* 6(2):89 –107.

Hammer, J. S. and P. Berman. 1995. "Ends and Means in Public Health Policy in Developing Countries." *Health Policy* 32:29-45.

Hanson, K., and F. Chindele. 1992. *Cost, Resource Use and Financing: A Study of Monze District, Zambia*. New York: UNICEF: Bamako Initiative Technical Report No. 1.

Hanson, K. and F. Nkunzimana. 1992. *Les couts et l'utilisation des ressources dans les centres de sante de la province de Muyinga, Burundi.* New York: UNICEF: Bamako Initiative Technical Report no. 13.

Harris, J. E. 1977. "The Internal Organization of Hospitals: Some Economic Implications." *Bell Journal of Economics* (Autumn):467-482.

Harrison, S., D. J. Hunter, G. Marnoch, and C. Pollitt. 1993. *Just Managing: Power and Culture in the National Health Service*. London: Macmillan.

Hsiao, W. 2000. *A Preliminary Assessment of Sri Lanka's Health Sector and Steps Forward*. In conjunction with Institute of Policy Studies, Sri Lanka and World Bank/Colombo.

Institute of Policy Studies, Health Policy Programme. Forthcoming 2000. "Sri Lanka National Health Accounts."

Jensen, G. and M. A. Morrisey. 1986. "The Role of Physicians in Hospital Production." *Review of Economics and Statistics* 68(3):432-442.

Kooreman, P. 1994. "Nursing Home Care in The Netherlands: A Non-Parametric Efficiency Analysis." *Journal of Health Economics* 13:301-316.

Lindsay, C. M. 1976. "A Theory of Government Enterprise." *Journal of Political Economy* 84(5):1061-1077.

——. 1975. *Veterans' Administration Hospitals: An Economic Analysis of Government Enterprise*. Washington, D. C: American Enterprise Institute for Public Policy Research.

Liu, Y. 1995. *Inefficient Use of Limited Resources in China's Poverty Areas: Problems and Policy Implications.*

Lovell, C. A. K. 1993. Production Frontiers and Productive Efficiency. In Fried, H. O., C. A. K. Lovell, and S. S. Schmidt, eds. *The Measurement of Productive Efficiency: Techniques and Applications*. New York: Oxford University Press.

Mackintosh, M. 1992. "Structure and Networks in the British Health Service Reforms." *Bulletin of the Institute of Development Studies* 23(4):43-50.

Mahapatra, P. and P. Berman. 1994. "Using hospital activity indicators to evaluate performance in Andhra Pradesh, India." *International Journal of Health Planning and Management* 9:199-211.

March, J. G. and H. A. Simon. 1958. *Organizations.* New York: John Wiley and Sons.

Mars, T. F. 1992. "Public Sector Organization: Where next?" *Bulletin of the Institute of Development Studies* 23(4):18-30.

Maxwell, R. 1988. *Reshaping the National Health Service*. Oxford: Transaction Books.

Maynard, A. 1989. *Whither the National Health Service?* York: University of York Centre for Health Economics.

McGuire, A., P. Fenn, and K. Mayhew. "The Assessment: The Economics of Health Care." *Oxford Review of Economic Policy* 5(1):1-19.

Mechanic, D. 1995. "The Americanization of the British National Health Service." *Health Affairs* Summer: 51-67.

Mester, L. J. 1989. "Testing for Expense Preference Behaviour: Mutual versus Stock Savings and Loans." *Rand Journal of Economics* 20(4):483-498.

Migue. J. L., and G. Belanger. 1974. "Toward a General Theory of Managerial Discretion." *Public Choice* 17:27-42.

Miller, G. J. and T. M Moe. 1983. "Bureaucrats, Legislators, and the Size of Government." *American Political Science Review* 77(2):297-322.

Mills, Anne. 1990a. "The Economics of Hospitals in Developing Countries. Part I: Expenditure Patterns." *Health Policy and Planning* 5(2):107-17.

——. 1990b. "The Economics of Hospitals in Developing Countries. Part II: Costs and Sources of Income." *Health Policy and Planning* 5(3):203-18.

———. 1997. "Improving the Efficiency of Public Sector Health Services in Development Countries: Bureaucratic versus Market Approaches." In Colclough, C., ed. *New Strategies for Financing Education and Health in Developing Countries: A Critical Assessment.*

Ministry of Health and Indigenous Medicine .1997. *Annual Health Bulletin 1997*. Colombo: MOH.

Mitchell, M., D. Donaldson, and J. Thomason. 1988. "Papua New Guinea Rural Health Services Cost Study." *Management Sciences for Health*. Boston.

Moor, M. 1992. "Competition and Pluralism in Public Bureaucracies." *Bulletin of the Institute of Development Studies* 23(4):65-77.

Mueller, D. C. 1979. *Public Choice*. Cambridge, UK: Cambridge University Press.

Murray, R. 1992. "Towards a Flexible State." *Bulletin of the Institute of Development Studies* 23(4):78-89.

Newhouse, Joseph P. 1994. "Frontier Estimation: How Useful a Tool for Health Economics?" *Journal of Health Economics* 13:317-322.

——. 1970. "Toward a Theory of Nonprofit Institutions: An Economic Model of a Hospital." *American Economic Review* 64-74.

Niskanen, W. A. 1971. *Bureaucracy and Representative Government.* Chicago: Aldine-Atherton.

——. 1975. "Bureaucrats and Politicians." *Journal of Law and Economics* 617-643.

North, D. C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge, U.K.: Cambridge University Press.

Nyman, J. A. and D. L. Bricker. 1989. "Profit Incentives and Technical Efficiency in the Production of Nursing Home Care." *Review of Economics and Statistics* 71(4):586 – 594.

Orzechowski, W. 1977. "Economic Models of Bureaucracy: Survey, Extensions, and Evidence." In Borcherding, T.E., ed. *Budget and Bureaucrats: The Sources of Government Growth*. Durham, NC: Duke University Press.

Pabon Lasso, Hipolito. 1986. "Evaluating Hospital Performance through Simultaneous Application of Several Indicators." *Bulletin of the Pan American Health Organization* 20(4)341-57.

Pauly, M. V. 1978. "Medical Staff Characteristics and Hospital Costs." *Journal of Human Resources* 8(Supplement):77-111.

——. 1987. "Nonprofit Firms in Medical Markets." *American Economic Review (papers and proceedings)* 77(2):257-262.

Pauly, M. and M. Redisch. 1973. "The Not-For-Profit Hospital as a Physicians' Cooperative." *American Economic Review* 63(1)87-99.

Perrow, C. 1986. *Complex Organizations: A Critical Essay, 3rd ed.* New York: Random House.

Pestieau, P. and H. Tulkens. 1990. *Assessing the Performance of Public Sector Activities: Some Recent Evidence from the Productive Efficiency Viewpoint.* Louvain-la-Neuve, Belgium: CORE, Universite Catholique de Louvain.

Powell, W. W. and P. J. DiMaggio, eds. 1991. *The New Institutionalism in Organizational Analysis.* Chicago: University of Chicago Press.

Purohit, B. C. and V. Rai. 1992. "Operating Efficiency in Inpatient Care: An Exploratory Analysis of Teaching Hospitals in Rajasthan, India." *International Journal of Health Planning and Management* 7:149-162.

Rannan-Eliya, Ravi P. and Aparnaa Somanathan. 1999. "Bangladesh Facility Efficiency Survey." Working Paper No. 16. Dhaka: Health Economics Unit, Ministry of Family Health and Welfare, Government of People's Republic of Bangladesh.

Rees, R. 1985. "The Theory of Principal and Agent, Part 1." *Bulletin of Economic Research* 37(1):3-26.

——. 1985. "The Theory of Principal and Agent, Part 2." *Bulletin of Economic Research* 37(2):75-95.

Schmidt, P. "Frontier Production Functions." *Econometric Reviews* 4(2):289-328.

Skinner, P. 1994. "What do Stochastic Frontier Cost Functions Tell Us About Inefficiency?" *Journal of Health Economics* 13:323-328.

Smirlock, M. and W. Marshall. "Monopoly Power and Expense-Preference Behavior: Theory and Evidence to the Contrary." *Bell Journal of Economics* 166-178.

Spicer, M. W. 1982. "The Economics of Bureaucracy and the British National Health Service." *Milbank Memorial Fund Quarterly* 60(4):657-672.

Stewart, J. and K. Walsh. 1992. "Change in the Management of Public Service." *Public Administration* 70 (Winter):499-518.

Stigler, G. J. 1976. "The Xistence of X-Efficiency." *American Economic Review* 66(1):213-216.

Taira, D. and W. Hsiao. 1992. *A Theoretical Framework on Health Expenditures and Inflation – A Review*. Boston: Program in Health Care Financing, Harvard School of Public Health.

Tatchell, M. 1983. "Measuring Hospital Output: A Review of the Service Mix and Case Mix Approaches." *Social Science and Medicine* 17(14):871-883.

Vita, M. G. 1990. "Exploring Hospital Production Relationships with Flexible Functional Forms." *Journal of Health Economics* 13:281-300.

Vitaliano, D. F., and M. Toren 1994. "Cost and Efficiency in Nursing Homes: A Stochastic Frontier Approach." *Journal of Health Economics* 13:281-300.

Wagstaff, A. 1989a. "Econometric Studies in Health Economics: A Survey of the British Literature." *Journal of Health Economics* 8:1-51.

——. 1989b. "Estimating Efficiency in the Hospital Sector: A Comparison of Three Statistical Cost Frontier Models." *Applied Economics* 21:659-672.

Weisbrod, B. 1988. *The Nonprofit Economy*. Cambridge, MA: Harvard University Press.

Williamson, O. E. 1963. "Managerial Discretion and Business Behaviour." *American Economic Review* 53: 1032-1057.

——. 1975. *Markets and Hierarchies*. New York: Free Press.

Wolf, C. Jr. 1993. Markets or Governments: Choosing Between Imperfect Alternatives. Cambridge MA: MIT Press.

World Bank. *Household Health Expenditure Survey 1991/92.* Colombo.

Wouters, A. 1993. “The Cost and Efficiency of Public and Private Health Care Facilities in Ogun State, Nigeria.” *Health Economics* 2:31-42.

Yoder, S. G. 1986. “Economic Theories of For-Profit and Not-for-Profit Organisations.” In Gray, B. H., ed. *For-Profit Enterprise in Health Care*. Washington DC: National Academy Press.

Zuckerman, S., J. Hadley, and L. Iezzoni. 1994. “Measuring Hospital Efficiency with Frontier Cost Functions.” *Journal of Health Economic*s 13:255-280.