

No. 1

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR REHABILITATION OF BIOMEDICAL ENGINEERING SERVICES  
IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

**BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT FOR REHABILITATION  
OF  
BIOMEDICAL ENGINEERING SERVICES  
IN  
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA**

**AUGUST, 1991**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

AUGUST

120  
928  
GRF

LIBRARY  
C.R.(2)  
91 86

GRF  
~~GRF~~  
91-86



JICA LIBRARY



1093040(2)

229P3



**BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT FOR REHABILITATION  
OF  
BIOMEDICAL ENGINEERING SERVICES  
IN  
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA**

**AUGUST, 1991**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

国際協力事業団

22783

## PREFACE

In response to a request from the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of the Biomedical Engineering Services and entrusted the study to the Japan International Cooperation Agency (JICA).

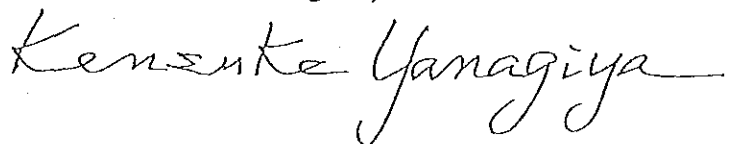
JICA sent to Sri Lanka a study team headed by Dr. Hiroshi Amemiya, Director of the Department of Surgical Research at the National Cardiovascular Center Research Institute, from March 17 to April 20, 1991.

The team held discussions with the officials concerned of the Government of Sri Lanka and conducted a field study at the sites. After the team returned to Japan, further studies were made. Then, a mission was sent to Sri Lanka in order to discuss the draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the study teams.

August, 1991



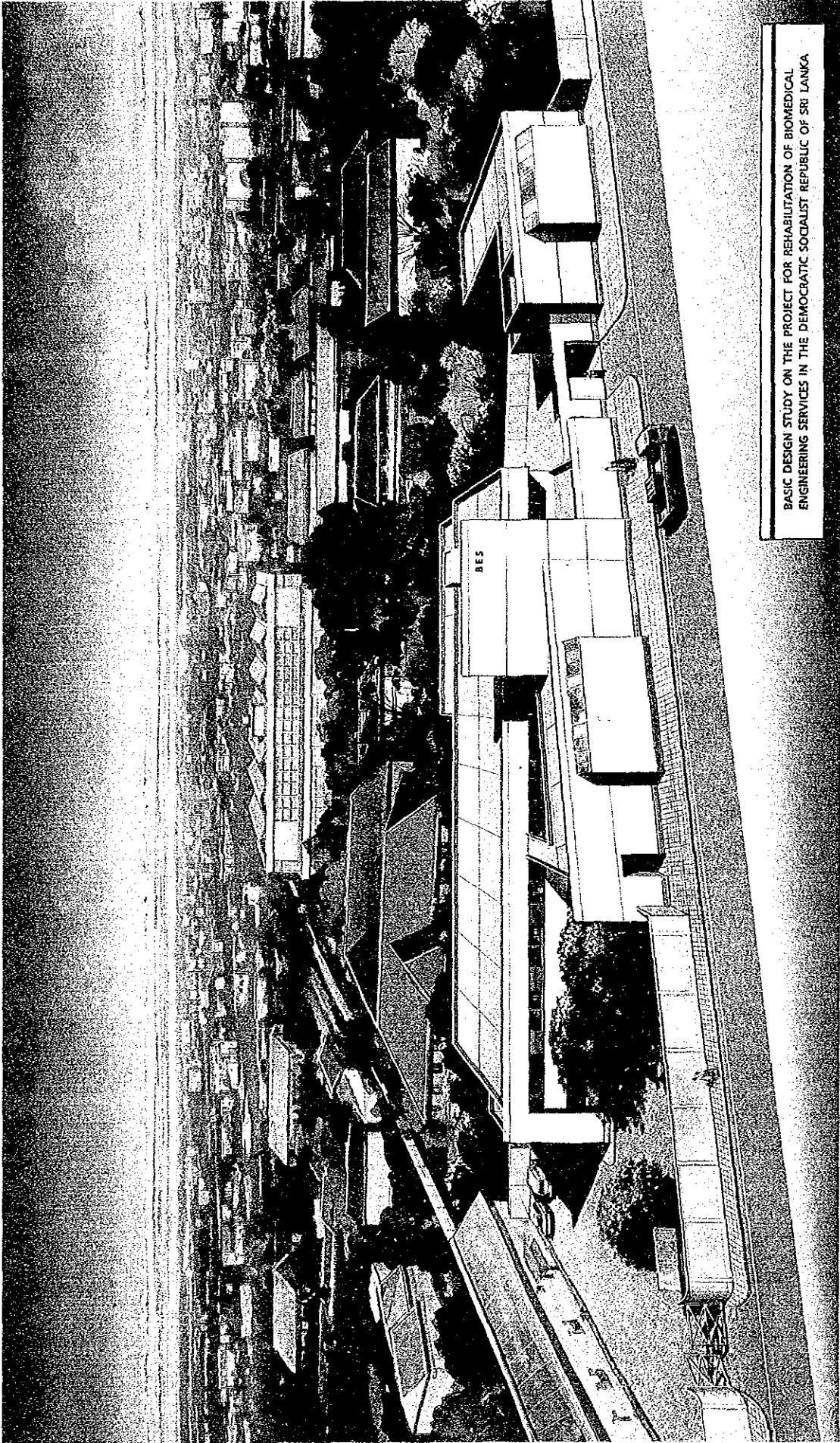
Kensuke Yanagiya

President

Japan International Cooperation Agency







BASIC DESIGN STUDY ON THE PROJECT FOR REHABILITATION OF BIOMEDICAL  
ENGINEERING SERVICES IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

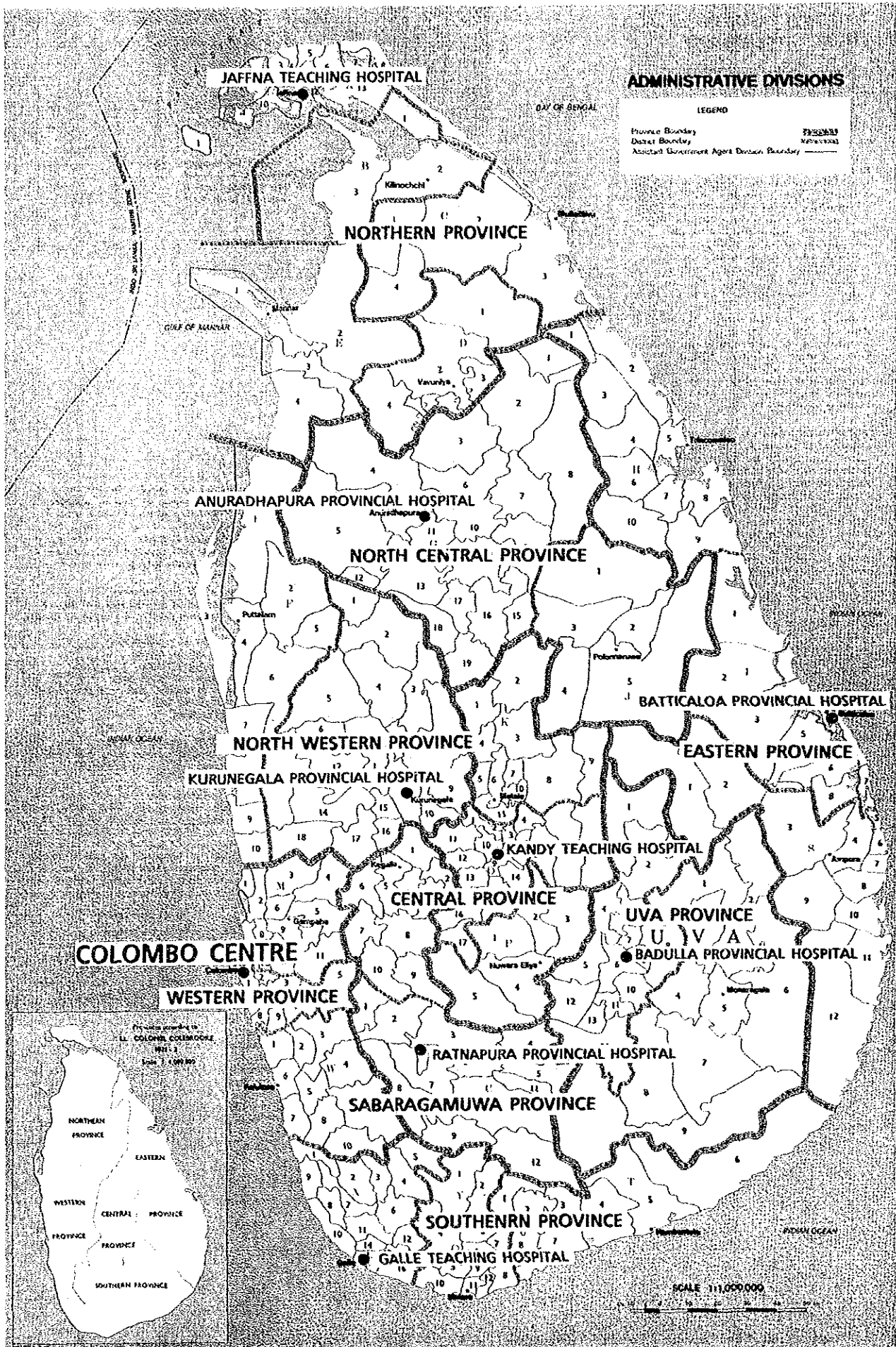
**AERIAL VIEW**





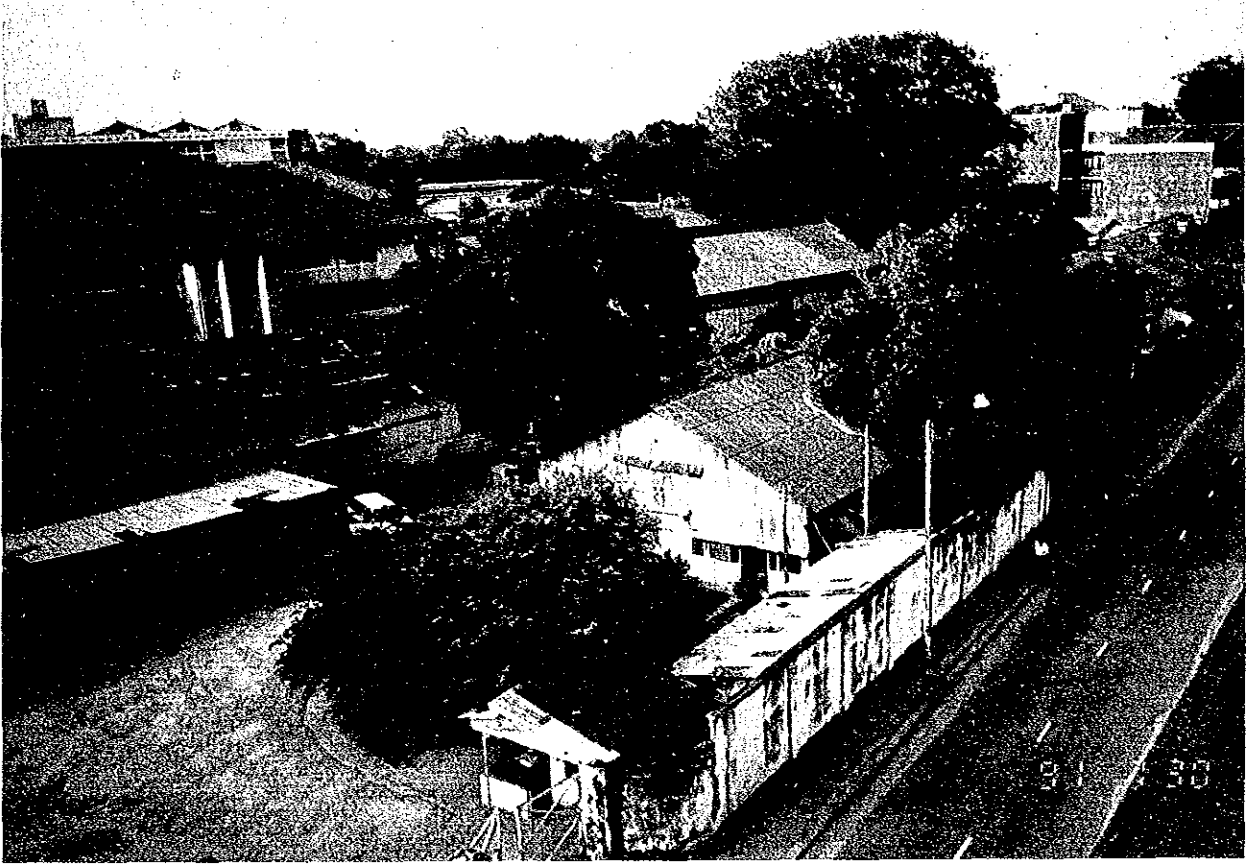
**SITE LOCATION MAP**



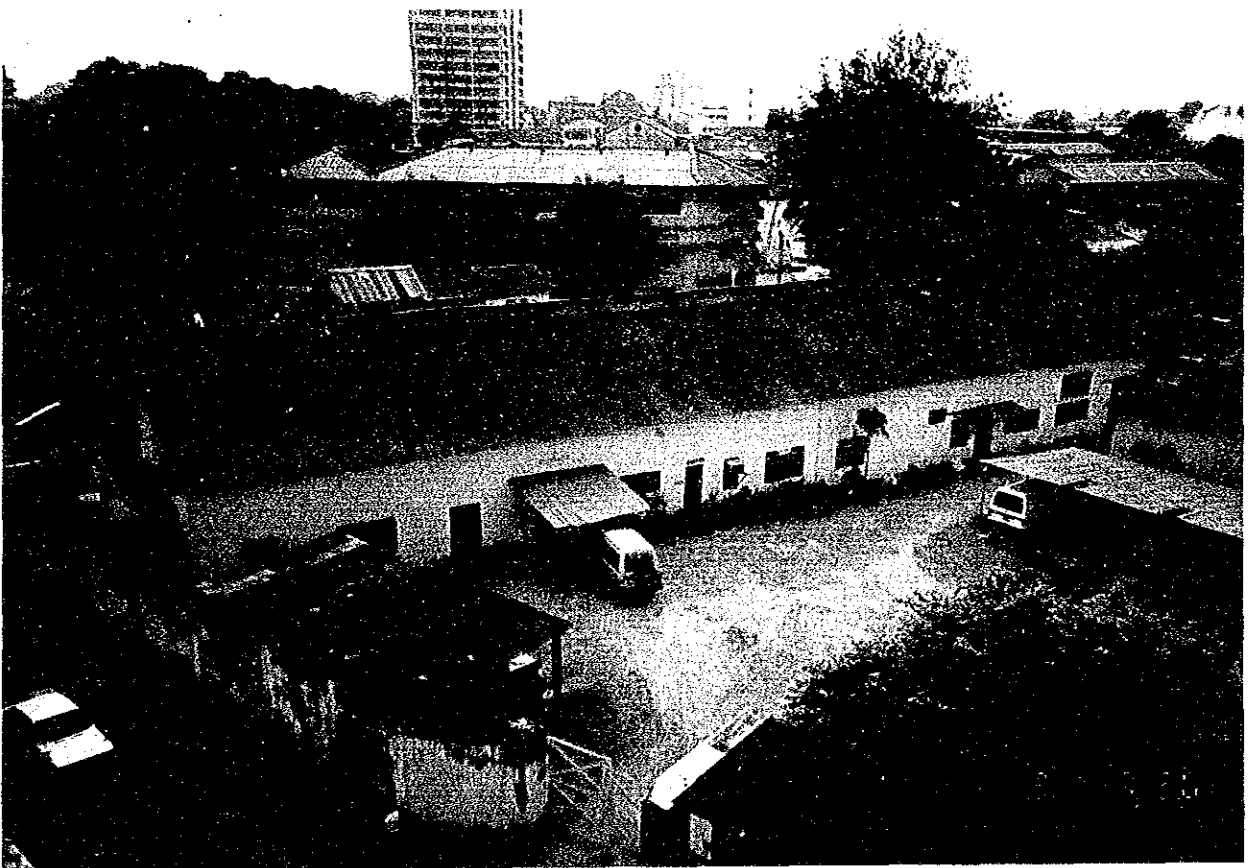


**ADMINISTRATIVE DIVISIONS OF SRI LANKA**





**PROPOSED SITE FOR COLOMBO CENTRE**



**EXISTING ADMINISTRATION BUILDING**







**PROPOSED SITE FOR SOUTHERN PROVINCE WORKSHOP**



## SUMMARY



## SUMMARY

The Government of Sri Lanka gave a promise to its people to provide comprehensive health services, and has adopted such goals as reducing the infant mortality rate from 37.7 (per 1,000 newborns) in 1979, to 15; and raising the life expectancy at birth to 69.5 for males and 73 for females. It is hoped that these goals can be accomplished by the year 2000.

The Government of Sri Lanka considers the improvement of the quality of the country's health services as one of its top priorities. It has been actively promoting the improvement and expansion of the country's hospitals and other medical institutions by introducing new medical equipment and placing increased emphasis on the quality of primary health care. In 1990, the country's population was estimated at about 17.07 million people. In 1989, the infant mortality rate decreased to 27 while the life expectancy at birth (for both sexes) increased to 71. These indicators are at far higher levels than in other Southwest Asian countries, which suggests the effectiveness of the central government's health policy measures.

The country's composition of main diseases, on the other hand, is characterised by relatively low death rates from infectious diseases. An analysis of the main causes of death at hospitals in 1989 reveals that ischemic heart disease, cerebrovascular diseases, and gastrointestinal diseases ranked 1st, 2nd, and 3rd respectively, while deaths from malignant neoplasms represented 4.8 percent of the total deaths. These facts suggest that the pattern of Sri Lanka's incidence of main disease falls between that of other developing Asian countries and that of industrially advanced countries. However, since tropical diseases such as malaria and filaria, as well as epidemic enteritis, still rank highest on the list of main diseases (judged by the number of inpatients), it is necessary for the country to continue efforts to improve its health environment by promoting primary health care.

In light of the fact that the pattern of the country's incidence of main disease is becoming more like that of industrialised countries, the central government has been actively introducing advanced medical equipment. However despite the marked improvement of the country's health services, some problems have surfaced. The qualitative differences between hospitals in and around Colombo and rural hospitals has widened. Medical equipment in use at medical research institutions is superannuated, and the methods for management and maintenance of the medical equipment are insufficient.

At present, the Ministry of Health and Women's Affairs is responsible for the provision of health services. The Division of Biomedical Engineering Services (BES), together with the Medical Research Institute and the Drug Quality Assurance Laboratory, operates under the direct control of the Ministry's Laboratory Services. BES is responsible for maintenance and management services -- from the purchase to the disposal of medical equipment used at all public medical institutions.

According to the Ministry's provisional estimate, about 150 types of medical equipment (around 30,000 items) are owned by the country's public medical institutions. The results of the field survey, conducted as part of the basic design study, revealed that almost 30 percent of the equipment is not in working condition. This means that about 600 million rupees worth of medical equipment cannot be used. This amount is equivalent to about 18 percent of the Ministry's 1989 current expenditures. The widespread breakdown of medical equipment is not only a major impediment to the implementation of health services, but a serious hindrance to the effective utilisation of government funds.

Under these circumstances, the Government of Sri Lanka formulated a project to procure medical equipment to be used in five rural hospitals and the Maharagama Cancer Institute, and another project to improve the management and maintenance capabilities of Biomedical Engineering Services. It is for these projects that the Government of Sri Lanka

requested the Government of Japan to provide grant aid cooperation.

In response to the Sri Lankan Government, the Government of Japan sent a preliminary survey team to Sri Lanka from October 27 to November 15, 1990 in order to assess the relevance, and priority for each item in the request, and further to discuss details of the projects. The conclusion was that improving management and maintenance methods for medical equipment should be given top priority. At the same time, a survey of Biomedical Engineering Services pointed to a need for improving its facilities and equipment as well. Based on these findings, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of Biomedical Engineering Services. The Japan International Cooperation Agency (JICA) dispatched a basic design study team to Sri Lanka from March 17 to April 20, 1991 in order to confirm the contents of the request, and to examine the basic concept for the facilities and equipment as well as the necessity and appropriateness for grant aid. After returning to Japan, the basic design study team prepared a draft report presenting details of a proposed basic design and the equipment selected. From July 21 to August 1, 1991, the basic design study team returned to Sri Lanka where they explained the contents of the draft report to representatives of the Government of Sri Lanka, following which, this basic design study report was prepared.

The Ministry of Health and Women's Affairs represents the Government of Sri Lanka in implementing this project aimed at improving the facilities and equipment of the Biomedical Engineering Services, division of the Ministry's Laboratory Services. After completion of this project, the improved facilities and equipment will be utilised at the division's head workshop facilities in Colombo (Colombo Centre) and at a local workshop in Galle, a city in Southern Province.

The division's main activities are: 1) ordering/purchase, 2) acquisition/inspection/storing/delivery, 3) maintenance/repair, 4) management of

records, 5) disposal of condemned equipment, and 6) training. The improved facilities will be operated by three senior engineers who will be responsible for the department of: a) Procurement and Supply, b) Maintenance and Repair, and c) Training, under the supervision of a director of the division. The Procurement and Supply section will be responsible for the management of the warehouse and records. The Maintenance and Repair section will be responsible for the management of seven repair workshops and the local workshop. The Accounting and Administration sections will be under the direct control of the director. The number of division staff following the completion of this project will be 164 members in the Colombo Centre, and 4 at the Southern Province Workshop in the city of Galle. At present, the total number of staff members in the division is 106 (excluding 2 persons at a local workshop in Kandy). The number of staff members will increase by 62 after completion of this project.

The annual total cost for the operation and management of the improved facilities is estimated at 8.327 million rupees.

In consideration of the above-mentioned facts and projections, the following lineup of facilities and equipment are considered appropriate:

- Project site

Main facilities: 27, De Saram Place, Colombo 10 (on the premises of BES in Colombo)

Provincial workshop: on the premises of Galle Teaching Hospital in the city of Galle, Southern Province

- Scale of new facilities: total floor area: approx. 4,166 m<sup>2</sup>  
main facilities in Colombo: approx. 3,960 m<sup>2</sup>  
Southern Province Workshop in Galle: approx. 206 m<sup>2</sup>



- Structure and number of storeies:  
a two-storey reinforced concrete building with a one-storey portion
- Facilities and equipment

(1) Main Facilities in Colombo (Colombo Centre)

Maintenance/Repair	Rooms	Equipment
Radiology Workshop	Workshop Foreman's room	High voltage ampere meter MA peak meter X-ray survey meter
Electronics Workshop	Workshop Foreman's room	Defibrillator analyser E.C.G. recorder checker E.C.G. monitor simulator
Laboratory Equipment Workshop	Workshop Foreman's room	Digital frequency counter Electrical safety analyser Function generator
Operation Theatre/Steriliser Workshop	Workshop Foreman's room	Electrosurgery analyzer Ventilator tester
General-Purpose Equipment Workshop	Workshop Foreman's room Garage	Mobile workshops Analog multimeter Insulation resistance meter Portable AC arc welder unit
Mechanical Workshop	Workshop Foreman's room	Electric drill (bench type) Universal milling machine Electric shearing machine

Procurement/Supply	Rooms	Equipment
Equipment Warehouse	Warehouse Test/inspection	Equipment rack
Spare Parts Services	Parts storage Office room	Parts rack Low temperature unit
Loading & Unloading Services	Equipment handling space Packing material room	Forklift

Others	Rooms	Equipment
Common use space	Locker room Guard's room	Locker
Utility	Substation Generator room Pump room/reservoir	—

(2) Southern Province Workshop in Galle

Provincial Workshop	Rooms	Equipment
Southern Province Workshop	Workshop Engineer's room	Field electric test pack Digital multimeter

Considering the scale of the facilities, it is possible to expect completion of the project in about 12 months for both the construction work and the equipment procurement/ installation work.

Once this project is implemented, Sri Lanka's system for management and maintenance of medical equipment will be strengthened. Substantial quantitative and qualitative improvement will be seen in medical equipment management, maintenance and repairs. The ability of the division to repair medical equipment will be increased from 4,400 repairs per year to about 10,000 repairs per year. Including the number of repairs at provincial workshops, the division will be able to carry out almost all of an expected 12,700 repairs in 1990.

Implementation of this project under Japanese grant aid cooperation is very significant in that it is expected to help the Government of Sri Lanka's health service functions thus contributing to the recovery and regulation of the Sri Lankan people's health.

The Government of Japan should also implement a technical cooperation project to improve medical equipment management and maintenance technologies in Sri Lanka. The Government of Sri Lanka, on the other hand, must make further efforts to expand and improve the division's medical equipment management and maintenance capability by providing a sufficient budget, and by securing the appropriate personnel.

# CONTENTS

PREFACE

AERIAL VIEW

SITE LOCATION MAP

PROPOSED SITE

SUMMARY

CHAPTER 1 INTRODUCTION .....	1
CHAPTER 2 BACKGROUND OF THE PROJECT .....	3
2-1 General Condition of Health Care in Sri Lanka .....	3
2-1-1 Present Condition of the Health Administration .....	5
2-1-2 General State of the Health Services .....	10
2-1-3 The Country's Medical Institutions and Related Institutions .....	17
2-1-4 Diseases and Composition of Main Diseases .....	23
2-2 Present Condition of Medical Equipment in Use at Hospitals .....	28
2-2-1 Medical Equipment Owned .....	28
2-2-2 Medical Equipment Operating Condition .....	29
2-2-3 Present Condition of Private Medical Equipment Repair Service Companies .....	32
2-3 Present Condition of Biomedical Engineering Services(BES) ..	35
2-3-1 Organisation and Functions .....	35
2-3-2 Status of Division's Activities and Problems .....	37
2-3-3 Present Condition of the Existing Facilities and Equipment .....	49
2-3-4 Management System .....	55
2-4 General Condition of the Country's Health Projects .....	57
2-5 Background and Contents of the Request .....	61
2-5-1 Background of the Request .....	61
2-5-2 Contents of the Request .....	62

<b>CHAPTER 3</b>	<b>CONTENTS OF THE PROJECT</b>	<b>64</b>
3-1	Objectives of the Project	64
3-2	Examination of Contents of the Requests	64
3-2-1	Examination of Appropriateness and Necessity of the Project	64
3-2-2	Examination of Project Implementation and Management System	71
3-2-3	Examination of the Project Constituents	74
3-2-4	Examination of Relationships with Other Assistance Projects	76
3-2-5	Examination of the Project's Relationship with BES's Operational Programming for the Future	77
3-2-6	Examination of the Facilities and Equipment Requested	79
3-2-7	Examination of Necessity of Technical Cooperation	82
3-2-8	Basic Policy for Implementation of Cooperation	82
3-3	Outline of the Project	83
3-3-1	Implementing Organisation and Management System	83
3-3-2	Activity Plan	87
3-3-3	Location and Present Condition of the Project Site	97
3-3-4	Outline of the Facilities and Equipment	104
3-3-5	Maintenance and Management Plan	107
3-4	Technical Cooperation	116
<b>CHAPTER 4</b>	<b>BASIC DESIGN</b>	<b>117</b>
4-1	Design Policy	117
4-2	Examination of the Design Conditions	123
4-2-1	Configuration of the Facilities	123
4-2-2	Size and Area of the Proposed Facilities	124
4-3	Basic Design	128
4-3-1	Site Plan	128
4-3-2	Architectural Plan	129
4-3-3	Structural Plan	131
4-3-4	Utility Plan	133
4-3-5	Construction Material Plan	137
4-3-6	Repair/Calibration Equipment Plan	138

4-3-7	Basic Design Drawings .....	144
4-4	Construction Plan .....	151
4-4-1	Construction Work Criteria .....	151
4-4-2	Situation of the Construction Industry in Sri Lanka and Points to note in Construction .....	152
4-4-3	Construction Supervision Plan .....	154
4-4-4	Appliance/Material Procurement Plan .....	158
4-4-5	Project Implementation Schedule .....	160
4-4-6	Estimated Project Costs .....	163
CHAPTER 5	PROJECT EVALUATION AND CONCLUSION .....	167
5-1	Expected Effects of the Project .....	167
5-2	Appropriateness of the Implementation of the Project .....	172
5-3	Conclusion and Recommendations .....	175

[ ANNEX ]

1. Member List of the Survey Team
2. Survey Schedule
3. Member List of Governing Party in Sri Lanka
4. Minutes of Discussion
5. Letter Regarding Staff Employment
6. Soil Investigation Data



## CHAPTER 1 INTRODUCTION





## CHAPTER 1 INTRODUCTION

The Government of Sri Lanka asked the Government of Japan to provide grant aid cooperation for the project to improve the facilities and equipment of Biomedical Engineering Services (BES), which is under the Laboratory Services of the Ministry of Health and Women's Affairs. The aim was to expand and improve the country's management and maintenance of medical equipment used at medical institutions.

In response to this request, the Government of Japan decided to conduct a basic design study of the proposed project. The Japan International Cooperation Agency (JICA) sent a basic design study team headed by Dr. Hiroshi Amemiya, Director of the Department of Surgical Research at the National Cardiovascular Center Research Institute, to Sri Lanka from March 17 to April 20, 1991. In Sri Lanka, the basic design study team confirmed the contents of the request, examined existing conditions, and held discussions with representatives of the Government of Sri Lanka regarding the background of the project. A feasibility study of the requested grant aid cooperation was also conducted. In the feasibility study, the following analysis and surveys were carried out:

- (1) Analysis of the background and the appropriateness of the project.
- (2) Survey of the present condition of the medical equipment used at the country's public medical institutions.
- (3) Survey of the present condition of BES.
- (4) Discussion on the scope of activities and activity plan of BES.
- (5) Examination of the necessity of the facilities and equipment requested.

(6) Confirmation of the project implementation system, the project management system, the budget plan, and the planned budgetary appropriations for the work to be covered by the Sri Lankan side.

(7) Survey of the project site.

(8) Survey of the construction industry in Sri Lanka.

In Japan, the basic design study team made a basic design based on an analysis of its surveys in Sri Lanka, and prepared a draft report.

JICA then sent another study team, headed by Mr. Hideo Yasuki, Resident Representative, JICA, to discuss the contents of the draft report with representatives of the Government of Sri Lanka from July 21 to August 1, 1991. Both sides agreed on the contents of the report. Detailed in this report are the findings of these surveys and investigations.

A list of the members of the basic study team, the schedules of the surveys, a list of the representatives of the Government of Sri Lanka interviewed, and copies of the minutes of the discussions are attached at the end of this report.

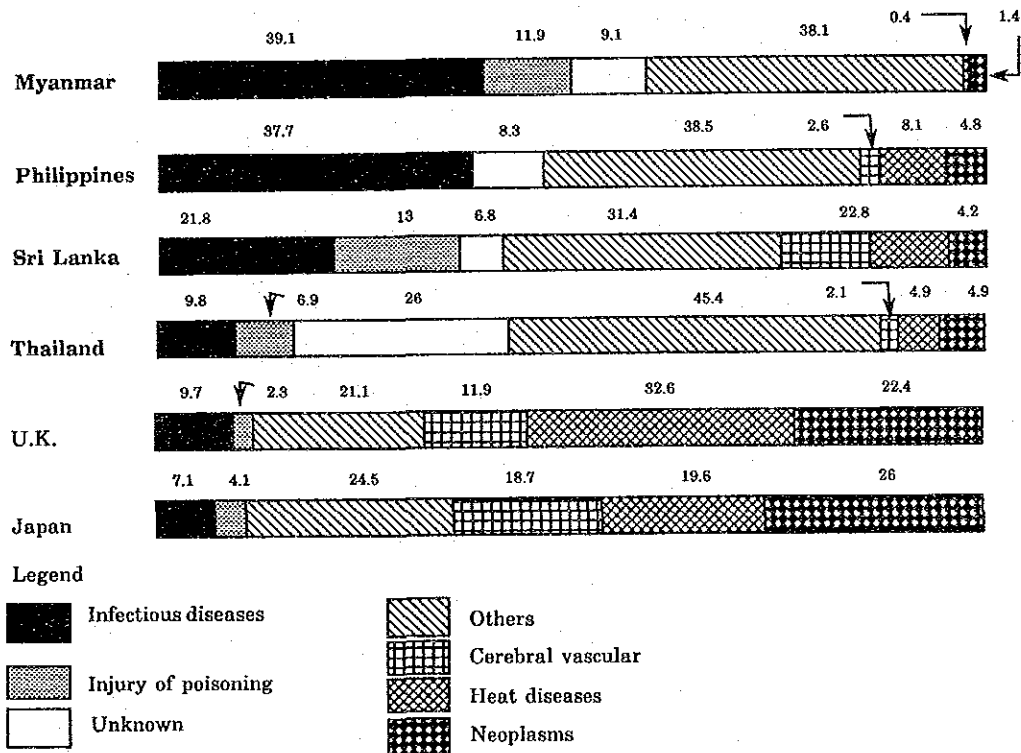
## **CHAPTER 2 BACKGROUND OF THE PROJECT**



## CHAPTER 2 BACKGROUND OF THE PROJECT

### 2-1 General Condition of Health Care in Sri Lanka

In 1990, Sri Lanka's total population was estimated at 17.07 million (about one-seventh of that of Japan). In 1989, life expectancy (for both sexes) was 71 years, far longer than the average of 55 years for Southwest Asian countries such as India, Nepal, Pakistan and Bangladesh. The country's infant mortality rate (per 1,000 new born) for 1989 was 27, which was lower by about 110 than the average for the above-mentioned four Southwest Asian countries. As shown in Fig. 2-1-1, the country's make-up of main diseases is characterised by a low death rate from infectious ones, including pneumonia. This is intermediate to that of other Asian developing countries and industrially advanced countries.



(Source: World Health Statistics Annual 1983~1985)

Fig. 2-1-1 International Comparison of Causes of Mortality

Despite Sri Lanka's low GNP and budgetary deficits, many factors have helped the country to maintain a high level of health compared to that of other developing countries. These include the relatively low neonatal mortality rate from tetanus and septicemia, attributable to a high in-hospital birth rate (77 percent in Sri Lanka, 33 percent in Myanmar), the spread of sanitation knowledge, attributable to the relatively high literacy rate (85 percent in Sri Lanka, 20 to 25 percent in Pakistan, Nepal and Bangladesh), the short time required to reach medical institutions, attributable to the country's small land area, and the country's climatic conditions.

By international standards, however, Sri Lanka has relatively low level health services. This is due in part to a considerable outflow of physicians to the Middle East and member nations of the British Commonwealth. In 1989, there were 1.32 physicians for every 10,000 people. This was fewer than the average of 2.4 for Myanmar, the Philippines, India and Thailand. The country's morbidity rate is still high, and both the morbidity and the mortality rate differ widely from one region to another. In light of these facts, the Government of Sri Lanka has been focusing its energies improving of the quality of health services offered at regional hospitals. Despite efforts, however, the regional hospitals still find it very difficult to offer sufficient services due to a shortage of labor, poor infrastructure, a shortage of necessary medical equipment, and overall poor management.

Along with the ongoing problems related to manpower and infrastructure, there has recently been a marked change in the country's composition of main diseases. Infectious diseases have been replaced by cerebrovascular disease heart diseases and neoplasms as the country's main diseases. Since 1980, ischemic heart disease has taken the heaviest toll on lives followed by cerebrovascular and gastrointestinal diseases in 1989. Clearly, the country's composition of main diseases is quite different from that of other developing countries. Thus, it is imperative for the

country to improve the quality and performance of its medical equipment needed for.

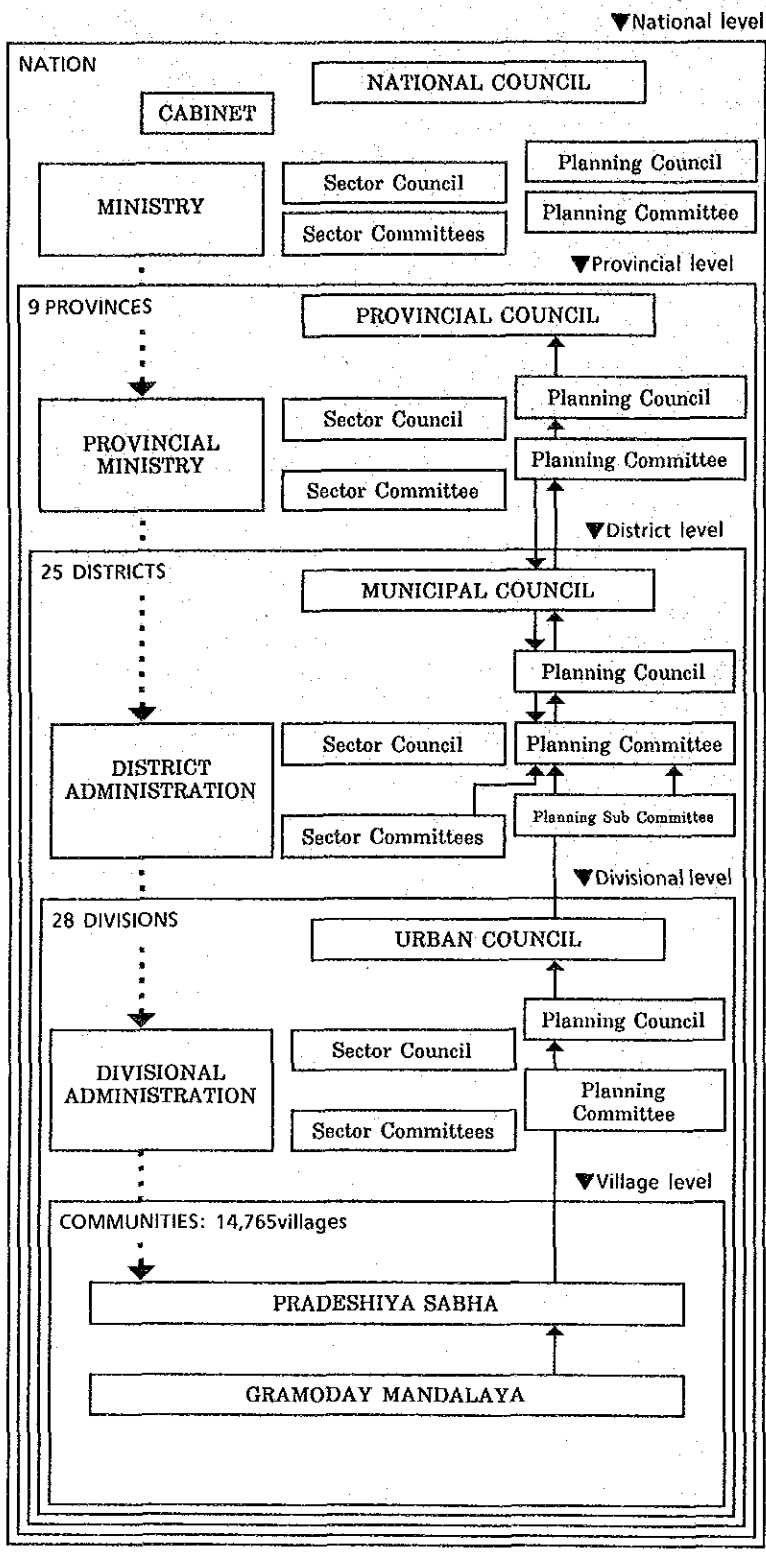
## 2-1-1 Present Condition of the Health Administration

### (1) Present State of the Government of Sri Lanka's Health Services

At present, the Government of Sri Lanka is promoting programmes to revitalise the country's economy as well as the country's public organisations. The major efforts includes decentralisation of the central government's administrative functions, and liberalisation of the country's economy. From 1986 to 1988, the Administrative Reforms Committee examined the possibility of scaling down the central government's organisation, and improving its administrative and developmental functions. It recommended guidelines for reducing central government personnel, such as scaling down less important government agencies and the hiring of fewer new government employees. Further, a council was established in each province as a public organisation to promote decentralisation.

#### 1) Sri Lanka's Administrative Organisational Structure

Sri Lanka's administrative organisational structure is divided broadly into a central government and provincial governments. The latter administrative organisations work out new development programmes by examining and adjusting the existing village development programmes, then submitting them to the central government. The central government then makes decisions based on existing national policies and development strategies.



- **Central Government**  
Formulation of National Development Strategy, National Policy, National Programme
- **Provincial Council**  
Control of lower councils, and approval of local plans, programmes, and projects
- **Provincial Planning Council**  
To ratify the annual implementation programme and review its progress. To review plan preparation implementation, and budget formulation.
- **Provincial Planning Committee**  
To identify district level development programmes and examine the programmes for inclusion in the provincial plan.
- **District Co-ordinating Committee**  
Integrated review and identification of district plan.
- **Planning Sub Committee**  
To consolidate the divisional plans and any capital development proposals for the district, proposed by the provincial planning authorities, into an integrated district development programme.
- **Divisional Planning Council**  
To monitor and review the annual implementation programme for the coming year.
- **Divisional Planning Committee**  
To coordinate government and provincial programmes.
- **Pradeshiya Sabha**  
To review the development needs identified by the Gramodaya Mandalayas and prepare an integrated divisional development plan.
- **Gramoday Mandalaya**  
Assessment of the needs of the community. To make proposals for the programmes, projects, or activities that will satisfy those needs.

Legend

.....→ Administrating Flow

————→ Planning Flow

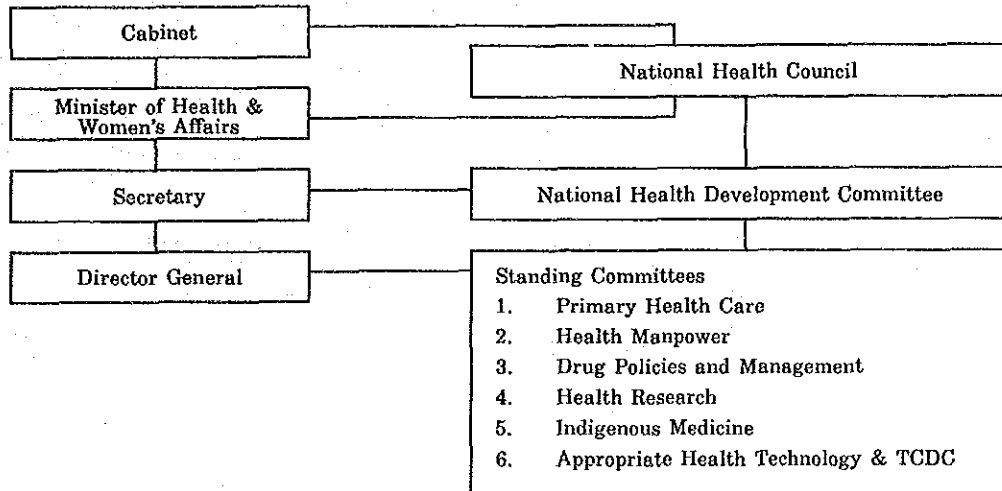
Fig. 2-1-2 Administrative Structure



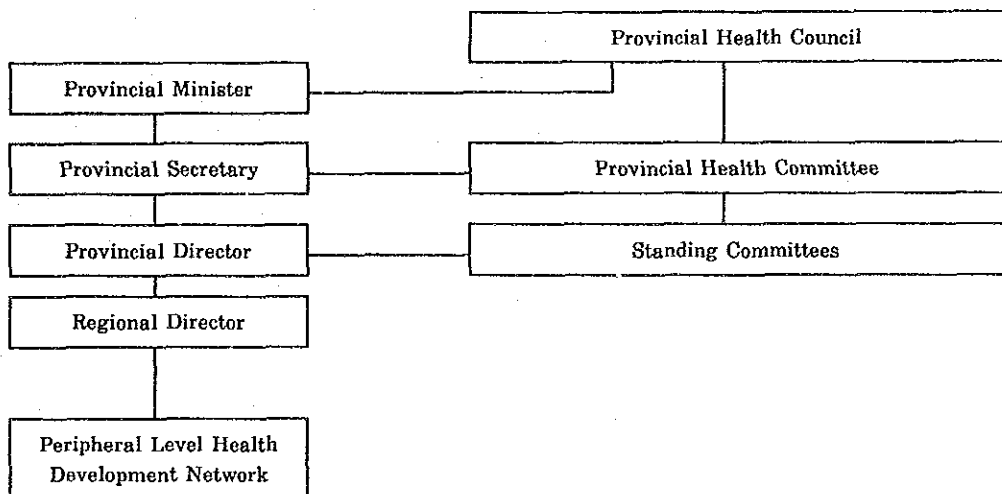
2) Present State of Sri Lanka's Health Services

The country's health services are provided through the Health Development Networks at the national, provincial and peripheral levels.

a) Health Development Network at the national level



b) Health Development Networks at the provincial and peripheral levels



3) Organisation of the Ministry of Health and Women's Affairs (MOH & WA)

In Sri Lanka, the Ministry of Health, the Ministry of Women's Affairs and Teaching Hospitals, and the Ministry of Indigenous Medicine were jointly responsible for the country's health services until 1989 when the three ministries were integrated into the present Ministry of Health and Women's Affairs (MOH & WA). As shown in Fig. 2-1-3, the Organisation of MOH & WA, excluding Women's Affairs and Indigenous Medicine, has eight bureaus, of which Public Health Services, Medical Services, Laboratory Services, Buildings and Transport, are responsible for work-site operation. Biomedical Engineering Services (BES), for whom this project will benefit, belongs to Laboratory Services. In addition to BES, the other areas not under direct control of MOH & WA who are responsible for the supply, maintenance and management of medical equipment include the State Pharmaceutical Corporation (SPC), Medical Supplies Division (MDS), Medical Technology & Supplies Division (MT & SD), and Buildings and Government Factory (GF). These organisation's respective responsibilities are as described below:

a) Biomedical Engineering Services (BES)

This division is responsible for the purchase (through SPC), acquisition, delivery, maintenance, management, repair, and disposal of the medical equipment for use at all public medical institutions with the exception of the Sri Jayawardenapura General Hospital, Medical Research Institute, and Drug Quality Assurance Laboratory (DQAL).

b) Medical Supplies Division (MSD)

This division is responsible for the purchase (through SPC), acquisition, and delivery of surgical instruments, expendable

supplies, reagents, beds, push carts and wheelchairs for use at public medical institutions.

c) Medical Technology & Supplies Division (MT & SD)

This division is responsible for the examination of pharmaceuticals, cosmetics, and medical equipment imported and sold by private companies.

d) State Pharmaceutical Corporation (SPC)

This department is responsible for preparing and evaluating tenders related to pharmaceuticals and medical supplies, gaining approval from the Tenders Board, placing orders, customs clearance and commissioning transportation from Colombo Port to BES and MSD.

e) Buildings, MOH & WA

This division is responsible for the design, supervision of construction, management, and maintenance of public medical institutions. It is also responsible for the repair of air conditioners and refrigerators in use at mortuaries. Actual repair work is contracted out to the Ceylon Electricity Board.

f) Government Factory (GF)

This department is responsible for the repair of nonmedical equipment such as push carts, wheelchairs, or kitchen equipment used by public medical institutions.

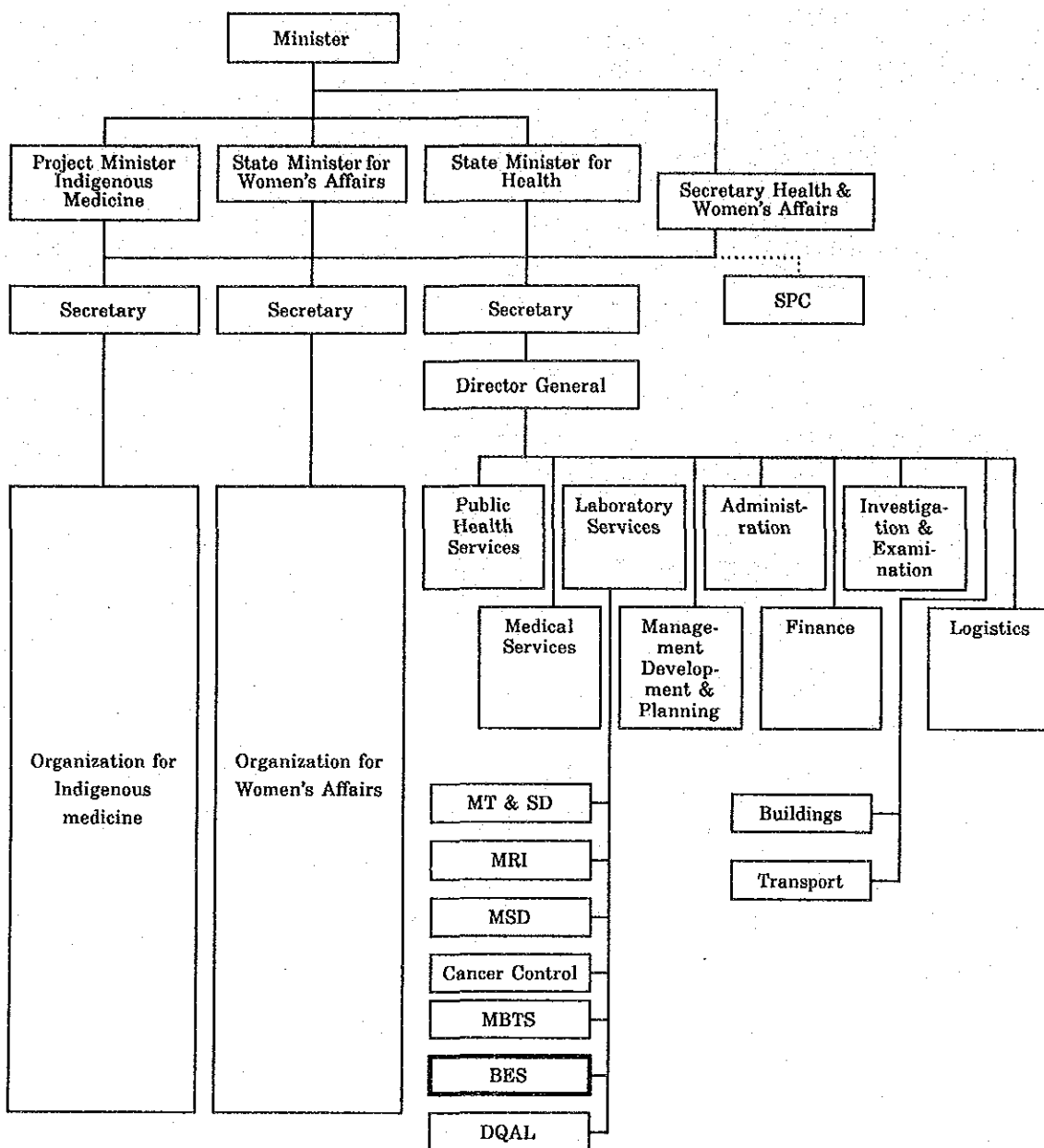


Fig. 2-1-3 Organisational Structure of Ministry of Health & Women's Affairs

### 2-1-2 General State of the Health Services

In Sri Lanka, the Ministry of Health, the Ministry of Indigenous Medicine (controlled by the Ministry of Health), and the Ministry of Teaching Hospitals and Women's Affairs, were jointly responsible for national health services until 1989, when the three ministries were integrated into the present Ministry of Health and Women's Affairs.

The Government of Sri Lanka is in the process of complete decentralisation of its administrative functions. Since 1984 when it was decided to decentralise functions of the Ministry of Health, many of the Ministry's health service functions have been transferred to Provincial Ministries of Health. At present, the country has a two-tier organisational structure of national health services, with the Ministry of Health and Women's Affairs being responsible for health services at the national level, and Provincial Ministries of Health responsible for health services at the provincial, district and peripheral levels.

(1) The Government of Sri Lanka's National Health Service Policy

The Government of Sri Lanka made a promise to its people that it would offer comprehensive national health services. There were 16 health indicators to be achieved by the year 2000 in compliance with the 1980 Charter for Health Development aimed at realising "Health for All by 2000". These indicators included reducing the infant mortality rate by more than half, inoculation of BCG, and an increase in the number of expectant mothers receiving medical examination.

Furthermore, the following guidelines were established for achieving these goals:

- 1) Provision of basic health services.
- 2) Community residents participation in the formulation health service programmes.
- 3) Involving related organisations in national health service programmes and promoting the cooperation between them.

As a result, many functions of health service bureaus, and departments of the central government, were transferred to provincial health service organisations within the framework of the 9-point national health policy guideline outlined below:

- 1) The central government should provide free health services, which include comprehensive health promotion measures, prevention and treatment of diseases, and patient's rehabilitation.
- 2) The central government should implement health measures with emphasis on primary health care in order to achieve the goals of "Health for All by 2000."
- 3) The central government should strengthen the relations between the Ministry of Health and other health service related sectors through improvement of health service networks at the national, district and peripheral levels.
- 4) The central government's health measures should be one of its top priorities because they form the basis of the country's socio-economic development.
- 5) The central government should recognise the practical value of indigenous medicine.
- 6) The central government should rectify the regional imbalance of its basic health services.
- 7) The Ministry of Health should give guidance on planning, adjustment, surveillance, and evaluation activities at the provincial, district and peripheral levels.
- 8) Research work related to health services should be carried out at the national level.
- 9) The central government should regularly examine ongoing health projects and use the findings as reference data when reviewing present and planned health guidelines.

The following policies were formulated on the basis of the 9-point guideline:

- 1) Strengthening the quality of health services at the administrative boundary area.
  - 2) Provision of sufficient treatment and prevention services at the peripheral level.
  - 3) Establishment of more advanced medical institutions and health networks to function as referral centres capable of providing secondary and tertiary health care services (some of these medical institutions should also serve as places for developing manpower).
  - 4) Improving the prevention and treatment of such high priority diseases as malaria, tuberculosis, leprosy, sexually transmitted diseases, filaria, and rabies.
  - 5) Strengthening of the major medical institution's clinical testing and research functions, and establishing a national research and testing network for the purpose of improving the country's overall health services.
  - 6) Promotion of educational activities aimed at spreading basic knowledge of health and encouraging community residents to participate in community health promotion programmes.
  - 7) Promoting the acceptance of international assistance.
  - 8) Development of health manpower.
  - 9) Supervision and evaluation of ongoing health projects.
- (2) The Central Government's Annual Revenues and Expenditures and Budgetary Appropriations for Health

From 1985 to 1990, the Government of Sri Lanka's annual revenues increased on the average of about 12 percent. In 1990, the scale of the annual revenues was 1.7 times larger than that of 1985. The country's annual inflation rates were respectively about 1.6 percent

in 1985, about 8 percent in 1986, about 7 percent in 1987, and about 14 percent in 1988. All this points to a relatively low growth rate for the central government's annual revenues. During the past 20 years, the country's inflation rate has remained at a level consistent with the world average, although this is considered relatively high compared to the average industrialised country. On the other hand, the central government's annual expenditures have been showing an expansionary trend. In 1988, the central government's fiscal deficit recorded an all-time high of 34,783 million rupees. In 1989, the central government's debt increased drastically from 1,500 million-rupees to 5,009 million rupees. The fiscal deficits were presumably attributable to an expansion in the central government's investments, and the subsequent increases in costs for the operation of facilities. It is also clear that the country's military, health, education and welfare spending has been a heavy financial burden on the central government.

Table 2-1-1 shows a comparison of the country's health spending, namely the combined total expenditures of the Ministry of Health, the Ministry of Indigenous Medicine, and the Ministry of Teaching Hospitals and Women's Affairs. With the central government's annual health budget posting a two-fold increase, total health expenditures a three-fold increase, and the central government's annual revenues and actual expenditures increased only about 1.6 times during the same period, it is clear that the central government is placing utmost emphasis on health.

Table 2-1-2 shows the trends in the Ministry of Health's annual budget and actual expenditures. The figures for 1985 through 1988 relate to the Ministry of Health, while the figures for 1988 and 1989 relate to the newly combined Ministry of Health and Women's Affairs.



Table 2-1-1 Government Finance and Health Expenditure, 1985~1990

(Unit: Rs Million)

year		1985	1986	1987	1988	1989	1990
Government	Revenue (grants) ratio to year before	39,556 (3,307)	40,991 (3,753)	46,822 (4,677)	48,337 (6,588)	61,719 (5,599)	68,062 (6,800)
	Expenditure (debt repayments)	55,324 (1,059)	59,184 (1,991)	63,894 (1,518)	76,531 (1,521)	90,322 (5,009)	89,862 (4,647)
	Balance	▲18,985	▲21,956	▲21,749	▲34,783	▲34,203	▲28,599
Health Expenditure	Recurrent ratio to year before	1,773 -	1,841 104%	2,401 130%	2,420 101%	3,379 140%	3,501 104%
	Capital ratio to year before	318 -	408 128%	979 240%	1,518 155%	1,246 82%	1,619 130%
	Total Expenditure ratio to year before	2,091 -	2,249 108%	3,380 150%	3,938 117%	4,625 117%	5,120 111%

Source: MOH &amp; WA, Central Bank of Sri Lanka Annual Report 1989

Table 2-1-2 MOH \*\* Budget and Expenditure, 1985~1990

(Unit: Rs Million)

year	1985	1986	1987	1988	1989	*1990
Budget	1,808	2,163	2,975	2,885	3,737	
Recurrent Expenditure	1,313	1,290	1,750	1,673	3,379	3,501
Capital Expenditure	182	278	1,093	1,087	1,246	1,619
Total Expenditure	1,495	1,568	2,843	2,760	4,625	5,120

\* Provisional

Source: MOH &amp; WA

\*\* MOH, and the Ministry of Teaching Hospitals and Women's Affairs were integrated into MOH &amp; WA in 1989

## (3) The Country's System for Supply of Health Services

In Sri Lanka, health services are supplied through national and public health service networks. Fig.2-1-4 outlines the country's system for the supply of health services. Private medical institutions are playing a supplementary role in the country's health services, but the actual extent of these services is unknown. The central government has a total of 11 teaching hospitals under its direct control which are mainly responsible for training, research and development, and national referral services. Other medical institutions are operated and managed by provincial governments, with the exception of Colombo

South General Hospital, Kalutar General Hospital, Mulleriyawa District Hospital, and three other medical institutions, all of which operate under the Ministry of Health and Women's Affairs. In regional areas, seven provincial hospitals serve as referral hospitals, while 21 base hospitals and 120 district hospitals form a provincial/ district-level health service supply network. Added to this are 122 peripheral hospitals, 119 rural hospitals, 361 central dispensaries, and 83 maternity homes across the country.

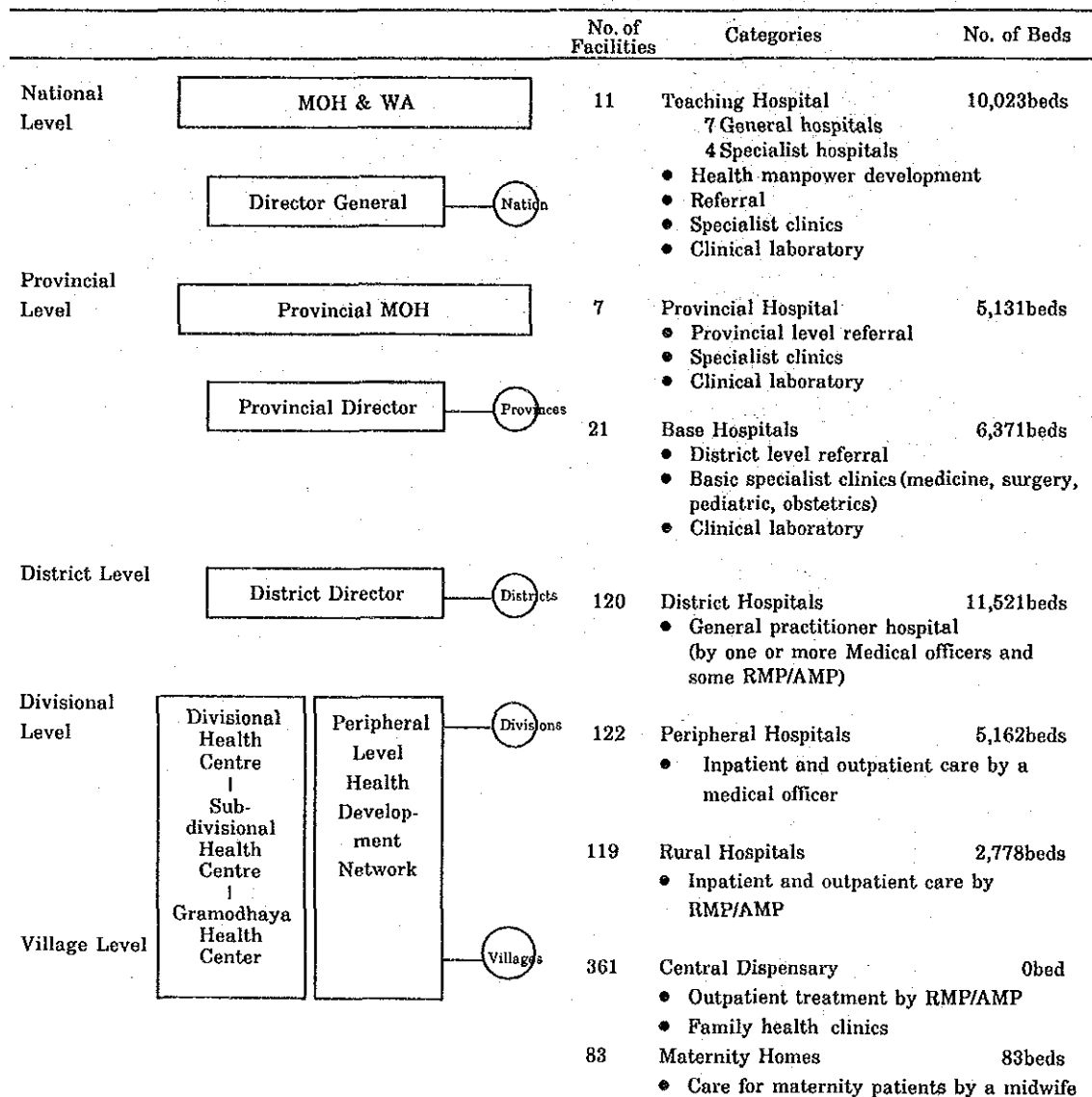


Fig. 2-1-4 Health Services Diagram

## 2-1-3 The Country's Medical Institutions and Related Institutions

The Organisational structure of the country's medical institutions places teaching hospitals at the top with central dispensaries and maternity homes at the village level. Other public medical institutions include: Prevention Services (which provides prevention services for 124 health units across the county), Laboratory Services (which provides laboratory services for the Medical Research Institute), Public Health Services (which is responsible for the health of mothers and children, environmental health and quarantine), Drug Supply Services, Medical Supplies Services, and Indigenous Medicine services. Private hospitals and clinics are also providing diagnosis and treatment supplementary to the government's health services.

### (1) Medical Institutions

#### 1) Teaching Hospitals

The country's teaching hospitals are divided broadly into "general hospitals", whose many clinical, examination, and laboratory departments provide both general and special diagnosis as well as treatment, and "special hospitals".

Table 2-1-3 List of Teaching Hospitals

Classification	Hospitals	No. of Beds	1990		No. of Med. Off.
			No. of Outpatient	No. of Inpatients	
Teaching Hospital	1. Sri Jayawardenapura	1,000	N.A.	N.A.	N.A.
	2. Colombo	2,395	N.A.	N.A.	N.A.
	3. Colombo North (Ragama)	1,100	432,000	18,000	95
	4. Galle	1,040	N.A.	N.A.	N.A.
	5. Kandy	1,509	597,516	81,971	105
	6. Peradeniya	556	294,369	30,213	39
	7. Jaffna	1,021	264,000	60,417	N.A.
Total Beds 10,023	8. Maternity Hospitals	353	N.A.	N.A.	35
	9. Children's Hospital	640	317,212	N.A.	N.A.
	10. Eye Hospital	471	228,951	13,370	34
	11. Dental Institute	44	113,671	N.A.	10

## 2) Provincial Hospitals

There are seven provincial hospitals, which operate under the direct control of the provincial governments. These hospitals provide health services in all the nine provinces in cooperation with the teaching hospitals. These provincial level referral hospitals have both general and special diagnosis and treatment departments, as well as examination and laboratory departments.

Table 2-1-4 List of Provincial Hospitals

	Hospitals	No. of Beds	1990		No. of Med. Off.
			No. of Outpatients	No. of Inpatients	
Provincial Hospitals	1. Colombo South	624	N.A.	N.A.	N.A.
	2. Kalutara	578	220,815	41,902	49
	3. Batticaloa	618	N.A.	N.A.	N.A.
Total Beds 5,131	4. Kurunegala	984	N.A.	N.A.	N.A.
	5. Anradhapura	794	2,170,330	56,006	36
	6. Badulla	693	N.A.	N.A.	N.A.
	7. Ratnapura	864	N.A.	N.A.	N.A.

## 3) Base Hospitals

The base hospitals are small-scale general hospitals located in major cities, and providing health services in all of the 25 districts in close collaboration with the provincial hospitals. They contain general diagnosis and treatment, internal, surgical, pediatric, obstetrical/gynecological, examination and laboratory departments.

Table 2-1-5 List of Base Hospitals

	Hospitals	No. of Beds	1990		No. of Med. Off.
			No. of Outpatients	No. of Inpatients	
Base Hospital	1. Avissawella	385	16,575	14,505	23
	2. Gampaha	391	262,955	29,576	28
	3. Negombo	396	170,124	37,747	23
	4. Watupitiwala	339	219,534	24,597	22
	5. Panadura	379	340,000	20,875	25
Total Beds 6,409	6. Nawalapitiya	306	137,512	13,876	10
	7. Matale	529	155,000	142,000	12
	8. Polonnaruwa	326	1,644,428	30,226	23
	9. Nuwara - Eliya	189	118,594	15,812	19
	10. Matara	625	180,000	50,000	64
	11. Hambantota	159	108,000	80,000	9
	12. Point-Pedro	216	N.A.	N.A.	N.A.
	13. Mannar	184	N.A.	N.A.	N.A.
	14. Vavuniya	142	N.A.	N.A.	N.A.
	15. Ampara	201	N.A.	N.A.	N.A.
	16. Kalmune	179	N.A.	N.A.	N.A.
	17. Trincomalee	290	N.A.	N.A.	N.A.
	18. Kuliyapitiya	350	182,500	27,624	4
	19. Nikaweratiya	155	N.A.	N.A.	N.A.
	20. Chilaw	409	318,880	29,930	25
	21. Kegalle	560	N.A.	N.A.	N.A.

- 4) District Hospitals (number of hospitals: 120, total number of beds: 11,521)

A typical district hospital has one or two physicians and a few medical experts providing general diagnosis and treatment services. The size of the district hospital in terms of the number of hospital beds ranges from 20 to 318 beds. Generally, a large-scale district hospital has one or two special clinical departments and a laboratory department.

- 5) Peripheral Hospitals (number of hospitals: 122, total number of beds: 5,126)

A peripheral hospital has a physician and provides general

diagnosis and treatment services. It has separate wards for male, female, and child inpatients.

6) Rural Hospitals (number of hospitals: 199)

A rural hospital has RMP/AMP and provides general diagnosis and treatment services. It has separate wards for male and female inpatients.

7) Central Dispensaries (number of clinics: 361)

A central dispensary has RMP/AMP and provides general diagnosis and treatment services.

8) Maternity Homes (number of homes: 5, total number of beds: 31)

9) Other Hospitals

The following table shows other hospitals which have special functions and objectives.

Table 2-1-6 List of Other Hospitals

	Hospitals	Number	No. of Beds	1990		No. of Med. Off.
				No. of Outpatients	No. of Inpatients	
Total Number 19	Mental	3	2,202	N.A.	N.A.	N.A.
	Tuberculosis	3	995	N.A.	N.A.	N.A.
	Leprosy	2	243	N.A.	N.A.	N.A.
	Police	N.A.	N.A.	N.A.	N.A.	N.A.
	Prison	2	N.A.	N.A.	N.A.	N.A.
	Infectious disease	1	272	17,513	N.A.	N.A.
	Yang offenders	N.A.	N.A.	N.A.	N.A.	N.A.
Total Beds 4,735	Cancer	1	462	23,313	N.A.	N.A.
	Rehabilitation	1	240	4,091	N.A.	N.A.

10) Health Units

The main objective of health units (part of the primary health care complexes) is to provide an accessible network of health services to the entire population, including the protection of

people from environmental health hazards and communicable diseases. A primary health care complex services a population of about 60,000 and consists of a divisional health centre, three sub-divisional health centres, and, for every 3,000 persons, an agramodhaya health centre.

## (2) Related Institutions

### 1) Laboratory Services

Laboratory Services is responsible for the supply of health support services. It provides support for clinical/laboratory research, pharmaceutical research, and regulation of health services. It also takes charge of the supply, maintenance, and repair of medical equipment, as well as developing manpower (clinical laboratory experts, technicians specialising in repair of medical equipment, and so on).

Described below are the main facilities of the department of Laboratory Services:

#### a) Medical Technology & Supplies Division (MT & SP)

This division is responsible for the examination of pharmaceuticals, cosmetics, and medical equipment imported by private business.

#### b) Medical Research Institute (MRI)

This research institute, (the country's largest and most advanced), is responsible for implementation of clinical laboratory services requested by hospitals, giving guidance on clinical examination to hospitals, research, development and manufacture of various vaccines, examination of public health programmes, and developing manpower (medical researchers and clinical laboratory technologists and so on).

c) Medical Supplies Division (MSD)

This division is responsible for the supply and management of pharmaceuticals, medical supplies, reagents and furniture for medical use (beds, wheelchairs, etc.) at public medical institutions.

d) Cancer Control

This division is carrying out research and treatment of cancer at the Cancer Hospital Maharagama.

e) National Blood Transfusion Services

This division is responsible as the country's central blood bank and manufactures blood type examination reagents. It also takes charge of developing manpower (laboratory technologists).

f) Biomedical Engineering Services (BES)

This division is responsible for the overall maintenance of medical equipment in use at public medical institutions.

g) Drug Quality Assurance Laboratory (DQAL)

This division is responsible for the analysis, research, and regulation of both domestic-made and foreign-made drugs for pre-clinical use.

2) Other Related Institutions and Facilities

In addition, the Ministry of Health and Women's Affairs, the State Pharmaceutical Corporation (SPC), the Government Factory (GF), the Ceylon Oxygen Company and other related institutions and facilities are providing specific support services to public medical institutions and otherwise.



### 3) Private Medical Institutions

In Sri Lanka, private hospitals and private clinics are the typical medical institutions. As the Ministry of Health and Women's Affairs has no registration or licensing system, physicians are free to open their own clinics. Presently, statistical data on the number and size of the private medical institutions is limited. There is no official data published on these institutions in the country.

## 2-1-4 Diseases and Composition of Main Diseases

### (1) Composition of Main Diseases

The country's composition of main diseases is characterised by a dominance in tropical diseases (such as malaria and filaria), slow post-natal recovery for both mothers and their newborns, malnutrition (as exemplified by newborn babies' extraordinarily low weight), and the prevalence of infectious diseases. Table 2-1-7 compares the number of inpatients (per 100,000 population) suffering from main diseases in 1970 to the number in 1988. In 1970 the top 5 diseases, in order, not including abortion, were intestinal infections, malaria, helminthiasis, anemia, and malnutrition, while in 1988 the top 5, in order, were malaria, intestinal infections, anemia, hypertension, and ischemic heart disease. It should be noted that helminthiasis and malnutrition ranking 3rd and 5th respectively in 1970, ranked 8th and 9th respectively in 1988 being replaced by hypertension and ischemic heart disease. This indicates a marked decrease in the number of patients suffering from helminthiasis and malnutrition.

Table 2-1-7 Trends in Hospitalisation and Hospital Death for Selected Diseases  
1970~1988

Diseases	Hospitalization Cases per 100,000 population			Hospital Death Cases per 100,000 population		
	1970	1980	1988	1970	1980	1988
Tuberculosis	102.6	76.2	61.0	6.6	4.3	3.3
Helminthiasis	516.5	207.4	52.1	3.5	0.5	0.1
Anaemias	507.8	334.8	193.6	5.7	3.3	1.5
Nutritional Deficiencies	151.4	134.4	25.0	1.7	1.3	0.5
Intestinal Infections	948.6	955.4	784.2	19.3	10.3	5.0
Diphtheria	7.6	0.3	0.0	0.6	0.0	0.0
Whooping Cough	13.2	3.7	0.1	0.1	0.0	0.0
Measles	32.6	34.1	16.0	0.1	0.1	0.1
Viral Hepatitis	61.4	31.7	53.2	1.1	0.4	0.3
Malaria	778.9	344.5	852.3	0.6	0.2	0.9
Hypertensive Disease	109.4	182.7	177.1	3.7	4.9	3.7
Ischemic Heart Disease	57.3	117.3	148.9	5.6	12.5	15.5
Abortions	675.3	869.5	828.5	1.3	0.3	0.3

Source: National Health Development Plan 1991

## (2) Main Diseases

Table 2-1-8 shows the country's current top 10 diseases (in terms of the number of inpatients). Respiratory organ diseases, malaria, intestinal infections, and external injury rank high on the list, accounting for 30 percent of the total.

However, examining the leading causes of death reveals ischemic heart disease, cerebrovascular heart disease, and gastrointestinal diseases ranking 1st, 2nd and 3rd respectively. It should be noted that if heart diseases and circulatory organ diseases are added, the combined figure for these diseases would account for 24.7 percent of the total deaths, and that malignant neoplasms would account for 4.8 percent of the total. Compared with 11.5 percent for gastrointestinal diseases and respiratory organ diseases, which are common infectious diseases

in this country, these figures are relatively high. It can be said that these diseases require more effective preventive measures. The Ministry of Health and Women's Affairs is now implementing preventive measures against malaria, filaria, tuberculosis, leprosy, sexually transmitted diseases, and cancer. These measures are as described below:

1) Malaria

Malaria is the infectious disease suffered by the largest number of patients. The Ministry continues applying preventative measures against this disease with the cooperation of WHO. From 1978 to 1983, the measures were fairly successful, but since 1983 the rate of incidence of this disease has been on the rise due largely to an increase in mosquito's tolerance to pharmaceuticals. In 1987, the disease's incidence reached its peak. In an examination of 1.95 million blood samples, 676,769 showed a positive reaction.

2) Tuberculosis

In 1989, a total of 6,429 cases of tuberculosis were registered. The ratio of the cases of tuberculosis to the total was lower than 15 percent for the cases of urinary organ diseases in the 1989 list of main diseases. However, the number of deaths from this disease for the same year was estimated to be about 1,000, ranking 7th to 9th in the list of main causes of death for the year. Furthermore, while the number of deaths from this disease per 100,000 population, decreased from 11.6 in 1976 to 7.4 in 1985, the number of cases has remained almost unchanged since 1976 when it was 5,955.

3) Filaria

As filaria is carried by mosquitoes which live in dirty water, there is a high incidence of this disease on the West Coast where cities are concentrated. As much as 25 percent of Sri Lanka's population lives in this area. Since 1983, however, the incidence

of Filaria has been steadily decreasing from 3,464 cases to around 1,239 cases in 1989.

#### 4) Leprosy

As of the end of 1989, there was a total of 2,416 active cases of leprosy, of which 1,053 were new cases. Presently, 1,264 active cases are receiving treatment and an additional 4,051 cases are under the supervision of physicians. Of the 1,053 new cases, 59 percent were discovered as a result of referral diagnosis, 17 percent as a result of field surveys, and 9 percent as result of patient's own reporting.

Table 2-1-8 Leading Causes of Hospitalisation

1989 Sri Lanka

ICD Code	Hospital	Cases	%
446 490-519	Diseases of the respiratory system excluding diseases of the upper respiratory tract, pneumonia, bronchopneumonia and influenza	189,004	9.4
800-904 930-939 950-957	Traumatic injuries	174,645	8.7
780-799	Signs, symptoms and ill-defined conditions	166,152	8.3
084	Malaria	121,433	6.0
001-009	Intestinal infectious diseases	119,003	5.9
710-739	Diseases of the musculoskeletal system and connective tissue	72,615	3.6
680-709	Diseases of the skin and subcutaneous tissue	70,530	3.5
530-579	Diseases of the gastrointestinal tract	69,089	3.4
045-079	Viral Diseases	66,366	3.3
910-925 958-959 990-995	Other injuries and early complication of trauma	55,832	2.8
589-599	Diseases of the urinary system	45,256	2.3
—	Others	860,433	42.8
Total		2,010,358	100.0

Excludes normal delivery and these admitted and discharged before delivery

Source: National Health Development Plan 1991

Table 2-1-9 Leading Causes of Hospital Deaths

1989 Sri Lanka

ICD Code	Disease	Cases	%
410-414	Inchaemic heart diseases	2,270	10.2
430-438	Cerebrovascular diseases	1,785	8.0
530-579	Diseases of the gastrointestinal tract	1,557	7.0
780-799	Symptoms, signs and ill-defined conditions	1,447	6.5
415-429	Diseases of the pulmonary circulation and other forms of heart disease	1,447	6.5
989.2-989.4	Pesticide poisoning	1,297	5.8
800-904 930-939 950-957	Traumatic injuries	1,080	4.8
140-208 230-234	Malignant neoplasms	1,078	4.8
490-519	Diseases of the respiratory system excluding diseases of the upper respiratory tract, pneumonia, bronchopneumonia and influenza	1,008	4.5
764-765	Slow fetal growth, fetal malnutrition and immaturity	925	4.1
480-486	Pneumonia and bronchopneumonia	915	4.1
	Others	7,527	33.7
Total		22,336	100.0

Source: National Health Development Plan 1991

## 2-2 Present Condition of Medical Equipment in Use at Hospitals

### 2-2-1 Medical Equipment Owned

Sri Lanka's public medical institutions are divided broadly into a higher level complex (teaching hospitals, provincial hospitals, and base hospitals, which have referral functions and offer specialised treatment services), and a lower level complex (district hospitals, peripheral hospitals, rural hospitals and central dispensaries and maternity homes, which offer regional health services). The Ministry of Health and Women's Affairs has drawn up a "List of Standard Items of Medical Equipment" for each of the two sectors to standardise the medical equipment owned. According to the lists, medical equipment is classified into "medical equipment which is indispensable for medical care activities and should be owned by all institutions", and "medical equipment which is used for specialised treatments." Here the former is termed "basic level equipment", the latter "middle level equipment", or more advanced equipment which is not referred to in the lists, as "advanced equipment". These three types of medical equipment include the following respectively:

#### 1) Basic Level Equipment

Sphygmomanometer, suction unit, X-ray film illuminator, bowl steriliser, instrument steriliser, examination lamp, phototherapy unit, water bath, water distiller, ambu bag, dental unit, sterilising drum, etc.

#### 2) Middle Level Equipment

Operating table, operating light, anesthesia apparatus, ventilator, electrosurgical unit, defibrillator, ultrasonic therapy unit, infrared lamp, basic X-ray, X-ray film processor, X-ray film drier, high pressure steam steriliser, centrifuge, photometer, microscope, monitor, infusion pump, defibrillator monitor, electrocardiograph, infant incubator, ventilator, flame photometer, blood gas analyser, calorimeter, sigmoidoscope, etc.

### 3) Advanced Equipment

CT scanner, angiography unit, fiberscope, etc.

Table 2-2-1 shows a breakdown of medical equipment owned, which is based on the contents of the "Lists of Standard Items of Medical Equipment" and the results of the field survey conducted during the basic study.

Table 2-2-1 Medical Equipment Owned

		Higher Level Complex	Lower Level Complex	Total
No. of Hospitals		39	463	502
No. of Beds		21,525	25,095	46,620
Medical Equipment Owned	Basic Level	11,500	14,000	25,500
	Middle Level	7,700	2,000	9,700
	Advanced Level	300	0	300
	Total	19,500	16,000	35,500

Records of medical equipment owned are kept by the pharmaceutical department of each hospital, but they have not been updated consistently. As a result, it is impossible to obtain accurate data on medical equipment owned at each hospital.

#### 2-2-2 Medical Equipment Operating Condition

The country's medical professionals do not have precise knowledge of medical treatment or medical equipment, and have broken many pieces of equipment through misuse, and sometimes have mistaken the state of the equipment. No accurate data of the medical equipment's operating status exists, and therefore, there is no way to know what percentage of the medical equipment is in good working condition. The results of a survey conducted during the basic study shows that about 20 percent of the equipment is out of order, and about 10 percent are not used through misjudgment of their condition.

Shown below is the present situation concerning the use of main medical equipment:

1) Operation/ICU Department

- (a) Most operating tables are still usable, although some of them are partially damaged.
- (b) Most mobile theatre lamps can work on AC current, but can not work during a power failure due to the deterioration of their emergency DC batteries.
- (c) Many electrosurgery units are used frequently although they are outdated. Their inactive electrodes are heavily damaged.
- (d) Few electrocardiograph monitors are used effectively in operating departments.

2) Radiology Department

- (a) Many basic X-ray units are used effectively and frequently for diagnostic use. However, due to a shortage of radiologists some of them are used despite failures of bucky function.
- (b) Most of the joints of the mobile X-ray unit's tube units require adjustment and repair.

3) Physical Therapy Department

- (a) Most equipment is outdated but used effectively.
- (b) Most infrared lamps are left unused because spare bulbs are not available.

4) Dental Department

- (a) Most dental equipment is heavily damaged because of the bad quality of the water used at hospitals. Many rotors and micro



motors are out of order since necessary daily maintenance and management has not been carried out.

(b) There is no functional problem with the outdated dental equipment.

5) Ward/Obstetric-Gynecological/Pediatric Department

(a) Most basic level equipment such as sphygmomanometers and instrument sterilisers are used effectively. At most of the hospitals surveyed, disposable plastic syringes and hypodermic needles are sterilised by boiling, and used repeatedly -- a situation which is very dangerous.

(b) Many fetal heart monitors and ultrasound scanners are used effectively but not maintained well.

(c) Most infant incubators are in use, but few nurses know how to use them correctly.

(d) A few automatic infusion pumps are in use. The rest are not used due to a shortage of the tubes designed for the pumps.

6) Clinical Laboratory

(a) Most flame photometers are left unused because few medical laboratory technologists know how to use them; reagents have expired. Detailed adjustment and replacement of spare parts is required.

(b) The other equipment is used effectively but not maintained well.

7) Ambulances

(a) Ambulances are well maintained. Their average annual mileage is more than 50,000 kilometers.

### 2-2-3 Present Condition of Private Medical Equipment Repair Service Companies

In Colombo, there are 18 major private companies serving as distributors for the medical equipment manufacturers. These companies contract mainly for the maintenance and repair of medical equipment in use at private medical institutions. Some private medical institutions offer high-level diagnosis and treatment services, utilising their respective clinical examination rooms, which are provided with advanced medical equipment such as basic X-ray units, CT and ultrasound scanners, blood cell counters, and automatic analysers. Thus there is presumably a substantial demand for medical equipment maintenance services in the country. These medical equipment distributors have a relatively high equipment management and maintenance capability, and are actively participating in training programmes offered by medical equipment manufacturers.

The medical equipment, particularly RI units, gamma cameras, and CT scanners, in use at public medical institutions is also managed and maintained by the maintenance staff of the medical equipment manufacturers, as well as by their distributors. Table 2-2-2 shows a list of the items of medical equipment currently managed and maintained by the 16 medical equipment distributors. As can be seen from this table, basic X-ray units, ultrasound scanners, ventilators, operation theatre tables, suction units, dental equipment, OT lamps, clinical laboratory equipment, and high pressure sterilisers are maintained and repaired by three or more distributors. Management and maintenance services of a relatively high level are available for these items of equipment.

Table 2-2-2 Major Medical Equipment Agency and Equipment Served - 1991

agency equipment	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1. X-ray Unit	○			○	○	○	○	○			○		○					
2. Film Processing Unit		○																
3. Angiography Unit													○					
4. Gamma Camera					○													
5. CT Scanner									○				○					
6. Ultrasound Scanner	○			○	○		○		○	○								
7. Colour Doppler													○					
8. Ventilator	○				○							○						
9. Heart Lung Machine	○											○						
10. Anaesthetic Unit	○											○						
11. OT Table	○							○										○
12. Electrosurgery Unit	○							○										
13. Dialyser Unit															○			
14. Suction Unit																○	○	
15. Infusion Pump	○																	
16. ENT & Eye Operating Microscope														○				
17. Binocular Microscope								○										
18. Fiber Scope				○														
19. Nebuliser								○										
20. Infant Incubator				○								○						
21. Incubator				○														
22. ECG Recorder				○														
23. EEG Recorder				○						○								
24. EMG Recorder										○			○					
25. Defibrillator Monitor										○			○					
26. ECG Monitor					○							○						
27. Dental Unit								○						○	○			
28. Slit lamp					○								○					
29. OT lamp				○				○							○			

agency equipment	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
30.Stress Testing Unit					○							○						
31.Physiotherapy Equipment					○									○				
32.Laboratory Equipment			○			○							○					
33.Blood Gas Analyser			○	○														
34.Electrolyte Analyser			○															
35.Spectro-photometer			○															
36.Microtome								○										
37.Tissue Processor																	○	
38.Tissue Embedding Unit																	○	
39.Centrifuge																	○	
40.Refrigerated Centrifuge																	○	
41.Steriliser							○						○			○		○
42.Sterilising Dram													○					
43.Instrument Steriliser								○										
44.Cobalttherapy Unit	○																	

(Source: BES)

## 2-3 Present Condition of Biomedical Engineering Services (BES)

The Government of Sri Lanka began, its medical equipment management and maintenance service as a public body back in 1946. A radiologist was established as the technical specialist immediately after the country's first X-ray unit was installed in Colombo General Hospital. The staff developed into the Electro Medical Technologist Division, which was responsible for repairs of all medical equipment. Later, the division moved into its present facilities which previously had been used for fiber storage. In 1948, the division was renamed Electro Medical Engineering Services. Later, in 1982, it was renamed the Biomedical Engineering Services (BES).

### 2-3-1 Organisation and Functions

#### (1) Organisation

Presently, BES has a staff of 108 persons -- a director, three engineers, two technologists, 18 foremen, 37 mechanics, 4 storekeepers, 19 labourers, 20 clerks, and 4 provincial workshop staff members. Its organisation is as illustrated below:

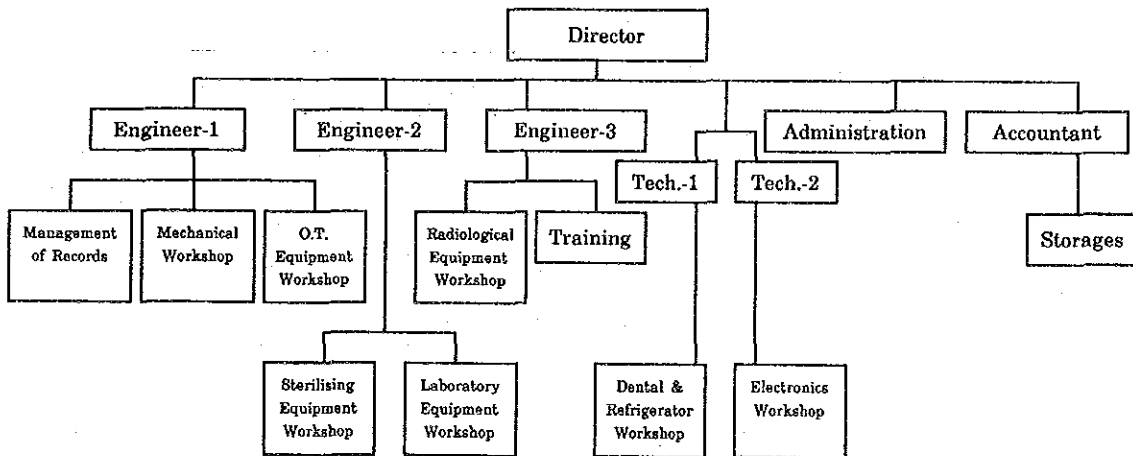


Fig. 2-3-1 Present Organisation of BES

## (2) Main Functions

BES's main functions include: 1) ordering/purchase, 2) acquisition/inspection/storing/delivery, 3) maintenance/repair, 4) management of records, 5) disposal of condemned equipment, and 6) training.

### 1) Ordering/Purchase

(a) Ordering and purchase of medical equipment.

(b) Ordering and purchase of spare parts and consumable goods.

### 2) Acquisition/Inspection/Storing/Delivery

(a) Accession and inspection of purchased medical equipment and spare parts.

(b) Storing medical equipment and spare parts.

(c) Delivery and installation of medical equipment.

### 3) Maintenance/Repair

(a) Preventive maintenance.

(b) Repair.

### 4) Management of Records

(a) Records of ownership and repair of medical equipment.

(b) Inventories of spare parts and consumable goods.

### 5) Disposal of Condemned Equipment

### 6) Training

(a) Training of medical staff in necessary skills.

(b) Training of technical staff in necessary skills.

## 2-3-2 Status of the Division's Activities and Problems

Demand for Services provided by BES has been increasing from year to year reflecting the increase in quantity as well as the qualitative improvement of the medical equipment used in the country. The demand now exceeds BES's capability. The present facilities, which had been used for fiber stores, are too old and too small to repair, yet handle sophisticated medical equipment. There is a lack of quality repair equipment to handle all of the breakdowns and check the results. The major problems faced by BES are described below:

### (1) Ordering/Purchase

#### 1) Purchase of Medical Equipment

BES purchases medical equipment based on requests from medical institutions. Provincial governments review applications for the purchase of medical equipment submitted by the provincial, base, district hospitals and peripheral units, and then forwards them to the Technical Advisory Committee (TAC) department of the Ministry of Health and Women's Affairs. Teaching hospitals submit applications directly to TAC. The final decision on each application is made by TAC, which also decides on the amount of medical equipment to be purchased during the year. TAC is chaired by the deputy director general of Laboratory Services, and it is comprised of the directors of BES, MSD and MT & SD.

Technical Specification Formulation and Evaluation Committee (TSF & EC), which was organised by the deputy director general of Laboratory Services, decides the specifications of each piece of equipment based on the results of the review by TAC. In principle, TSF & EC consists of an engineer from BES and two government medical doctors.

All medical equipment is purchased through competitive tenders. After the Ministry and provincial governments agree on an appropriation of a budget for the purchase of medical equipment, the budget is allocated to BES. BES orders medical equipment through the State Pharmaceutical Corporation (SPC), which is the executive agency of the government medical tenders. SPC performs a series of tasks, from preparing tender documents based on the specifications drawn out by TSF & EC, to awarding tenders. SPC also evaluates the tender documents and prices, while TSF & EC evaluates the technical specifications.

All medical equipment purchased is delivered directly to BES from the bonded warehouse immediately after customs clearance.

Fig. 2-3-2 outlines of the flow for the purchase of medical equipment.

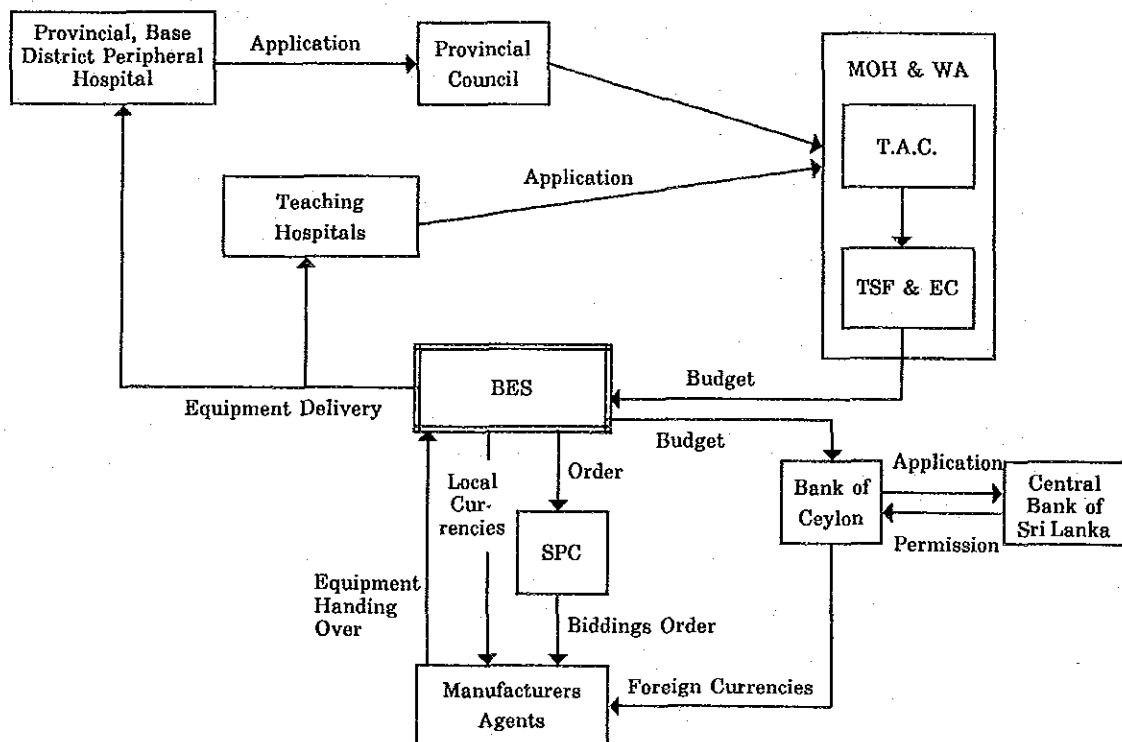


Fig. 2-3-2 The Purchase Flow Chart of Medical Equipment



Under the competitive tender system, the tenderer who submits the lowest price is chosen as a supplier. As there are no detailed requirements in the specifications of the tender documents, products which are lower-priced but inferior in quality are often supplied. This is one of major causes of the present problem. Although one of the BES's more important functions is to prevent the purchase of defective medical equipment in the process of screening tenders, at present, BES has no clear grasp of the operating status of medical equipment it has purchased in the past, and therefore it is unable to conduct a quantitative evaluation of individual items of equipment newly purchased.

It is possible to work out a method of sharing spare parts, and standardising methods of operation by specifying manufacturers and product models for each type of equipment. This will enhance the efficiency in maintenance and management of equipment. Under the present competitive tender system, however, it is impossible to realise such standardisation. No examination has yet been made of which approach will be more economical from the viewpoint of the medical equipment's total life-cycle cost.

## 2) Purchase of Spare Parts and Consumable Goods

Spare parts and consumable goods are purchased by BES. In the case of domestic procurement, at least three suppliers are requested to submit quotations, of which one submitting the lowest price is chosen as the contractor upon receipt of approval from the proper authority. Payments are made on receipt of the goods at BES. Overseas procurement is carried out through mostly selective tendering. In actuality, therefore, suppliers are requested to submit tenders and the one submitting the lowest price is chosen as in the case of domestic procurement.

The approving authority varies with the purchase price, as shown in the table 2-3-1.

Table 2-3-1 Approving Authority

Tender Value	Proper Authority
Up to RS 6,000	Director, BES
Rs. 6,000~15,000	Dy. Director General, LS
Rs. 15,000~25,000	Director General, Health Services
Rs.25,000~50,000	Secretary, Ministry of Health
Rs.50,000~2,000,000	Department Tender Board
Rs.2,000,000~5,000,000	Ministry Tender Board
Over Rs.5,000,000	Cabinet Tender Board

As there are no medical equipment manufacturers in Sri Lanka, all the medical equipment purchased is foreign. If the importers or local suppliers have spare parts in stock, delivery is fast. However, when they have to be procured from overseas, it usually takes four months to transport them and clear them through customs.

Some foreign manufacturers do not immediately respond to BES's request for estimates. As a result, BES often finds it impossible to repair some item of medical equipment due to the lack of necessary spare parts.

As Japanese manufacturers must go through the time-consuming COCOM export procedures, BES cannot expect delivery of spare parts from Japanese manufacturers as quickly as its Japanese counterparts do.

## (2) Acquisition/Inspection/Storing/Delivery

When a delivery is made, it is customary for the purchaser and the supplier to jointly inspect the medical equipment for identification and performance. Presently, BES can not conduct satisfactory

inspection due to lack of an inspection room and calibration equipment.

The medical equipment BES purchased through tenders and the ordered spare parts are transported first to BES. However, large-sized medical equipment, such as high pressure sterilisers, dental equipment, and X-ray units, are transported directly to the hospitals and other medical institutions which requested them. Once there, the inspection (including trial runs), is conducted after installation. When the hospitals or other medical institutions are not ready to receive the requested medical equipment, they are delivered to BES, where they are left unpacked. BES does not conduct inspection of such items of medical equipment.

BES also serves as a primary distribution warehouse. Due to the problem of many medical institutions being unable to directly receive requested medical equipment, and the poor level of transportation in the country, some equipment delivered directly to BES are kept for more than a year. Furthermore, due to the limited floor area, garages are being used for storage purposes.

Loading and unloading of large-sized, heavy medical equipment is carried out manually for lack of any elevating machinery. This situation is dangerous to the workers, as well as to the equipment. Medical equipment is precision equipment with many electronic parts, and if left unattended for a long time in an environment of high temperature humidity, it could break down before it is even used.

There have actually been some cases in which medical equipment delivered to a hospital was found to be already out of order because it had been left unattended for a long time. Since inspection had not been conducted on these items, many of them were found to be past the term of warranty. Even when they were not past the term of warranty, they were disqualified for free repair service because of their

mishandling. As a result, they inflicted repair costs which could have been avoided with proper handling.

As BES does not keep accurate records of inspection or management and maintenance of the medical equipment delivered, it is impossible to calculate the total amount of avoidable repair costs. In order to improve BES's medical equipment management and maintenance function, it is essential to conduct inspection and to improve its record keeping methods.

### (3) Preventive Maintenance of Medical Equipment

In order to ensure a safer and more proper use of medical equipment, it is necessary to keep them in good operating condition. For this reason, medical equipment must be inspected daily by the operator, and periodically by the engineer in charge of management and maintenance of the equipment.

Due to the medical staff's relatively low level of knowledge with medical equipment, daily inspection of the equipment is not carried out, and breakdowns are more likely to occur. Medical doctors are supposed to play a leading role in the operation of medical facilities and equipment, so they are also responsible for this situation.

In 1990, BES conducted only 13 preventive maintenance activities -- eight for surgical operation equipment and five for high pressure sterilisers. Four out of the 13 were carried out at Colombo General Hospital and another four at Kandy Teaching Hospital.

Although BES is responsible for giving hospitals guidance on the characteristics of medical equipment, its use, and the methods of daily inspection, BES is still unable to carry out well-organised preventive maintenance of equipment nationwide for lack of competent technical staff, and lack of efficient transportation.

The necessity of preventive maintenance varies with the type of medical equipment. However medical equipment is precision equipment, and its operation affects patient's lives. Therefore, it is essential to conduct preventive maintenance regardless of the type of equipment, so that it may be kept in normal operating condition.

#### (4) Repair of Medical Equipment

BES has seven medical equipment repair workshops which are responsible for the repair of: 1) radiological equipment, 2) operation theatre equipment, 3) sterilising equipment, 4) dental equipment, 5) electronics, 6) laboratory equipment, and 7) mechanical work respectively. The refrigerating equipment repair workshop, which repaired refrigerators until 1990, has been absorbed into the other repair workshops, since repair of general purpose refrigerators has been excluded from BES's medical equipment repair responsibilities.

##### 1) Repair Order

BES offers its medical equipment repair services at the request of hospitals. The pharmaceutical departments of the hospitals make requests for repairs directly to BES. The written requests in the form of a postcard or a document are sent to the director of BES. In case of emergency, however, it is possible to make the requests by telephone or telegraph. The director allocates the requests for repair among the seven workshops, and each workshop sends its repair specialists out to the hospital required the repair. The specialists decide whether or not it is possible to repair the medical equipment in question on site. If not, they take it back to the BES workshop for repair.

## 2) Repair Activity

As BES has neither a clear grasp of the hospital's medical equipment owned nor the operating status of the equipment, it is time consuming to trace defaults and order the necessary spare parts. In some cases, downtime continues for more than one year. Moreover, as each workshop operates independently, it is very difficult for BES to meet demands for comprehensive repair services. The repair activity carried out at each of the workshops is described as follows:

### a) Radiological Equipment Workshop

All radiological equipment is repaired at this workshop, with the exception of CT scanners and angiography units, which are special items of radiological equipment. It is difficult to repair tomographs and X-ray units with fluoroscopy using the repair technologies currently available at this workshop. Although repair technologies for basic radiological equipment are available at this workshop, there are no reliable repair tools there. Also, this workshop is incapable of completely meeting the hospital's needs because of the difficulty in procuring spare parts.

### b) Operation Theatre Equipment Workshop

Except for some medical appliances, all items of medical equipment used in the operation theatre are repaired by this workshop. The repair technologies used at this workshop range from basic repair technologies to advanced electrical and electronic technologies. This workshop has a staff of 20 electrical, electronic, mechanical, and precision machinery engineers. As the medical equipment used in the operation theatre directly affects patient's lives, BES places the utmost importance on raising the of quality of this workshop's

repair services. However, due to the lack of calibration instruments to check the results of the repair work, engineers are unable to verify the performance and precision of repaired equipment. For this reason, this workshop's repair services are unreliable.

c) Sterilising Equipment Workshop

Mainly instrument sterilisers and autoclaves table are repaired at this workshop. The breakdown of instrument sterilisers is caused mostly by defective heaters. As this workshop has adequate numbers of parts in stock, it does not take much time for repairs. Only certain models of high pressure sterilisers are used at almost all the hospitals, and the engineers of this workshop have received training by their manufacturers. Therefore these engineers have a satisfactory knowledge of the sterilisers.

d) Dental Equipment Workshop

In Sri Lanka, there are practically no facilities or equipment for use in dental laboratories. At the moment, this workshop is in charge of the repair of dental units. The quality of the water used at most Sri Lankan hospitals is very poor, which often causes equipment failure. In addition, there are many manufacturers and models of dental units. As a result, this workshop finds it very difficult to meet hospital needs in terms of repairing dental units. Repair work on these dental units at BES is very limited since these units are usually repaired at the hospitals.

e) Electronics Workshop

In addition to the repair of electronic equipment, this workshop is responsible for the repair of electronic substrates which cannot be repaired at any of the afore-

mentioned repair workshops. Usually, this workshop takes charge of repairing those items of medical equipment which requires expertise in electronics, and cannot be handled by the other repair workshops. In reality this workshop is hampered by the lack of necessary replacement elements used to repair the defective circuits of some special electronic substrates. This despite the workshop's engineers having adequate skills.

f) Laboratory Equipment Workshop

Since modern clinical laboratory equipment contains so many electronic components, their repair is carried out at the electronics workshop. Therefore, this workshop is responsible only for the repair of mechanical parts and simple devices. This workshop lags behind the other repair workshops in terms of the facility's quality, equipment, and size of staff. It performs almost none of the functions required of a repair shop, and most of the equipment and devices are actually repaired at the hospitals themselves. For this reason, hospitals do not place much confidence in this workshop.

g) Mechanical Workshop

This workshop is not directly involved in the repair of medical equipment, but instead accepts the requests of other departments for the repair of general machines. Although it has a relatively small staff, its technical level is very high. The repair work conducted at this workshop shows a high level of craftsmanship.

h) Provincial Workshops

At present there are three provincial workshops, one each in Galle Teaching Hospital, Peradeniya Teaching Hospital, and Kandy Teaching Hospital. These workshops are staffed by four



repair workers. The workshop in Kandy Teaching Hospital is staffed by a mechanic and the workshop in Peradeniya Teaching Hospital is staffed by a foreman. Repair work at the local workshop in Galle Teaching Hospital is carried out by a foreman and a mechanic.

### 3) Repair Work Commissioned to Private Businesses

#### a) Repair Work

Repair work which can be done only at repair facilities comparable to those of medical equipment manufacturers, while technically difficult repair work is contracted out to equipment manufacturers or distributors. In 1990, BES contracted out repair of two units of automatic X-ray film developer and the total repair cost was roughly 60,000 rupees. However, this kind of repair work can be done using repair techniques currently available at BES workshops, and therefore the costs for such repair work will be reduced in the future.

#### b) Maintenance Contracts

Repair of radiological equipment, such as gamma cameras, CT scanners and angiography units, is carried out by private companies in accordance with the provisions of the maintenance contracts. The annual cost of these maintenance contracts is about 3.5 million rupees.

### (5) Management of Records

#### 1) Records of Ownership

At present, BES has no specific knowledge of what items of equipment are owned by each medical institution. Furthermore, the relative working condition of the equipment is not clearly documented. Under such circumstances, the BES has to waste valuable time identifying equipment to be repaired as requested by

each hospital. For this reason, BES plans to start a survey of medical equipment ownership at 10 teaching hospitals in July 1991 with the financial assistance of the World Bank.

## 2) Records of Repair

Repair activities at BES are first recorded as entries on job cards which are then transferred to repair record ledgers. As a job card is used for each repair operation, it is necessary to enter the summary of each repair operation in a repair record ledger. At BES, each workshop maintains a repair record ledger for each type of equipment, each hospital, and each region.

But since BES has no centralised system for managing these ledgers, it makes it impossible for BES to have an accurate grasp of repair activities at each workshop. There are many cases where only "Repaired" is entered in the "Summary" spaces of the repair record ledger. Although it is possible to learn the name of the equipment repaired by looking at the ledgers, it is impossible to know how this equipment was repaired, or how safe it is after repair. Even when a certain item is repaired repeatedly, each repair operation is recorded separately on the repair record ledger. Furthermore, sufficient explanations are not given to hospitals about follow-up on repaired equipment or about equipment judged to be past its usefulness. This has caused an uneasy relationship between BES and hospitals.

## 3) Inventory Control

Inventory control at the spare parts storages is not efficient. Newly purchased spare parts and those removed from discarded equipment are piled together, making it very difficult to locate the needed ones. Furthermore, communications are poor between the workshops and the warehouse. There are many cases where the workshops place new orders for spare parts already stored in the warehouse.

## (6) Training

### 1) Training of BES technical staff members

One of the most practical and effective ways for the repair engineers to learn about the medical equipment and how to repair them is to receive in-service training at the medical equipment makers' production facilities. In view of the fact that all items of equipment used in Sri Lanka are foreign-made, BES sent a total of 20 repair engineers overseas, on 45 occasions through 1990, for in-service training.

### 2) Training of the medical professionals

BES has been training the medical professionals who work at the hospitals and who deal with the medical equipment, in how to use, inspect, and recognise equipment failure. BES workshop's repair engineers and foremen are thus acting as instructors. To date, approximately 44 training courses have been given at provincial hospitals, base hospitals, and district hospitals. The medical equipment used as models for these training courses has mainly been basic medical equipment such as sphygmomanometers, suction units, and instrument sterilisers.

## 2-3-3 Present Condition of the Existing Facilities and Equipment

### (1) Present Condition of the Existing Facilities

#### 1) Scale of the Existing Facilities

BES is located in the Maradana district, which is the central area of the city of Colombo. Surrounding the site are the Colombo General Hospital, the Eye Hospital, the National Tuberculosis Research Institute, and other medical institutions. The Medical Supplies Division's central warehouse (constructed under a 1986 grant aid cooperation of the Government of Japan) is also located in an adjacent area. The site of the existing facilities is a

corner lot facing Deans Road and De Saram Place. The total land area is about 5,600m<sup>2</sup>.

The scale of each existing building is shown below:

- |   |   |                        |
|---|---|------------------------|
| ① | Warehouse/workshop building                     |                        |
|   | one-storey building of steel-frame construction | (1,134m <sup>2</sup> ) |
| ② | Administration building                         |                        |
|   | one-storey building of steel frame-construction | (544m <sup>2</sup> )   |
| ③ | Mechanical workshop building                    |                        |
|   | one-storey building of steel-frame construction | (426m <sup>2</sup> )   |
| ④ | Purchased equipment warehouse                   |                        |
|   | one-storey building of steel-frame construction | (348m <sup>2</sup> )   |
| ⑤ | Condemned equipment warehouse                   |                        |
|   | one-storey building of steel-frame construction | (126m <sup>2</sup> )   |
| ⑥ | Garage No.1                                     |                        |
|   | one-storey building of steel-frame construction | (84m <sup>2</sup> )    |
| ⑦ | Garage No.2                                     |                        |
|   | one-storey building of steel-frame construction | (48m <sup>2</sup> )    |
| ⑧ | Guard house/warehouse                           |                        |
|   | one-storey building of steel-frame construction | (30m <sup>2</sup> )    |

---

Total floor area:

2,740m<sup>2</sup>

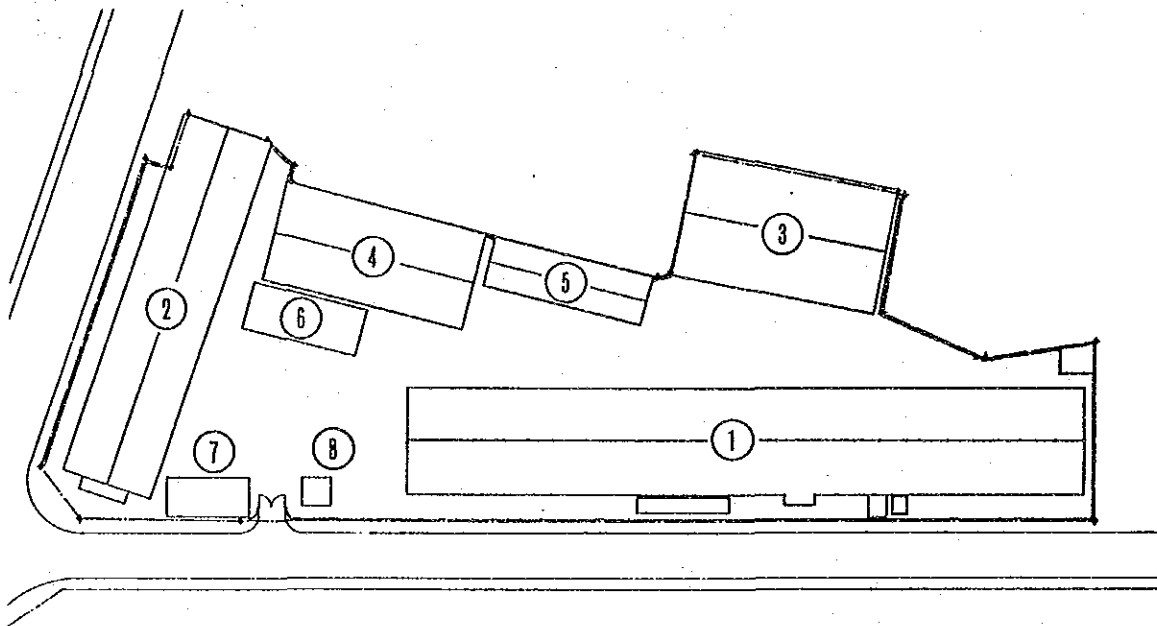


Fig. 2-3-3 Present Condition of BES's Facilities

## 2) Present Use of the Existing Facilities

The Warehouse/Workshop Building currently houses the following workshops: radiological equipment, operation theatre equipment, sterilising equipment, dental equipment, and electronics workshops. There is also a spare parts storage. The workshops are relatively small, with overcrowded working tables being a major hindrance to repair work.

The Administration Building houses the Administration and Accounting Departments and the laboratory equipment workshop. Part of the building is used as a warehouse to store newly purchased medical equipment. Due to a shortage of engineer's rooms, an engineer and an accountant officer share the same room.

Part of the Mechanical Workshop Building is used as storage for condemned equipment. Although this building has an adequately large floor area, the concrete floor is damaged, and interferes with the engineering work.

Although the purchased equipment warehouse has sufficient floor area, it does not have a roofed space for unloading equipment, which makes it virtually impossible to unload and load equipment on rainy days.

The floor area of each of the above-mentioned facilities is shown below:

### Repair Workshop

● Radiological equipment workshop	120 m <sup>2</sup>
● Operation theatre equipment workshop	135 m <sup>2</sup>
● Sterilising equipment workshop	95 m <sup>2</sup>
● Dental equipment workshop	45 m <sup>2</sup>
● Electronics workshop	45 m <sup>2</sup>
● Laboratory equipment workshop	45 m <sup>2</sup>
● Mechanical workshop	425 m <sup>2</sup>

Storage

● Purchased medical equipment warehouse	460 m <sup>2</sup>
● Spare parts storage	635 m <sup>2</sup>
● Condemned equipment storage	125 m <sup>2</sup>

Administration Building

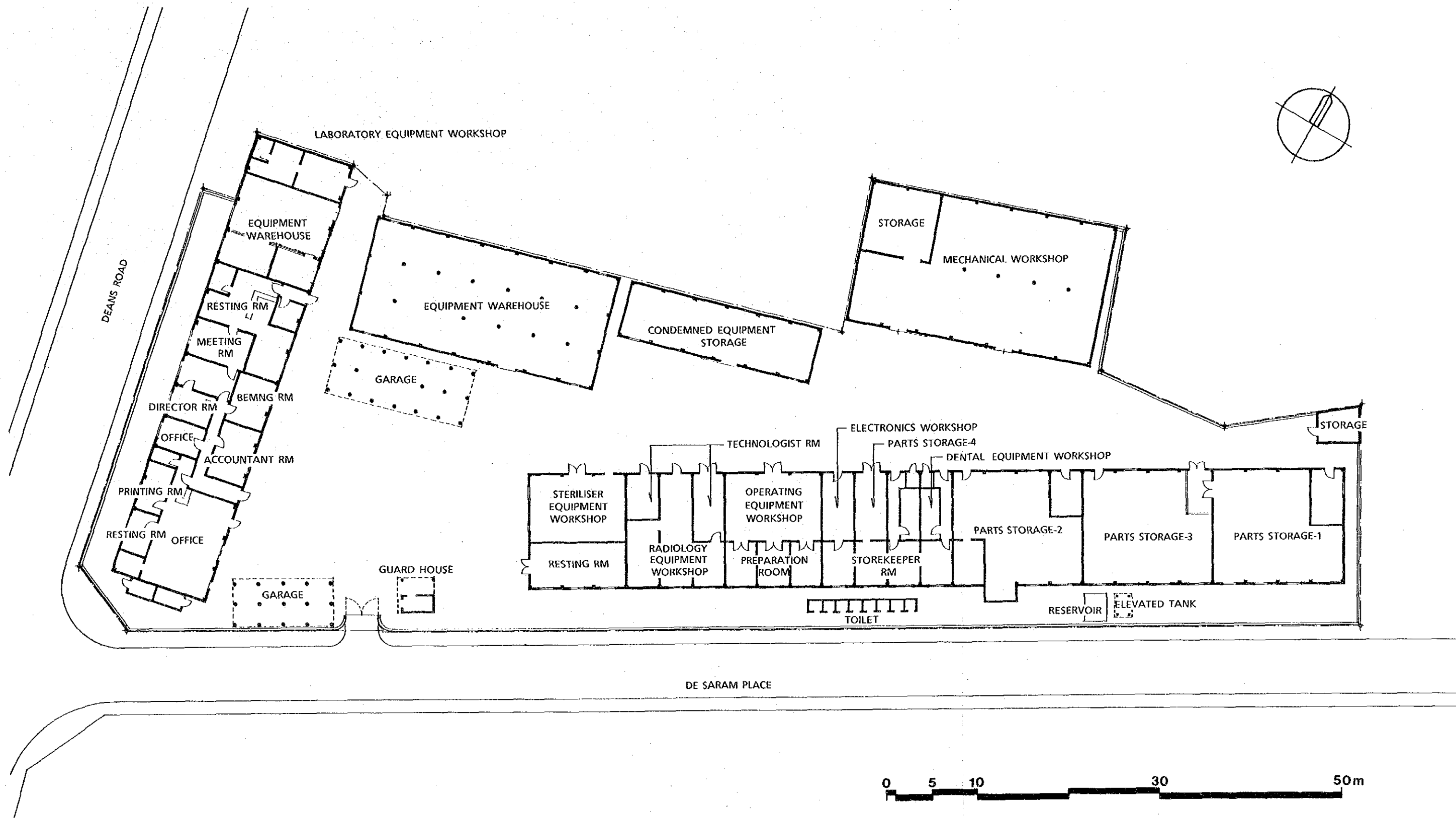
● Office	343 m <sup>2</sup>
● Meeting room	30 m <sup>2</sup>
● Resting room	75 m <sup>2</sup>
● Garages	132 m <sup>2</sup>
● Guard house/others	30 m <sup>2</sup>

---

Total	2,740 m <sup>2</sup>
-------	----------------------

There are no inner corridors in the existing buildings, making the total floor area of the rooms equal to the total floor area of the buildings. Fig. 2-3-4 shows the plan of the existing facilities.





BASIC DESIGN STUDY ON THE PROJECT FOR REHABILITATION OF BIOMEDICAL ENGINEERING SERVICES

Fig. 2-3-4 LAYOUT OF EXISTING FACILITIES





### 3) Present Condition of the Existing Facilities

The existing facilities were constructed as warehouses before World War II, and are physically beyond use and repair. Since they were not originally designed as workshops, they have posed many functional problems for BES's medical equipment repair work.

#### a) Workshop

The entire facility is outdated. Each room is so small; working tables are entirely occupied by the equipment waiting to be repaired. Repair work and desk work must be done in the same room, which makes it very difficult to keep records of repair jobs. The slate roof leaks; openings are not glazed and the entire building is not airtight. Moreover, the roof has relatively low heat insulating capabilities. The building's ability to receive electricity is also poor, which causes declines in voltage.

#### b) Storage/Warehouse

Neither the spare parts storage nor the purchased equipment warehouse has a roofed space for receiving equipment, making it impossible to load and unload on rainy days. As neither building has a loading platform, there is also the possibility that equipment will be damaged during handling. The corrugated steel plates which cover the external walls of the warehouse have been eaten away by rust. There are several holes in the walls, through which rats have entered the building and caused serious damage to the equipment. Substrates of electronic parts and reagents, which are likely to be damaged by differences in temperature and humidity, are stored in very hot and humid rooms, which shortens their service life.

## (2) Present Condition of Existing Repair Equipment

Most existing repair equipment has been used for more than ten years and have outlived their usefulness. Due to budgetary limitations, existing equipment is managed inefficiently, and the purchase of new equipment and disposal of condemned equipment is not carried out smoothly. As a result, workshop staff must continue to use outdated equipment. Repair and calibration tools for electronic equipment are not in proper operating condition. The tester, one of the most basic repair tools, is also in surprisingly poor operating condition. Adding to the inefficiency, tool units are not sorted by type of use. On the other hand, lathes and drills used at the mechanical workshop are well-maintained.

### 2-3-4 Management System

#### (1) Management System

In principle, the workshops are managed by three engineers. The dental equipment repair workshop and the electronic equipment repair workshop are managed by two BES technologists. However, there are some problems with the way BES operates the facilities. The warehouses are under the direct control of the chief accountant, and there are no departments responsible for inventory control of spare parts, or for records of testing/acceptance and ownership/repair of medical equipment.

The number of staff members in each department is shown in Table 2-3-2.

Table 2-3-2(a) Existing Staff (Colombo Centre)

	Director	B.M. Eng.	Techno- logist	Foreman	Mechanic	Store- keeper	Driver	Labourer	Clerk/ Others	Total
Radiological Equipment Workshop				4	4			1		9
Electronics Workshop		1	1	1	2			3		8
Laboratory Equipment Workshop				3	1					4
Operation Theatre Equipment Work		1		4	12			3		20
Sterilising Equipment Workshop		1		3	9			3		16
Dental Equipment Workshop			1	3	5			2		11
Mechanical Workshop					4			1		5
Storage						4				4
Administration/ Accountant	1						11	6	9	27
<b>Total</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>18</b>	<b>37</b>	<b>4</b>	<b>11</b>	<b>19</b>	<b>9</b>	<b>104</b>

Table 2-3-2(b) Existing Staff (Provincial Workshop)

	Foreman	Mechanic	Total
Central Province (Kandy Teaching Hospital)	1	1	2
Southern Province (Galle Teaching Hospital)	1	1	2
<b>Total</b>	<b>2</b>	<b>2</b>	<b>4</b>

## (2) Budget

Table 2-3-3 shows a breakdown of BES's annual budget.

Table 2-3-3 Expenditures of BES

	1986	1987	1988	1989	1990
Purchase of Medical Equipment	66,338	189,638	64,213	52,934	144,576
Purchase of Spares Maintenance Contract Fees	22,088	13,278	13,662	35,189	61,919
Personnel Costs	2,465	2,508	3,525	4,023	4,365
Traveling Expenses	1,073	1,238	1,163	1,046	1,040
Maintenance of Facilities	2,654	2,337	2,455	1,043	1,367
Others	135	558	▲2	215	125
<b>Total</b>	<b>94,753</b>	<b>209,557</b>	<b>85,060</b>	<b>94,450</b>	<b>213,392</b>

(Unit: Rs thousand)

## 2-4 General Condition of the Country's Health Projects

The Government of Sri Lanka is now implementing three health projects. An additional 12 health projects are scheduled to be implemented.

### (1) Ongoing Health Programmes

#### 1) Health and Population Project

Overseas cooperator: International Development Association (IDA)

Project cost: 618 million rupees.

Objective: To strengthen the central government's health service system through more efficient management of the medical supplies system and the promotion of population-related policy measures.

Relation with this project: Strengthening of the country's medical equipment management system.

#### 2) Development of General Hospital, Colombo

Overseas cooperator: FINNIDA (Finland)

Project cost: 981 million rupees.

Objective: To improve the facilities of General Hospital, Colombo.

#### 3) Improvement and Expansion of Medical Research Institute

Overseas cooperator: Japan International Cooperation Agency (JICA)

Project cost: 654 million rupees.

Objective: To improve and expand the facilities of Medical Research Institute with the production of vaccines, anti-sera, diagnostic reagents, and laboratory pharmaceuticals, and to improve the training and teaching of medical and para-medical personnel.

## (2) Proposed Health Projects

### 1) Rehabilitation of the Biomedical Engineering Services Division

Overseas cooperator:

Project cost:

Objective: To advance the medical equipment management and maintenance system through improvement of the workshops and the administration building. also to establish a training and research centre.

### 2) Rural Hospital Development Project (Phase II)

Overseas cooperator:

Project cost: 250 million rupees.

Objective: To supply medical equipment to Peradeniya, Kalutara, Nuwara Eliya, Gampaha, Hambantota Hospitals, and Cancer Institute.

Relation with this project: Supply of medical equipment to BES

### 3) Medium Term Plan for Prevention and Control of AIDS/Sexually Transmitted Diseases

Overseas cooperator: WHO

Project cost: 130 million rupees.

Objective: To implement measures for prevention and control of AIDS and STDS.

### 4) Proposed Second Health and Population Project

Overseas cooperator: Asian Development Bank (ADB)

Project cost: 1,068 million rupees.

Objective: To improve small-scale, primary health care-level hospitals, and the system for operating large-scale hospitals. To supply basic pharma-ceuticals and medical equipment.

- 5) Establishment of an Institution to Train Nurses and Medical Laboratory Technologists at Sri Jayawardenapura General Hospital, Kotte

Overseas cooperator:

Project cost: 363.6 million rupees.

Objective: To establish a nursing school at Sri Jayawardenapura General Hospital.

- 6) Project Proposal for the Establishment of a Cardiac Surgery Unit at Sri Jayawardenapura Hospital

Overseas cooperator:

Project cost: 363.6 million rupees.

Objective: To establish a cardiac surgery unit at Sri Jayawardenapura General Hospital.

- 7) Proposal for the Implementation of Primary Health Care

Project cost: 520 million rupees.

Objective: To construct a divisional health center and three sub-health centres in the Anuradhapura, Puttalam and Kurunegala District and Gramodhaya health centers at a rate of one per 3,000 people.

- 8) Strengthening of Maternal Care Services

Overseas cooperator:

Project cost: 570 million rupees.

Objective: To strengthen the country's maternal care services.

- 9) Expansion of School Medical Services

Overseas cooperator:

Project cost: 78 million rupees.

Objective: To improve and expand the country's school medical services.

10) Provision of Basic Sanitary Facilities

Overseas cooperator:

Project cost: 508 million rupees.

Objective: To construct sanitary facilities for low-income groups using funds furnished as loans, and materials provided as development assistance.

11) Outreach Programme for School Dental Health Services

Overseas cooperator:

Project cost: 39 million rupees.

Objective: To improve and expand the country's school dental health services.

12) Integrated Control of Vector Borne Diseases

Overseas cooperator:

Project cost: 945 million rupees.

Objective: To control such vector-borne diseases as malaria, filaria, encephalitis and dengue.



## 2-5 Background and Contents of the Request

### 2-5-1 Background of the Request

Major health indicators are higher in Sri Lanka than in any neighboring country. This is because the Government of Sri Lanka has placed utmost emphasis on the provision of health services for its people, and has given top priority to investment in health care. The procurement of medical equipment by the Government has contributed to raising the quality of the country's health services. However, problems such as the qualitative differences between hospitals located in and around Colombo and rural hospitals, superannuation of medical equipment in use at medical research institutions, and the inadequate medical equipment management and maintenance system, have surfaced. Aiming to resolve all these problems simultaneously, the Government of Sri Lanka worked out a project to provide five rural hospitals, and the Cancer Institute Maharagama, with the necessary medical equipment, as well as a project to provide Biomedical Engineering Services with the necessary equipment for management and maintenance. In August 1989, the Government of Sri Lanka asked the Government of Japan to provide grant aid cooperation for the implementation of these projects.

In response, the Government of Japan sent a preliminary survey team to Sri Lanka from October 27 to November 15, 1990, to confirm the relevance of the proposed projects, and to discuss details of the request with representatives of the Government of Sri Lanka. The team concluded that top priority should be given to improving and expanding the facilities and equipment of Biomedical Engineering Services.

## 2-5-2 Contents of the Request

The contents of the request, concerning the improvement of facilities and equipment used at Biomedical Engineering Services, which were clarified after review in Sri Lanka, are summarised below:

### (1) Contents of the Project

- 1) Improvement of Colombo Centre's functions.
- 2) Implementation of training programmes for engineers and health care staff.
- 3) Reinforcement of management and maintenance services for regional hospitals.

### (2) Sri Lankan Government Agency to Take Charge of the Implementation of This Project

The Ministry of Health and Women's Affairs.

### (3) Project Sites

Maradana District, Colombo (on the premises of BES, Colombo) and 8 regional hospitals.

### (4) Main Activities

- 1) Ordering/Purchase
- 2) Acquisition/Inspection/Storing/Delivery
- 3) Maintenance/Repair
- 4) Management of Records
- 5) Disposal of Condemned Equipment
- 6) Training

(5) Staffing Plan

Scale of the present staff:	108 staff members (including four provincial workshop staff members)
Scale of the staff after completion of the project:	376(including 104 provincial workshop staff members)

(6) Facilities concerned

- 1) Colombo Centre
  - a) Repair Workshops
  - b) Warehouses
  - c) Administration Department
  
- 2) Training Centre
  
- 3) 8 Provincial Workshops
  - a) Central Province (Kandy Teaching Hospital)
  - b) Southern Province (Galle Teaching Hospital)
  - c) North-Central Province (Anuradhapura Provincial Hospital)
  - d) Uva Province (Badulla Provincial Hospital)
  - e) North-Western Province (Kurunegala Provincial Hospital)
  - f) Sabaragamuwa Province (Ratnapura Provincial Hospital)
  - g) Eastern Province (Batticaloa Provincial Hospital)
  - h) Northern Province (Jaffna Teaching Hospital)