Management of Institution-based Diagnostic Laboratory Facilities in Health Care Delivery System

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Declaration

The work contained in the dissertation has been done under my supervision and it is her own work, not published anywhere before.

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Tahmina Haque

List of Abbreviations

AEC	Atomic Energy Commission
AFIP	Armed Forces Institute of Pathology
ANOVA	Analysis of Variance
BIDS	Bangladesh Institute of Development Studies
BIRDEM	Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders
BSMMU	Bangabandhu Sheikh Mujib Medical University
CMH	Combined Military Hospital
CT	Computed Tomography
DAB	Diabetic Association of Bangladesh
DH	District Hospital
DMCH	Dhaka Medical College Hospital
ECG	Electrocardiogram
EEG	Electroenchalogram
EET	Exercise Tolerance Test
EPI	Expanded Program on Immunization
FWC	Family Welfare Centre
HFA	Health For All
HPSS	Health and Population Sector Strategy
ICDDR, B	International Centre for Diarrhoeal Diseases Research, Bangladesh
IDCH	Institute of Chest Disease Hospital
IEDCR	Institute of Epidemiological Disease control and Research
IMR	Infant Mortality Rate

IPH	Institute of Public Health
ISE	Ion Selective Electrode
LGRD	Local Government and Rural Development
MCH	Maternal and Child Health
MHFW	Ministry of Health and Family Welfare
MRI	Magnetic Resonance Imaging
NGO	Non Government Organization
NIPSOM	National Institute of Preventive and Social Medicine
ORS	Oral Rehydration Solution
ORT	Oral Rehydration Therapy
PHC	Primary Health Care
QA	Quality Assurance
QC	Quality Control
RD	Rural Dispensary
RHC	Rural Health Centre
SSMC	Sir Salimullah Medical College
THC	Thana Health Complex
THFPO	Thana Health and Family Planning Officer
TQM	Total Quality Management
TT	Tetanus Toxoid
UNICEF	United Nations Children's Fund
UHFWC	Union Health and Family Welfare Centre
WHO	World Health Organization

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Summary

Background: Diagnostic laboratory service is an indispensable component in all stages of health care delivery. The laboratory investigations are not only essential for proper diagnosis and treatment of diseases, but also necessary for planning the disease control and prevention. Therefore, a good health care delivery requires a good diagnostic laboratory service. The physicians recommend the laboratory tests, and the diagnostic laboratory personnel provide the service to the patients. A laboratory investigation process involves several steps- a requisition from physician, registration and related procedures including pre-investigation preparation of patient, sample collection, investigation proper, report preparation and report delivery. In each of these, appropriate management can improve the quality of diagnostic medical services. The diagnostic service management in Bangladesh is still an unexplored area of study. Therefore for studying this field of health care service, it is important to understand the role and performance of diagnostic service providers from their own perspective as well as from the perspective of the service seekers in the context of skill, practices, performance, cost and satisfaction. To find out the existing facilities and problems in laboratory service management, this study was carried out in Dhaka City at several public and private diagnostic centers.

Research Objectives: The objectives are to identify the diagnostic laboratory service facilities and laboratory management and to assess the outcome of services by diagnostic laboratories in Dhaka city under the existing situation with a view to suggest a model for standard laboratory services.

Research Methods: Diagnostic laboratory services conducted by government institutions like Dhaka Medical College Hospital (DMCH) and Bangabandhu Sheikh Mujib Medical University (BSMMU), non-government institution e.g. Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) and several private diagnostic centers in Dhaka city were selected for this study. Key elements of the study were referring physicians, patients and diagnostics personnel. In addition to the personnel practices, objectives and planning of diagnostic centers or departments, demand estimation and identification of barriers, productivity and training needs of laboratory workers, maintenance cost and monthly income by the laboratories were also analyzed. For data collection, stratified sampling of service providers, patients and referring doctors from selected organizations were done. Collected data were statistically analyzed and hypotheses were tested for deriving conclusions.

Results and Observations: It was found that majority of the diagnostic investigations in government institutions were advised by physicians from those institutions. On the other hand, 42% of the BIRDEM physicians as well as 26% of government physicians were found to refer patients to private diagnostic centres but they referred patients to a lesser extent to the government institutions. Of 196 patients, 27% indicated their preference for BIRDEM, and 22% for private diagnostic centres but they rarely (2%) preferred service at government institutions. However, it was noticed that the physicians selected the diagnostic laboratories in 71% cases. More than 50% of the patients also indicated that problem exist with respect to sample collection and report delivery in government institutions and to a lesser extent in BIRDEM. In patients' opinion, test prices were comparatively higher in private laboratories and BIRDEM

than government institutions but qualities of tests were more satisfactory to patients in BIRDEM and private laboratories.

Attendants involved in pathological sample collections and sample processing were found more experienced in institutional laboratories than the private laboratories. In BIRDEM and private laboratories the workload on diagnostic personnel was found appropriate to a large extent. Sample collection problems were more in institutions than in private laboratories and are related to receipt-mistakes, collection errors and labeling errors. Loss of time and mistakes in report delivery were more frequent in BIRDEM, and to a lesser extent in private laboratories, whereas in government institutions test withholding was the major obstacle for reporting properly. Checking of test quality was more frequent in BIRDEM and private laboratories. Environmental, administrative, instrumental and reagent problems also caused low performance in government laboratories. Safety measures during sample collection were mainly use of disposable syringes and gloves, however, 25% collection attendants mentioned non-availability of precautionary measures in government institutions. Most of the laboratories used dustbin for waste disposal, a small number also burnt the waste but washing basins were also used by 20% laboratory attendants in government institutions.

Planning and long-term objectives that affected ultimate goal of diagnostic services were found to vary among diagnostic laboratories. These were attributable to plan makers and their participation in planning, interdepartmental co-ordination, supervision of lab works and standards. Overall, these were found better in institutional laboratories than private diagnostic laboratories. Training need assessment for the working personnel was also better in BIRDEM and government

laboratories. Estimation of demand was mainly dependent on patients' response and cost of services in BIRDEM but in private laboratories, it was mainly dependent on doctors' referral. Main service barriers in government institutions and BIRDEM were the lack of expertise and instrumental facilities whereas financial problems affected all types of diagnostic institutions.

BIRDEM was found serving a significantly higher number of populations than other organizations; however the yearly service did not increase much over time in any of the organizations. Government institutions were dominant in the service of imaging, clinical pathology/histopathology and microbiology over BIRDEM; but clinical biochemistry and serology/immunology departments in BIRDEM provided more service than government institutions. Although in most departments the number of tests performed in the government laboratories were higher than other laboratories, monthly net income in BIRDEM was higher owing to the higher fee charged for the tests.

Conclusions: Doctors selected the diagnostic center where a test to be done and they were found to prefer private laboratories and non-government institutions. Patients' response to diagnostic services also reflected that an unsatisfactory situation prevails in the government institutions. The load of task on the part of collection attendants was more in private and government laboratories, however, sample collection errors were more in institutional laboratories. Report delivery problems also existed in all, more in institutional laboratories. Load of work per test was also more in government institutions and private laboratories than in BIRDEM and however withholding tests were more in government institutions. Safety measures and laboratory waste disposals were found unsatisfactory in most instances. However, problems were less frequently

discussed in government laboratories. Better academic and practical training of laboratory personnel, a better cross checking system as well as timely discussion of problems to supervisors may help to overcome these problems.

In Dhaka city, total diagnostic service to population was provided more by BIRDEM than government or private laboratories. As to revenue generation, imaging, clinical pathology and microbiology departments were important for government institutions, whereas clinical biochemistry and immunology departments were so for BIRDEM. Costs of tests were higher in private diagnostic laboratories and BIRDEM leading to a higher revenue generation compared to government institutions.

Finally, it should be mentioned that major clinical health care service of the country is provided by public hospitals, but for many of the common diagnostic laboratory services, patients are referred to private laboratories. This is due to lack of such service facilities in public sector. Although patients receive the clinical care in public hospitals free or at a very low cost, often they have to pay for the service of private diagnostic laboratories and it is a large amount of money. This burden becomes more frustrating when a poor patient fails to buy the prescribed medicine after paying the charges of pathological tests. This existing condition can be changed if the management identify their drawbacks and take necessary initiatives to overcome them. With proper planning and management, if most of the necessary laboratory tests can be offered in the public sectors and if the diagnostic facility in private laboratories are provided at affordable cost.

1. Introduction

Diagnostic laboratory service is an indispensable component of health care delivery. It plays a vital role in all stages of disease management (Gaw et al, 1995). All types of diseases produce certain pathological changes in the body. Without proper laboratory tests to detect those pathological changes, diseases cannot be diagnosed properly. On the other hand, inaccurate test results may cause serious harm to patients by leading the attending clinicians to erroneous decisions.

Diagnostic laboratory services are usually of two main types, medical imaging and laboratory investigation (Gaw et al, 1995). Medical imaging deals with the anatomical or functional imaging of the organ of pathology, whereas, laboratory investigation is concerned with testing pathological samples collected from the patients. Medical imaging departments offer the services like X-ray, ECG, ultrasonography, computed tomography, scanning, endoscopy etc. and laboratory departments offer biochemical, microbiological, immunological, hematological and histopathological investigations (Gaw et al, 1995). Rapid advancement of medical techniques in both of these sectors has revolutionized the concepts in diagnosis, patient follow-up and prediction of prognosis in diseases. Wider and far-reaching innovations in molecular biology, biotechnology, biophysics and biomedical engineering are also bringing newer diagnostic tools for medical services every year (DAB, Annual report, 1997-1998).

The present health facilities in Bangladesh in quite insufficient compared to the need (Hussain M A, 2000). However, in the recent years, some remarkable improvement in the health indicators has been noticed (BBS, 1998). The diagnostic facilities in the country have also improved but the overall development in laboratory service

facilities is still at a primary stage (DAB, Annual report 1994-95, p95). It has also been mentioned in a recent report of the Ministry of Health and Family Welfare of Bangladesh that one of the major deficiencies that hinder hospital based health services in the country is the lack of diagnostic laboratory facilities (HPSS, 1997). According to that Health and Population Sector Strategy report, establishment of laboratory services have been considered also as very expensive (HPSS, 1997). However, there may be many other reasons for the inadequate development of diagnostic facilities in Bangladesh. The most important ones are *poor idea* regarding the contribution of laboratories in clinical medicine, *low-tech medicine* in practice, *poor infrastructure* of the diagnostic laboratories, *lack of expertise* in the field of laboratory medicine, and *lack of quality control* in diagnostic laboratory service (DAB, Annual report 1994-95, p-95). Added to this, the commercial motive of referring clinicians and the diagnostic laboratories may also be responsible for disregarding quality in professional service.

Most of the recent progress in the field of diagnostic laboratory services has been observed in private sectors especially in Dhaka city. Unfortunately, at the same time, the public sector has experienced not much up-gradation of their facilities in diagnostic laboratories and some deterioration of their performance due to lack of maintenance of equipments and facilities. Although, some modern diagnostic facilities of medical imaging like ultrasonography, radionuclide scanning, computed tomography, MRI and endoscopy are available in public sector at government medical college hospitals, overall hospital based laboratory services in public sector lack the advancement of technical facilities which have been adopted in the private sector. In Dhaka city, Dhaka Medical College Hospital (DMCH), Sir Salimullah Medical

College Hospital (SSMCH) and Bangabandhu Sheikh Mujib Medical University (BSMMU) hospital are the major government institutions offering diagnostic services to the patients. Among the non-government and donor reliant organizations in Dhaka city, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM, and International Center for Diahorreal Disease Research, Bangladesh (ICDDR, B) have been playing the premier role in diagnostic services. Several private diagnostic laboratories in Dhaka city namely Popular Diagnostic Centre, Lab-Aid, Medinova Medical Services, Compath Diagnostics, Comfort Diagnostics, Samorita Hospital Ltd, Modern Diagnostics, Mina Laboratory, Ananya Diagnostic Centre, Microlaboratory and City Diagnostic Centre have also expanded their laboratory services significantly in recent years.

In Bangladesh, the public hospitals are still considered as the major service centers in clinical section like internal medicine, surgery, gynecology & obstetrics, casualty, cardiology, chest medicine, pediatrics, orthopedics, ophthalmology, otolaryngology, dentistry etc, but the diagnostic services are not similar. While the clinical service in non-government institution based hospitals like BIRDEM or ICDDR, B is appropriately coordinated with their diagnostic services; a different picture is evident in government institutions. When patients hospitalized in government institutions like medical college hospitals require diagnostic services, the doctors sometimes need to refer them to private laboratories for such services. As a result, the patients are required to spend a large amount of money to perform pathological laboratory tests in private laboratories. Therefore, it is important to investigate the difference in diagnostic service facilities existing between government institutions and non-government organizations. The problems have never been identified and no study has

ever been carried out to identify the underlying reasons of inadequate performance by diagnostic service in diagnostic organizations especially in public sector.

This study is aimed at finding out the drawbacks and limitations of government institution based diagnostic laboratory service management compared to that of non-government diagnostic laboratories. The results of this study may be utilized to improve the existing situation of diagnostic service facilities in public sector. The poor patients can be helped by alleviating an extra burden of expenses with the introduction of improved institution based laboratory service facilities in the government hospitals. An improvement in the diagnostic service in the government hospitals may also serve as a good income-generating source to be utilized in public health sector development.

2. Rationale of the Study

Diagnostic service is an essential part of disease management but medical investigation facilities in Bangladesh is still inadequate. Some of the recent progresses in diagnostic techniques have been adopted in private sector, which is insufficient and inappropriate to the common patients' need. Patients have to show much patience, spend lot of time and money for diagnostic test purposes. Frequently, the patients are dissatisfied with the service. In many instances, inefficient laboratory management is responsible for that. Identification of problems in diagnostic center management and execution of necessary steps to solve those may help development of proper services in these institutions.

The individuals involved in providing the diagnostic services are central authority, departmental head, test performer, lab attendant and sample collection attendant. Overall outcome of diagnostic service depends on their skills, capabilities and optimized system in providing the service. Diagnostic services offered by the government institutions, non-government institutions and private laboratories may be compared to identify the deficiencies in the management of existing diagnostic service facilities, which may ultimately be utilized to propose a guideline to improve the diagnostic service in the country.

Diagnostic service management in health care delivery of Bangladesh is an unexplored area of study. Therefore, it was important to evaluate the role and performance of diagnostic service providers from their own perspective as well as from the perspective of the service seekers in the context of skill, practices, performance, cost and satisfaction of service seekers. Accordingly, the study objectives were set and the research methodology was designed.

3. Research Objectives

Existing diagnostic service facilities in Bangladesh, management of the diagnostic organizations, and the outcome of the diagnostic service in the field of health care delivery have never been studied properly. This study was designed to investigate the diagnostic service offered by the government and non-government institutions compared to that of private diagnostic laboratories in Dhaka city. Diagnostic service in government institutions which were included in the study are DMCH and BSMMU, whereas that of non-government institutions so selected are BIRDEM and some privately owned and operated laboratories. For analysis, government institutions (DMCH and BSMMU) were treated as a single unit; similarly, private diagnostic laboratories were similarly grouped into a single unit. Overall purpose of the study was to find out management issues responsible for inappropriate diagnostic service and to propose a model for standard diagnostic service management.

Objectives of this study are:

1. To verify the practice of investigation referral by the physicians with respect to service quality of different diagnostic organizations,
2. To evaluate the patients' view about the services provided by different types of diagnostic laboratories so as to identify the specific problems faced by the patients at diagnostic centers and
3. To verify the different aspects of diagnostic service management in different organizations. i.e.
    a. to identify the administrative settings and constraints including long-term objectives, planning, demand estimation and barrier identification by laboratory authority,

b. to find out the common sources of errors in laboratories including sample collection errors, investigation errors and reporting errors,

c. to assess the efficiency and activities of diagnostic personnel in different organizations in the context of their educational background and working experience,

d. to examine the productivity and workload of laboratory personnel in various diagnostic organizations,

e. to evaluate the quality control systems for different diagnostic organizations including internal supervision, task allocation, feed-back system of respective activities and standard setting,

f. to find out the problems in physical facilities like laboratory space, instruments and reagents,

g. to compare the safety measures in pathological sample collection in different laboratories and waste disposal systems, and

h. to compare the management success among the laboratories in terms of longitudinal analysis of diagnostic services and to attempt a comparative analysis of income of various departments in the same laboratory.

4. Review of Literature

Medical investigations provide an accurate information about the pathological changes of a disease, which may be of use to the clinicians in establishing proper diagnosis and in the monitoring of treatment (Gaw et al, 1995). Diagnostic tests may also be of value in assessing the prognosis once a diagnosis has been made or in screening for diseases in the community (Gaw et al, 1995). Therefore, from curative to preventive medicine, in all stages of health care delivery, medical investigations play a major guiding role and diagnostic laboratories with medical investigation facilities are considered as an integral part of health care service. Research works into the pathological basis of diseases and experiments on developing interventions are also performed in the diagnostic laboratories. Diagnostic services are necessary for deciding health priorities and resource allocation priorities, monitoring spread or outbreak of infectious diseases, investigating preventable premature loss of life, deciding effective control measures against major prevalent diseases (Cheesbrough M, 1987). Without reliable laboratory support, patients are less likely to receive the best possible care, resistance to essential antibiotics may develop due to improper use, the sources of disease may not be identified correctly, epidemics and the spread of major communicable disease can not be checked in time and valuable financial and human resources may be diverted to ineffective control measures (Cheesbrough M, 1987).

4.1 Diagnostic services in medicine

Diagnostic services in medicine include laboratory services, medical imaging, and physiological function tests (Gaw et al, 1995). Laboratory services include clinical biochemistry, clinical pathology, hematology, histopathology, microbiology and immunology (Gaw et al, 1995). Laboratory tests are usually performed on

pathological samples collected from patients like blood, urine, stool, sputum, pus, etc. whereas, medical imaging is performed physically on patient's organ or tissue of pathology. Physiological tests like ECG, EEG, lung function tests, uroflometry are usually included in the medical imaging section. Nuclear medicine includes also laboratory investigations and imaging services, using radioisotope based diagnostic techniques (Cheesbrough M, 1987).

4.1.1. Laboratory services

Clinical Biochemistry includes the common laboratory tests like liver function tests (serum bilirubin, SGPT, SGOT, alkaline phosphatase, γ-GT, total protein, albumin, A: G ratio etc), renal function tests (serum urea, creatinine, creatinine clearance etc), metabolic assays (blood glucose, BUN, uric acid etc), lipid profile (cholesterol, triglycerides, HDL, LDL, apoproteins etc), serum electrolytes (Na^+, K^+, Cl^-, HCO_3^-, Ca^{++}), blood gas analysis (PO_2 and PCO_2), acute phase proteins like C-reactive protein(CRP), blood coagulation parameters (prothrombin time, APTT, FDP, fibrinogen, factor VIII etc), cardiac enzymes and others. Commonly tests are performed on blood, urine, CSF or other tissue fluids. Most of the modern laboratories use automated chemistry analyzer for biochemistry (Cheesbrough M, 1987).

Laboratory tests for hormones (T_3, T_4, TSH, LH, FSH, estrogens, progesterone, prolactin, testosterone, etc) are usually done in the department of clinical biochemistry, however, now a day, these tests are also performed in a separate section named endocrinology. With advancement of clinical endocrinology separate test facility for endocrinology laboratory is also growing (Cheesbrough M, 1987).

Clinical pathology includes routine morphological examination of body fluids e.g. blood, stool, urine, CSF etc. *hematology*, although a separate field in modern

laboratory medicine, it is included in the clinical pathology section in our country. Hematological investigations include Hb%, TC, DC, ESR, PBF, MP, bone marrow examinations etc. In some laboratories, still *histopathology* as well as *cytopathology* is performed in clinical pathology departments (Cheesbrough M, 1987).

Histopathology/ cytology section examines tissue biopsies of pathological interest. Other than open biopsy section, cytological examinations are also done on needle aspirated materials. Special staining is also done to identify pathological organisms in tissue sections. Immunostaining, which is also, used both in routine diagnosis and research works, is not commonly available in our country (Cheesbrough M, 1987).

Microbiology department is involved in isolation, identification and characterization of the infectious disease agents. Depending on the target organism to be isolated, it has defined various fields like bacteriology, parasitology, mycology and virology. In a microbiology laboratory, Gram staining, AFB staining and other special staining are performed to identify pathogens microscopically in body fluids of pathology e.g. urine, stool, sputum, pus, swab etc. culture and sensitivity (C/S) tests for bacteria are also done in microbiology laboratories. In developing countries like Bangladesh where infectious diseases are common, microbiological investigations are most informative in diagnosis of diseases (Cheesbrough M, 1987).

Immunology, although a new section in laboratory medicine, encompasses many laboratory tests. In *immunochemistry* section, tests are performed to detect common immunological parameter changes in diseases. However, serology section is involved in detection of the serological response to infectious disease organisms e.g. antibody response to hepatitis virus (Cheesbrough M, 1987).

4.1.2. Radiology and Medical Imaging

Radiology section offers services like X-ray examination of different organs. It also includes computed tomography (CT) scan and magnetic resonance imaging (MRI) facilities. Ultrasonography, echocardiography and mammography are commonly done in modern radiology laboratories. In some imaging departments, endoscopy and laparoscopy facilities are also available. ECG, EEG, uroflometry, lung function etc. these physiological tests is also included in the imaging sections.

4.2. Management of Laboratory Services

Usually a medical investigation needs the sequential process of several stages- a requisition from physician, registration and related procedures including pre-investigation preparation of patient, sample collection (not in imaging), testing/processing of images (not in laboratory), report preparation and report delivery. In case of institutions, hospitals and clinics, diagnostic service is available for both in-patient and outpatient service seekers; but in case of private diagnostic laboratories these services are given only as the outpatient service. In each of these stages of investigation, appropriate management can improve the diagnostic medical service quality in the country.

Personnel directly involved in different procedure of a laboratory investigation are *Clerical Assistants* in registration of the patients according to the requisition from referring doctors. In laboratory medicine, *Sample Collection Attendants* who are responsible for appropriate sampling and numbering of the collected sample and sending the samples to the laboratories for testing. Sample collection attendants are either medical technologists, or trained technicians. In the laboratories, *Laboratory Attendants* receive the collected samples and process the samples according to the

requested tests. They are responsible for preserving the samples if the tests are not immediately performed. The *Test Performers* carryout the assays, analyze the results and prepare the reports. Laboratory test performers are usually medical technologist or medical scientists or specialist pathologists with medical background. Clerical assistants then deliver the test reports. In medical imaging sections, after pre-investigation processing, patients are taken to the imaging rooms and the radiographers and radiologists perform the imaging, process the images and prepare the reports and then deliver them in the same way as in laboratory medicine departments.

4.2.1. Scope of management in diagnostic laboratories

Management is a process, mental and physical, whereby subordinates are brought to execute prescribed formal duties and to accomplish certain given objectives or it is the art and science of mobilizing and administering human, financial and physical resources towards the achievements of specified objectives (Geyndt DW, 1990). In other words, management as a means that serves the institutions and organizations, was created by the society to fulfill a specific social purpose and to satisfy a specific societal or communal need (Geyndt DW, 1990). Principal function of a diagnostic laboratory is to provide reliable information on a medical investigation submitted to it for examination. The user of the information, physicians and the beneficiary, the patients have the right to demand and be satisfied that the information generated by the laboratory is correct. Responsibility for the accuracy of the information lies on the management of the laboratory (Wilcox Jr et al, 1978). Other major responsibilities of the management are to make pre-investigation processing convenient, provide investigation report earlier and keeping the investigation prices within the patients'

reach. In this relation, several management functions have been identified, which are planning, beneficiary analysis, cost-effectiveness, maintaining physical facilities, personnel practices and control system (Wilcox Jr et al, 1978).

Defective management is one of the most difficult and pervasive constraints for effective health services in developing countries (Cheesbrough M, 1987). The degree to which a diagnostic laboratory service performs its important functions and contributes to a higher standard of health care and the prevention of disease, depends on well coordination between different components of the health care services. Recognition of the role of laboratory by health authorities is essential. The correct proportion of available funds must be allocated to educate laboratory employees and for development of a professional career structure, running the diagnostic, investigative and disease control components of the laboratory service and extending laboratory services to where they are needed (Cheesbrough M, 1987). At the same time, it is also important for laboratory service to develop and enforce a professional code of conduct, train appropriately its employees and provide opportunities for continuing education, provide and maintain reliable diagnostic and epidemiological services and enable the community to avail of its services at reasonable cost (Cheesbrough M, 1987).

Laboratory errors can occur in many areas, starting from registration to sample collection, test procedure and in reporting. Other common problems in the diagnostic laboratory are inconvenient pre-investigation processing, delay in investigation and reporting, and extremely high price of the investigation. Indicators of proper management of a diagnostic laboratory are the level of experience and training of the laboratory staff, equipment support in the laboratory, safe and reliable operation of the

laboratory equipment, quality control of the tests, the costs involved in laboratory tests and quick delivery of test results (Cheesbrough M, 1987).

4.2.1.1. Organizational Planning

Organizational planning is the way of selecting mission and objectives for the laboratory that helps to determine the organizational structure. It is the responsibility of the management that all personnel of the laboratory have a common understanding of the laboratory objectives. Management is also responsible for planning the strategies, policies, programs and procedures as well as decision making, the selection of a course of action from among alternatives to achieve the objectives (Geyndt DW, 1990). Two types of planning must be distinguished, strategic planning and operational planning. Strategic planning is a long-term planning that covers the time span from 5 to 20 years. It is usually prepared by top managers/executive bodies/policy makers to achieve long-term goal of the organization. Strategic planning is the process of deciding long term allocation of resources used to attain the objectives, and the acquisition, use and disposition of theses resources. In diagnostic laboratory authority/head of the respective department can set strategic plans. Tactical plan is a short-term plan which covers the time span from 1 to 5 years, and is usually prepared by the top and middle level managers. The main purpose of tactical plan is to implement the strategic planning. Marketing plan, financial plan, production plan etc., are the tactical plans that are narrow in scope than strategic plan. Operational plans are developed by lower levels of management which cover the time span from 1 year or less to achieve day to day activities of the organization (Bovee CL *et al*, 1993). Operational planning refers to the process of defining activities and tasks, scheduling human, material and financial resources, and assigning activities and tasks to people. In diagnostic organizations, operational planning includes identification of

appropriate test methods, the training of lab personnel to provide the appropriate service, etc. In fact, the scope of planning involves all management functions (Geyndt DW, 1990).

4.2.1.2. Beneficiary analysis

In diagnostic services beneficiaries are the patients. The mechanism of beneficiary analysis encompasses response to the needs of the patients through correct identification of service needs, convenient setting of service delivery, affordable pricing of services and monitoring, utilization and seeking feedback from patients. A valid beneficiary analysis must be supported by evidence from a demand analysis; patient profile and a patients' need assessment including estimation of their latent demand (Geyndt DW, 1990).

4.2.1.3. Physical facility

The management task includes maintenance of the organizational or institutional physical facility to provide specific service. Special skills may be essential in general maintenance of laboratory instruments. It is management's responsibility to evaluate the organization's physical facilities for the diagnostic service and maintain the instrumental and technical facilities.

4.2.1.4. Procurement and logistics

It is the cost of materials and supplies, maintenance and replacement of service equipments and maintenance of capital assets such as buildings that determines the price for quality of service. A management system for the procurement and logistics of materials encompasses the sub-system which are: planning and budgeting for materials and supplies, procuring and purchasing, receiving and inspecting, storing,

controlling inventories, requisition and distribution, handling of unused supplies and materials (Geyndt DW, 1990). This is crucial aspect of laboratory management as it directly influences the investigation charges.

4.2.1.5. Personnel practices

Personnel management is the management of human resources in an organization. It is vital for the management that ensures personnel system is adequate to deal with laboratory functions and problems. Quality personnel are essential to ensure quality of work in the diagnostic laboratories. Thus in terms of cost, productivity and meeting stated objectives, personnel management requires special attention. An assessment of the functional areas of personnel management must consider adequacy of work force, number of personnel in different categories, ranges of skills, work load distribution, recruitment, selection and these are important for efficient management of the laboratory. Then training, how and where these processes are carried out should be considered. Retention of laboratory personnel, evaluation of pay structure and incentive system, motivation to work, projection of manpower needs in light of projected volume of services are also the responsibilities of the management (Geyndt DW, 1990).

4.2.1.6. Control system

Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives. Operational control is the process of assuring that specific tasks are carried out effectively and efficiently. Operational control needs continuous and day-to-day feed back to track progress with respect to its objectives and plans. Management control relies on periodic feedback, generally in the form of

performance appraisals, of measuring, appraising and improving management performance and evaluation of the whole organization. Operational controls are usually specific to functional areas, e.g. the auditing functions, financial management, inventory control in procurement and logistics, the assessment of productivity in personnel, the quality control in provision of goods and services, epidemiological surveillance of target population included in beneficiary analysis. Control systems can be placed on a continuum ranging from highly qualitative to highly quantitative. The more quantitative the control system emphasis is, the greater the need for a structured management information system (Geyndt DW, 1990).

4.3. Defining, measuring and assessing quality of diagnostic care

There are three levels of measurement of quality of diagnostic care- structure, process and outcome (Annemarie, 1995). *Structure* of laboratory service includes adequacy of facilities and equipment, administrative process, qualification of laboratory staff and organization. This assumes that given proper settings and instrumentality, good diagnostic care will follow. Measures of structure included: skill of lab staff, inventories of test reagents, availability of appropriate equipment as well as furniture and fixtures, organizational structure, and supervision (Annemarie, 1995). The *Process* covers reagent quality, accuracy of tests, timely delivery of test results, technical competence and repetition of extreme cases. They assume that given the proper procedures, accurate laboratory test report will result. Measures of process include welcoming the patient, taking the samples, testing the samples, diagnostic examination and communicating with patients about the investigation procedure (Annemarie, 1995). *Outcome* of the diagnostic laboratory service is the utility and propriety of test results as reflected in patients and doctors satisfaction with service rendered. Patients and doctors should be asked about their perception of quality in

general and what aspects of quality appear to be satisfactory or unsatisfactory (Annemarie, 1995).

4.4. Health Care Service in Bangladesh

Before we proceed to describe the diagnostic laboratory services in Bangladesh, we should briefly state the current status *(Table 4.1)* of the health care delivery system. Bangladesh has an area of 147,570 sq. km and is situated on this southeastern part of Asia. It has a total population of 123.4 million with a population density of 2,454/sq. mile (World population data sheet, 1998). According to the available information, only 45% of the total population of Bangladesh have access to government health care service facilities (Huq M et al. 1997) whereas the others go for traditional treatment through quacks, homeopaths etc. Only a few people can go to private clinics which are very expensive for general people.

According to Bangladesh Bureau of Statistics (BBS, 1998), in Bangladesh there are 1362 union sub centers, 96 maternity and child welfare centers and 398 Thana health complexes. There are also 650 government hospitals including 60 District Hospitals, 13 Medical College Hospitals and 5 Postgraduate hospitals. In private sector there are also a number of hospitals and clinics which are located mainly in the big cities.

In Bangladesh there is one doctor for every 4512 people, one nurse for 8066 people and one hospital bed for 3261 people (BBS, 1998). This poor picture becomes more serious when a doctor, a nurse or a medical technologist does not like to stay at rural health centers due to the poor infrastructure like housing, safe drinking water, electricity supply, poor sanitation transportation etc. (Hossain MA, 2000).

❖ **Table 4.1 Indicators of health and family planning sectors**

Health Indicators	Status in 1997
Total no. of hospitals	938
Government hospitals	650
Non Govt. hospitals	288
Govt. Dispensaries	1,397
Total hospital beds	38,106
Beds in Govt. hospitals and dispensaries	30,081
Beds in non govt. hospitals	8,025
Persons per hospital bed	3,261
Registered physicians	27,546
Persons per physician	4,512
Registered nurse	15,408
Govt. Medical Colleges	13
Post graduate hospital	6
District hospital	60
Others general hospital	03
THC/RHC	398
Crude Birth Rate	21.0
Crude Death Rate	5.5
Infant Mortality Rate	60
Life Expectancy at Birth: Male	61
Female	60
Total government expenditure on health and family planning (crore Taka)	1,831
Per capita government expenditure on health and family planning (Taka)	147
Total area (sq. km)	147,570
Total population (million)	123.4

Source: Bangladesh Bureau of Statistics, 1998

4.4.1. Health Administration in Bangladesh

Health services administration in Bangladesh follows the general administrative divisions of the country. Administratively, the country is divided into 6 divisions, 64 districts and 496 Thanas, 4451 unions and 68,000 villages. A scheme for Rural Health Centers (RHC) was introduced in 1961 following the recommendation of Bhore Committee in which one RHC having 6 maternity beds and 3 sub-centers was planned for every 50,000 population, and such 150 RHCs were set up prior to liberation of Bangladesh (Rashid KM *et al,* 1995).

After the liberation of Bangladesh in December 1971, the Thana Health Complex (THCs) scheme was introduced upgrading the RHCs to 25 bed hospitals. Thana Health Complex scheme was approved in 1976 increasing the number of beds to 31. The government also decided to increase the number of Rural Health Sub-centers to 4 or 5 depending on the size and population of a Thana. Each Sub-center was staffed by one mid-wife or a trained traditional birth attendant or *dai*, one compounder and one health assistant (Rashid KM et al, 1995).

The existing structure and functioning of the Health Services in Bangladesh is oriented toward delivery of primary health care (PHC) to the rural masses. At present health and family planning services in Bangladesh are provided mainly by the government and in a limited way by non-government organizations (NGOs) and private agencies. The Ministry of Health and Family Welfare (MOHFW) is responsible for developing policy and programs for health and family planning services and promotion of good health. The MOHFW is headed by the Minister of Health and Family Welfare, supported by the Minister of state. The top civil servant is the secretary who is assisted by one additional secretary, six joint secretaries and a

joint chief (planning) and a number of deputy secretaries, deputy chiefs, assistant secretaries, assistant chiefs and research officers.

There are five directorates MOHFW namely 1) Directorate of Health Services 2) Directorate of Family Planning 3) Directorate of NIPORT 4) Directorate of Drugs 5) Directorate of Nursing. First three are headed by Director Generals. Director General of Health Services is responsible for implementation of health policies and programs. Health care is available at 13 Medical College Hospitals, 7 post graduate level hospitals and a few other specialist hospitals. There are five directors for the administrative divisions. The chief of health services at the district level is the civil surgeon. The civil surgeon is responsible for overall management of Health Services in the district except for medical college hospitals which are headed by concerned Directors. District level health care is delivered through district hospital often called *sadar* hospital. There are 43 (50 bed), 14(100 bed), 2(150 bed) hospitals. In addition there are 2 more hospitals at regional level (a 200 bed and 250 bed). There is Thana Health Complexes (THC) at the thana level. Both outdoor and indoor facilities are available in THCs. There are 397 THCs functioning with beds varying from 31 to 50 beds. At present there are 3172 union centers/union health and family welfare centers where only outdoor services is available.

Top management usually formulates policies and strategies, plans for human resource development, sets national and regional targets and allocates resources. The mid level and operational level deal with the instructions formulated by the top level management, focus their activities through supervision and maintenance of record keeping, managing logistic and carrying out personnel functions, such as disbursement of salary and allowances, transfer of personnel, granting of leaves and

making arrangement for training. Because of the rigidity of policies and procedure set at the highest level, functions at the mid and operational level has become restricted to routine task. Program failure in most developing countries can be attributed to top-down planning process. Except in the case of experimental or pilot projects, local level planning is rarely undertaken because of organizational weaknesses of the public health care planning process planning process. Current management system, however, provide few incentive to improve quality of care and respond to client's need. The management system in this sector needs to be changed so that the providers are motivated to serve the needs of customers (Rashid KM et al, 1995).

The Ministry of Health and Family Welfare (MOHFW) realizes that the present structure of Population and Health Directorate does not adequately respond to the needs of child and maternal health and clinical contraception and limits the potential for increasing the range, quality and effectiveness of services. The current structure is not also considered to be cost effective. There exist inadequate inter-project linkages and poor institutional co-ordination and support within the sector. As a result there are instances of duplication of efforts and/or inadequate utilization of resources. Functionally, the separate structures impede referrals, generate internal conflicts, and contribute to the low utilization of public facilities. Moreover, field functionaries are not putting up their best efforts owing to, interalia, job insecurity despite having long years of service. Current management systems provide few incentives to improve quality of care, and respond to clients' needs. The present service system does not allow clients to obtain health, reproductive health and family planning services from a particular service point.

The health and population programs of the Government of Bangladesh have undergone a basic transformation in which the service delivery under two parallel programs are unified up to Thana level and the management is under one command without loosing focus either on health or on family planning services. Under the Health and Population Sector Program (HPSP) of the Ministry of Health and Family Welfare (MOHFW), the basic emphasis is now on the delivery of essential services package (ESP) with more attention to the reproductive health care, control of communicable diseases, maternal and child health care, limited curative care and behavior change communication. For successful implementation of HPSP and the delivery of ESP, the organization structure has been changed and the management of the system must respond to the needs of the changes. Thana as the focal point is now under the unified command of Thana Health and Family Planning Officer who will be assisted by other professionals and will be responsible for both health and family planning activities within the Thana. Certain other changes are also there in the working processes down to the village level. Thus the new role of the Thana managers will demand more managerial skills development for successful running of different program concepts. In other words, there is a need to develop the management and human resources skills of the newly designated managers so that they are effective in their job performances. A series of training programs will be organized, so that the reform goals of the Health and Population Sector Strategy (HPSS) can be achieved in due course.

Approval of HPSS was one of the agreed milestones to have been achieved before preappraisal of HPSP. The HPSS has accordingly been approved by Executive Committee of the National Economic Council (ECNEC) in its meeting held on 19 August 1997.

Overview of HPSS, HPSP and ESP

HPSS

It was felt by all concern that following issues need to address for effective health system in HPSS.

1. Rationalizing service delivery systems through a reorganization of the MOHFW's implementing structures to eliminate duplicative systems and minimize inefficiencies.
2. Improving management through
    - Capacity development
    - Human resource development
    - Effective management information system
    - Application of lessons from innovative and pilot projects.
3. Developing a comprehensive national reproductive health strategy, including family planning, maternal health care, STD/AIDS control and other reproductive services.

HPSS was approved by the democratic Government's commitment to reform, accountability and serving the interest of the people of Bangladesh.

HPSS identified basic strategies and a number of support systems. The Essential Package Service (ESP) identified in HPSS consists of basic reproductive and child health services, including family planning, maternal care and immunization as well as control of selected communicable diseases, limited curative care and behavior change communication. The ESP will be delivered through different levels of the primary health care system (community, union, thana and districts levels). HPSS also identified support systems, including communications, logistics, human resources

development and management information systems that need to be strengthen. These support systems are complemented by the basic policy changes required to make the system more cost-effective, including improved organization and management of services delivery and increased involvement of the community in monitoring and evaluation.

HPSP

Health and Population Sector Program developed and approved by the Government to materialized the principles of HPSS. The goal of HPSP is improvement of the health and family welfare status of the population particularly among the most vulnerable women, children and poor Bangladesh. The main purpose of HPSP is to implement within MOHFW and achieve " Client-centered provision and client utilization of an Essential Package, plus selected services".

ESP

Essential Services Package (ESP) includes an economic choice, meeting the need of the population, and easy management which is giving importance to reproductive health care, child health care, communicable disease control, limited curative care and behavior change communication. The delivery strategies of ESP are client focused and community oriented.

4.4.2. Major Drawbacks of the Health Care System in Bangladesh

4.4.2.1. Low range of available services

The factors influencing the low range of available services are inadequate operational planning, implementation and lack of cooperation among the service providers. These

were in turn related to a number of factors that is inadequate awareness of job responsibilities, inadequate technical skills etc.

4.4.2.2. Deficiency of trained manpower

Manpower is a critical resource for the health sectors. It is impossible to improve the health services without improving the quality of working manpower. Lack of proper training and other personal negligence are the important causes of deficiency in regard of health manpower. These were due to inadequate training facilities, improper manpower planning and complicated recruitment procedures.

4.4.2.3. Institutional and structural inadequacies

Though there was agreement in policy that the services provided by the personnel of two wings were to be effective by coordinated and integrated strategies, the actual modalities of achieving these objectives of functional integration were not properly translated into action. Thus the health and family planning services were functionally integrated at the Thana level and below leaving the supervisory controls mostly branched. Lack of modalities for integrated health and family planning services and lack of intersectional co-ordination are responsible for inefficiency of domiciliary services as well as inadequacy of health care system. Usually, the UHFWCs and THCs are run with shortage of essential drugs functional overload and absence of proper physical facilities. Referral system with clearly spelled out linkage and communication is not yet be established among UHFWCs, THCs and district hospitals as well as tertiary level teaching and specialized institutions.

Epidemiological surveillance and monitoring system and other essential subsystems like health laboratory services, maternal and child health care, school health care, industrial health services, enactment and administration of public health legislation

are not only inadequate but also not properly integrated with the overall health care system.

4.4.2.4. Inadequate support from other sources

Due to lack of application and realization of the coordinated relation between health and other sectors, lack of appropriate collaborative systems and proper and timely actions by health sector authorities to enhance multi-sectional support, the situation of miss-cooperation has occurred many a times. Initiatives in this direction were not there because of absence of appropriate guideline and orientation.

4.4.2.5. Insufficient circulation of health services

The factors which are contributive to this deficiency are lack of effective referral and follow up system at all levels, insufficient co-operation of the officials involved in planning with those who provide health services and are responsible for proper utilization of all physical facilities in different geographical areas.

4.4.2.6. Problems in management system

The management of health services suffer antiquate bureaucratic system which was appropriate for a small establishment. Regular delay in project works with not properly conceived projects, lack of effective cooperation between the executive agencies and construction agencies resulted in insufficient service delivery. The lack of proper delegation of authority as well as accountability had created confusion in the management of public sector health service delivery system. For the shortage of required supplies in health complexes, hospitals and health persons, the system is run inefficiently.

4.4.2.7. Cost sharing

Hospital based health care is usually most expensive. These services were made available almost free of cost. These systems seriously constrained expansion and

further development of public health care system. Besides, lack of cost sharing led it over use of services by the privileged groups.

4.4.2.8. Health services and its frustrating quality

Because of too much private practice by medical personnel, insufficient diagnostic facilities at the laboratories, ineffective referral and follow up system at all levels, inadequate supply of support facilities and medicines, the health services quality has become a matter of concern.

The changing patterns of health care from a predominantly public sector dominated system to one where the private sector is becoming increasingly important. This picture has clearly been shown in this assignment. So, the total health sector poses newer challenges to health service management. These ongoing challenges in our country call for a closer look at the role of the private sector in the overall national health development strategies. Therefore, the issues of what makes for an appropriate mix of public and private sectors in the provisions and financing of health care managers and planners are important for health policy formulation. This need will continue to grow in Bangladesh. The growth of private sector does not diminish the importance of the state and the public sector as formulator of national health policy regulator of health acre services and provider of such services. It is important to consider changes in the conventional role of the state and endow it with an even more critical and essential role. What will be necessary in the coming decades is for health policy makers, planners and managers to look objectively at the needs of preventive and curative services. They will need to carefully determine the complementary roles of the private and public sectors in the given milieu and harmonize their respective advantages using a realistic mixture of incentives, controls and other policy instruments. The health care system has suffered from poor management from the

beginning. The public hospitals have been traditionally poor in management skills because they are operated on a budgetary allocation break-even basis in which charges are not designed to meet all the expenses. Clinical laboratories perform a large proportion of the diagnostic tests necessary for the diagnosis and treatment of patients on a full cost basis. The timeliness and accuracy with which tests are performed and reports given also need proper management approach (J H U Brown, 1984).

4.5. Diagnostic Service Facilities in Bangladesh

4.5.1. Diagnostic service in public health sector

Diagnostic service in public sector is available in government hospitals. However, in most cases it is inadequate as identified by the HPSS, 1997. All government medical college hospitals have establishment for laboratory services and radiology departments. Although X-ray and ECG facilities are available in all, ultrasonography, echocardiography, CT scan, MRI, and other modern investigation facilities are only available in medical colleges in Dhaka City. Laboratory service is also not adequate all district hospital. Biochemistry analyzer or an enzyme immunoassay reader, which is basic equipment today is only available in the medical university. Routine investigations like stool, urine and blood examination facilities are also inadequate and irregular in government hospitals other than medical colleges. In district level or Thana level hospitals, radiology services like X-ray and ECG facilities are available, however, available laboratory service is minimum. In union sub-centers, the diagnostic service is almost absent in most instances.

In 1986, there were 1027 health laboratory technologists of seven categories i.e. laboratory, radiology, pharmacy, blood bank, radiotherapy, physiotherapy and

occupational therapy. However, most of them had been working in the teaching or referral hospitals. If as envisaged, technologists are to be posted at the union level, the requirement will be at least 4500, for which the annual intake should be more at the two paramedical institutes (Experience With Economic Reform, 1995).

4.5.1.1. Beneficiary report on Diagnostic Service in Bangladesh

As evident in the following *(Table 4.2),* from the viewpoint of beneficiaries, the physical facilities for overall *Diagnostic Health Service* in Bangladesh have improved in the specialized hospitals and the Thana health complexes followed by the rural dispensaries. But it has clearly indicated the negligence of the health care facilities outside the metropolitan cities (Growth or Stagnation? A review of Bangladesh's Development, UPL, 1996). Trained medical personnel have been available in teaching hospitals, specialized hospital, district hospitals and rural dispensaries or in THCs but not in the FWCs. Availability of diagnostic equipment has markedly increased in the THCs and DHs but seems to have deteriorated in the rural dispensaries. The use of diagnostic equipment seems to have increased in the district hospitals and THCs more than the others. In interpreting these perceptions one should realize that small improvement in the THCs and DHs are perceived to be of relatively greater significance than improvements in the SH and TH (Growth or Stagnation? A review of Bangladesh's Development, UPL, 1996).

❖ **Table 4.2 Diagnostic facilities in Bangladesh according to beneficiaries perception**

Indicator	FWC		RD		THC		DH		SH		TH	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Physical facility	47	41	61	51	70	60	42	39	86	73	47	43
Trained med. person	55	45	82	68	66	53	96	73	62	77	73	71
Support personnel	44	40	53	57	80	57	80	65	38	31	55	57
Diagnostic equip	47	43	13	7	84	71	80	70	55	65	49	51
Diag equip increase	48	44	25	10	83	69	81	73	52	63	49	50

FWC: Family Welfare Center, RD: Rural Dispensary, THC: Thana Health Complex, DH: District Hospital, SH: Specialized Hospital, TH: Teaching Hospital
1st survey was carried out in September 1995 and 2nd was in April 1996.
Source: Growth or Stagnation? A Review of Bangladesh's Development, UPL, 1996, p-363

Services indicators at District and THC hospitals

According to the beneficiary perception *(Table 4.3)*, 69-72% considered that availability and use of diagnostic equipment has increased and the maintenance of basic equipment is better than before. 83% thought that equipment are being well maintained but more diagnostic equipment at these hospitals are needed and should be used when possible (Growth or Stagnation? A review of Bangladesh's Development, UPL., 1996).

The following are the diagnostic service indicators in district and THCs hospitals:

❖ **Table 4.3 Diagnostic service indicators in district and THC hospitals**

Service indicators	*Average Annual Number*	
	1990	1995
Average Laboratory Investigation (DH)	9333	8711
Average Laboratory Investigation (THC)	5310	6102
Average no of X-rays taken	2009	4604
Average no of ECGs Taken	150	250

Source: Growth or Stagnation? A review of Bangladesh's development, 1996, p-368

Diagnostic and logistic support in THC

As stated in the following *(Table 4.4)*, storage facilities seem to be generally satisfactory in most places except for X-ray films and drugs. In THCs, either a support facility is non-existent or it is made inoperative due to lack of supply of complementary materials or lack of personnel (Growth or Stagnation? A review of Bangladesh's Development, 1996).

❖ **Table 4.4 Diagnostic and Logistic Supports in TH hospitals**

Services	*TH1*	*TH2*	*TH3*
Pathological lab	Exist but equipment not in order	Exist but technicians absent	Exist but shortage of reagents and chemicals
Reag and Chemical	Inadeq. but approp	Adeq and approp	Adeq and approp
X-ray Unit	Exist but competent technician absent	Exist but machine not in order	Exist but chemical and film not in supply
X-ray Films	Inadeq but approp	Inadeq but approp	Inadeq inapprop

TH: Thana health complex hospital, Reag; reagents, Inadeq: inadequate, Adeq: adequate, Approp: appropriate, Source: Growth or Stagnation? A review of Bangladesh's development, UPL, 1996, p-372-373

Status of Diagnostic Service Indicators at THCs

The status of the various service indicators is shown in the *(Table 4.5)* below. These indicate that the physical facilities were found to be good in all the THCs surveyed whereas the availability of diagnostic equipment was found to be average. These indicate that there is considerable scope for improvement in health care services without much additional investment of resources in man and materials (Growth or Stagnation? A review of Bangladesh's Development, UPL, 1996).

❖ **Table 4.5 Status of various service indicators in THCs**

Indicators	*THC1*	*THC2*	*THC3*	*THC4*
Physical facilities	Good	Good	Good	Good
Diagnostic equipment	Good	Average	Average	Poor
Availability of technical personnel	Good	Good	Good	Good
Quality of service	Average	Average	Below aver	Poor
Satisfaction with service	Moderate	Moderate	Moderate	Moderate
Maintenance of equipment	Poor	Poor	Poor	Poor
Regularity of service	Good	Good	Poor	Poor

Source: Growth or Stagnation? A review of Bangladesh's development, UPL, 1996p-374

Management and Supply of Diagnostic Materials in DH and THCs

The health providers indicated that diagnostic investigations tended on average to be less than is needed. The health providers were of the opinion that the supply of X-ray films and laboratory reagents were irregular. The health providers felt that additional diagnostic facilities were needed, particularly Biochemical, Serological as well as Bacteriological investigations. The overall opinion was that laboratory facilities at

Thana level were poor and the management of the supply of X-ray films and laboratory reagents needed augmentation for matching supply with needs. In addition, it was reported that the pathological laboratory was under-utilized due to lack of inclination of doctors and lack of the willingness of the paramedics who make better use of the facilities outside the health complexes. As the clinical pathological laboratory plays a vital role in diagnosis and treatment of patients, it need to be properly staffed with technicians, biochemists etc. and adequately equipped with reagents, chemicals and equipment and it must have a proper record keeping system and validation process. It was the opinion of the health service providers that the existing resources, including equipment, reagents-, budgetary allocation, manpower and investigation facilities were highly inadequate for this facility. Storage facilities seem to be generally satisfactory in most places except for X-ray films and drugs. It is evident that the THCs either lack a support facility or the facility is made inoperative due to lack of supply of complementary materials or lack of personnel (Growth or Stagnation? A review of Bangladesh's Development, 1996).

4.5.2. Institution-based Diagnostic laboratory service

There has been notable expansion in the number and availability of health service institution since 1972. There are 13 medical colleges located in different part of the country- Dhaka, Mymensingh, Chittagong, Comilla, Sylhet, Rajshahi, Rangpur, Dinajpur, Bogra, Faridpur, Khulna, Barishal. Medical college hospitals and a central public health laboratory service provide specialized and reference laboratory support. In Dhaka City, institution based hospitals in public sector which are well equipped with diagnostic facility are DMC, SSMC, NICVD, IDCH, and IEDCR. There are also several institutions of excellence, namely NIPSOM, Institute of Public Health (IPH),

and BSMMU in government sector and the ICDDR, B, and BIRDEM in non-government sector. Other non-government hospitals in Dhaka City supported with laboratory facilities are Holy Family Red Crescent Hospital, Ibne Sina, Central Hospital and private medical college hospitals. All these institutions have well-developed laboratory facilities for service, training and research. However, in most of other public hospitals, the state of laboratory infrastructure is weak and inadequate. There is a need to develop and strengthen the laboratory infrastructure, particularly at the peripheral levels, as an essential component of health infrastructure development.

4.5.3. Diagnostic laboratory service in private sector

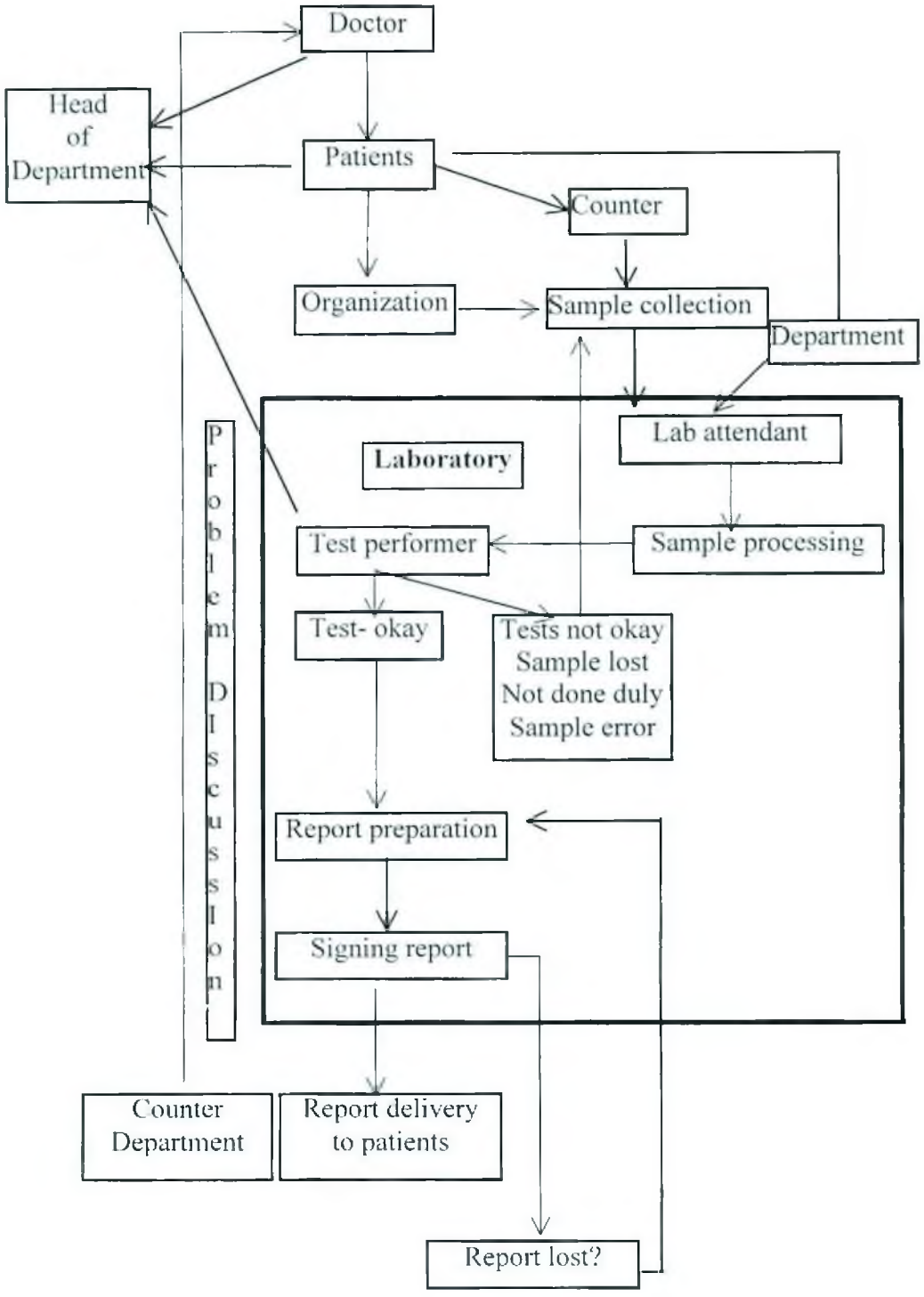
The deficiency in diagnostic service in public sector is partially supported by the development of diagnostic centers under private entrepreneurship. The private diagnostic centers have been initiated mainly in the big cities. A major problem in the private diagnostic center is the high cost for diagnostic investigations. In recent years, there have been introduction of many newer investigation facilities in private sectors, compared to the public sector. In metropolitan cities, in districts and in Thana s, private diagnostic centers have brought technological advancement far ahead of the public hospitals, which have resulted in ultimate dependency of the public hospital patients on expensive service from the private diagnostic centers. Unfortunately, due to lack of government initiatives, diagnostic facilities are not developing or are not being upgraded in public hospitals and due to lack of the proper management even the existing facilities are not properly maintained or optimally used.

4.5.3.1. Private diagnostic centers in Dhaka City

There are more than 100 private diagnostic centers in Dhaka City. Among them, about 11 laboratories have modern diagnostic facilities namely Popular Diagnostic Center, Lab-Aid, Medinova Medical Services, Compath Diagnostics, Comfort Diagnostics, Samorita Hospital, Modern Diagnostics, Mina Laboratory, Anannya Diagnostic Center, Microlaboratory, City Diagnostic Center and Central Hospital. These big diagnostic centers are well equipped with automated analyzers, X-ray, echocardiography, CT scan facilities. Most of these diagnostic centers are established in their own buildings and are registered as private limited companies. Among them, only Samorita, Comfort and Popular diagnostics have indoor patients' facility whereas others have only outdoor patients' diagnostic service facility. All the private diagnostic centers offer facility to private practicing doctors with chambers and other working facilities. The doctors practicing in private diagnostic centers are not only private practicing physicians but also clinicians and physicians from all major government institutes including academic and teaching institutes.

Existing service system in diagnostic centers in Dhaka City

The following is a schematic diagram of existing diagnostic service facility in common laboratories in Dhaka City.



4.6. Problems in diagnostic service in Bangladesh

There are many problems regarding the medical diagnostic service system in Bangladesh. A major problem mentioned earlier is overall diagnostic facility in our country is not yet modernized especially in the public sector and thus competition in providing services is limited. In private sector, newer techniques are available, however that is quite expensive for the average income group. Another problem is inadequate service facility available in the public hospitals. In addition to these, there is no guideline for the quality assurance and diagnostic laboratory management in our country. In a diagnostic center usually patients spent unnecessarily long time for registration, for investigation and even longer to get the reports. Moreover there is sample collection error, investigation error as well as reporting errors. All these limitations and problems compound to result in inaccurate test results and cause sufferings to the patients. Inaccurate test results can also cause serious harm to patients by leading the attending clinicians to erroneous decisions.

There may be many reasons for poor development of diagnostic facilities in our country. The major points identified in a recent report (DAB annual report 1994-95) are the followings:

Poor idea regarding the contribution of laboratories in clinical medicine

Generally there is a lack of awareness regarding the importance of a modern laboratory in clinical medicine, both amongst the public and the professional circles.

Low-tech medicine

In most of the cases, the medical practice in our country is still low technology-oriented. Consequently, support of laboratory investigations seems to be dispensable

in many of the situations. High-tech medicine usually demands a high quality laboratory service.

Poor infrastructure

Most of the diagnostic laboratories do not have proper or complete laboratory facilities and attendant infrastructure for providing one stop service.

Lack of expertise

Lack of expert personnel in the field of laboratory medicine due to inadequate facility for training of laboratory personnel and negligence of development of medical technology.

Lack of quality control

A good laboratory requires strict quality control, which has not yet been well appreciated in our country. Quality control not only protects against bias but also saves us from unintentional mistakes.

Added to this, the commercial motive of referring clinicians and the diagnostic laboratories may be responsible for disregarding quality in professional service.

5. Hypotheses

Laboratory services vary from organisation to organisation in quality of service, internal staffing, monitoring and supervision of laboratory activities as well as long-term planning, identification of barriers, assessment of patients' needs and responses. Quantification of laboratory services in terms of test costs and monthly income is difficult due to the variation in size and availability of facilities in various diagnostic service organisations. However, a relative assessment of population served, monthly income etc. can be compared among the organisations. On the other hand, internal activities of laboratories over quality, work-load, reporting problems, productivity, supervision and monitoring, patients' view about laboratory service etc. can be compared and there are not affected by the variation in size and extent of services provided.

The present work was designed to test the following hypotheses:

Hypothesis (1): *Doctors do not determine the laboratory where tests are to be done.*

Hypothesis (2): *Doctors send patients to different laboratories because they know about the quality of laboratories.*

Hypothesis (3): *Patients have no preference of laboratories for test purpose*

Hypothesis (4): *Quality of service is better government laboratories than BIRDEM and other private laboratories.*

Hypothesis (5): *Test cost is higher in private laboratories and BIRDEM than government laboratories.*

Hypothesis (6): *Sample collection is more satisfactory in BIRDEM and private laboratories than government institutions.*

Hypothesis (7): *Timely report delivery is better in private laboratories than*

government institution based laboratories.

Hypothesis (8): *Test problems are better discussed in private laboratories than BIRDEM and government institutes.*

Hypothesis (9): *Test problems are higher in government institutes than and private laboratories.*

Hypothesis (10): *Supervision of the internal activities and problem discussion are better in government laboratories than BIRDEM and private laboratories.*

Hypothesis (11): *Quality Control (QC) and test checking is better in BIRDEM and private laboratories than government institutes.*

Hypothesis (12): *Workload is more in government institute than BIRDEM and private laboratories.*

Hypothesis (13): *Precautionary measures for sampling and disposals are better in private laboratories than BIRDEM and government institutes.*

Hypothesis (14): *Government laboratories serve more population than BIRDEM and private laboratories.*

Hypothesis (15): *Central authority makes plan in government institutions than BIRDEM.*

Hypothesis (16): *Interdepartmental co-ordination is better in BIRDEM than government institutions and private laboratories.*

Hypothesis (17): *Monthly income varies among departments in private laboratories.*

6. Research Methodology

6.1. Population and sampling elements

The sampling units of this study were both institutional and private medical diagnostic laboratories in Dhaka City. *Institutional laboratories* studied were from government institutions i.e. DMCH and BSMMU, and from the non-government institution i.e. BIRDEM. *Private laboratories* studied were Popular Diagnostic Center, Laboratory-Aid, Medinova Medical Services, Compath Diagnostics, Comfort Diagnostics, Samorita Hospital, Modern Diagnostics, Mina Laboratory, Anannya Diagnostic Center, Microlaboratory, and City Diagnostic Center. Where available and applicable, data were collected on departmental basis as sub-unit of the study. Departments encompassed in the study were imaging, biochemistry, immunology/serology, microbiology, clinical pathology, histopathology and endocrinology. Study elements were grouped into three categories: patients, doctors (referring the patients to diagnostic centers), and laboratory personnel. Laboratory personnel were pathological sample collection attendants, laboratory attendants, test-performers, and departmental heads of the laboratories.

6.2. Respondent profile

Respondents of this study were practicing doctors who referred the patients to diagnostic laboratories for investigations, patients seeking advice and the laboratory personnel which includes sample collection attendant, laboratory attendant, test performer and head of the respective departments. A detailed respondent profile is described below.

6.2.1. Doctors

Total 196 doctors were interviewed during this study. Of 44 doctors included from government institutes, 20 were from DMCH and 24 from BSMMU. From non-government institute BIRDEM, 61 doctors were interviewed and from the doctors practicing at private diagnostic centers and private clinics, another 91 doctors were also included in this study. Referring doctors could be categorized on the basis of sex, level of education, field of specialty as shown below:

❖ **Table 6.1 Distribution of doctors on the basis of sex and level of education (N=196).**

Characteristics	Male n (%)	Female n(%)	Total n(%)
Level of education			
MBBS only (general)	71(46)	26(60)	97(50)
Specialization with postgraduate degree	46(30)	6(14)	52(26)
Specialization without postgraduate degree	36(24)	11(26)	47(24)
Total	153(100)	43(100)	196(100)
Employment status			
Govt. institute	39(25)	5(11)	44(22)
Non govt./private institute	71(46)	20(44)	91(46)
Autonomous	46(29)	20(44)	61(31)
Total	156(100)	40(100)	196(100)

(Percentages are over respective column total)

General practitioners were found to be mainly MBBS degree holders without post-graduation whereas doctors with postgraduate degrees (e.g. MD, FCPS, MRCP,

FRCS, FRCOG etc.) were involved in specialized field of medical practice (e.g. in the fields of internal medicine, surgery, gynecology, etc). However, many doctors were also found involved in specialized field of medicine without any postgraduate degree in respective field (specialized knowledge without postgraduate level of education) and a few with clinical research degrees (MPhil/ PhD) were also engaged in medical practice.

50% of the practicing doctors were general practitioners with MBBS degree only. The number of practicing female doctors was fewer than that of male doctors. Moreover, among doctors with specialization or specialized knowledge, only 14% were female. Numerically at all levels, male doctors were more predominant than female doctors.

6.2.2. Patients

Patients referred to different diagnostic laboratories by their doctors were surveyed to find out their views about laboratory services and specific problems. A total of 190 patients were included in this study. From government laboratories 77 (37 from DMCH and 40 from BSMMU), from BIRDEM 66 and from private diagnostic laboratories 47 patients were interviewed during this study. Respondent patients have been classified on the basis of occupation, age and monthly income. Modal patient profile was dominated by individuals in service, belonging to 30-40 year age group, and having an average family income of Tk.10, 000 per month.

❖ **Table 6.2 Distribution of patients on the basis of age, sex, occupation and family income (N=190)**

Characteristics	Male n(%)	Female n(%)	Total n (%)
Age (yr.)			
<20	10 (8)	2 (3)	12 (6)
20-30	17 (14)	20 (28)	37 (19)
31-40	42 (35)	21 (30)	63 (33)
41-50	22 (18)	21 (30)	43 (23)
>50	28 (24)	7 (10)	35 (18)
Total	119 (100)	71 (100)	190 (100)
Occupation			
Business	19 (17)	1 (1)	20 (11)
Service	53 (46)	25 (33)	78 (41)
Student	12 (11)	12 (16)	24 (13)
Housewife	0	37 (49)	37 (19)
Others	30 (26)	1 (1)	31 (16)
Total	114 (100)	76 (100)	190 (100)
Family Income Range (Tk)			
< 5000	11 (9)	4 (6)	15 (8)
5000-10000	60 (51)	225 (31)	82 (43)
10000-15000	7 (6)	4 (6)	11 (6)
15000-20000	17 (14)	25 (35)	42 (22)
> 20000	23 (19)	17 (24)	41 (21)
Total	118 (100)	72 (100)	190 (100)

(Percentages are shown over respective column total)

As shown in the *(Table 6.2)* we have classified patients' occupation in four major categories-business, service, student, housewife, and the remaining as others. Out of 190 patients, 41% were in service, 19% were housewife, 11% had business as

occupation, and 13% were student. Majority of male patients was service holders whereas majority of females were housewife.

The middle aged (30-40 yr.) patients were predominant compared to other age groups irrespective of sex. This age group is either particularly vulnerable to different diseases or more conscious about health problems or had better access to health care facility. Patients were also observed among older age group (above 40 yr.) perhaps because they need medical attention due to increased morbidity.

Most of the patients (both male and female) have family income (personal as well as) ranging from Tk.5, 000 to Tk.10, 000. The highest frequency of the respondent were dependent, those who had no income were females who are mostly housewives. There was no female patient earning within the income level of Tk.20000 or more. The patient who had no income they actually depended on the family income for treatment. Within the dependent there were three categories of respondents- student, housewife and older people. Therefore, family income was important in health care. As shown in the table, 43% of the patients had their monthly income level in Tk.5000-10000 group, 22% had their income level in Tk.15000-20000 and 21% patients had their income level above Tk.20000.

6.2.3. Laboratory personnel

Individuals involved in sample collection, processing, test performance, reporting, supervisors, head of the departments or laboratory were included in this group.

Sample Collection Attendants

This group of laboratory personnel included medical technologists and technicians responsible for collection of pathological samples (blood, urine, swab, scraping etc) from the patients as prescribed by the referring doctors. In radiology/imaging section, equivalent attendants were responsible for registration and pre-investigation preparation of the patients. Eighty-nine sample collection attendants were interviewed for this study. From government institutes 20 (15 from DMCH and 5 from BSMMU), from BIRDEM 33 and from private diagnostic centers 36 sample collection attendants were included in this study. Sample collection attendants could be categorized on the basis of age and education as shown below:

❖ **Table 6.3 Distribution of sample collection attendants on the basis of age, sex, level of education (N=89).**

Characteristics	Male n (%)	Female n (%)	Total n (%)
Age (yr.)			
20-30	42 (56)	8(57)	50(56)
31-40	19 (25)	6 (43)	25 (28)
41-50	12 (16)	0	12 (13)
>50	2 (3)	0	2(2)
Total	75(100)	14(100)	89(100)
Education			
Below SSC	11(15)	0	11(12)
SSC-HSC	46(61)	10(71)	56(63)
Diploma/Training	10(13)	2(14)	12(13)
Graduation	7(9)	2(14)	9(10)
Masters degree	1(2)	0	1(1)
Total	75 (100)	14(100)	89(100)

(Percentages are shown over respective column total)

Modal sample collection personnel were of 20-30 yr. age. Both male and female, were involved in similar type of job, however, female attendants were mainly involved in sample collection from female patients. Overall 63% of the sample collecting attendants had HSC level of education. About 15% of the male as well as female attendants had also additional diploma or training for this job and only one attendant was found to have education at postgraduate level.

Laboratory Attendants

Laboratory attendants (laboratory attendants) were the trained personnel in the laboratories responsible for processing and preservation of the collected pathological samples before the tests are performed. In radiology/imaging section, equivalent personnel were technicians involved in processing, developing and printing images. From the laboratories of government institutes, 36 laboratory attendants were included, 25 from different departments of DMCH and 11 from BSMMU. From BIRDEM, 35 laboratory attendants and from the private diagnostic centers, another 39 laboratory attendants were included in this study.

Laboratory attendants were also categorized on the basis of age, sex and education as shown below:

❖ **Table 6.4 Distribution of laboratory attendants on the basis of age, sex, level of education (N=97).**

Characteristics	Male n (%)	Female n (%)	Total n (%)
Age (yr.)			
20-30	35(42)	9(69)	44(45)
31-40	27(32)	4(31)	31(32)
41-50	20(24)	0	20(21)
>50	2(2)	0	2(2)
Total	84(100)	13(100)	97(100)
Education			
Below SSC	9(11)	0	9(9)
SSC-HSC	40(48)	10(71)	50(52)
Training & diploma	17(20)	1(7)	18(19)
Medical technologist	7(8)	2(14)	9(9)
Graduate	7(8)	0	7(7)
Master degree	3(4)	1(7)	4(4)
Total	83(100)	14(100)	97(100)

(Percentages are over respective column total)

The predominant age group was 20-30 yr. and male laboratory attendants were more in number than female laboratory attendants. The mode education of laboratory attendants was HSC. Training and diploma were obtained by 31% of the laboratory attendants and amongst them male were also predominant. There were only a few laboratory attendants with graduation (7%) or postgraduate (4%) degrees.

Test Performer

A total of 146 test performers were included in this study. They were medical technologists and laboratory scientific officers directly involved in performing the diagnostic investigations. In radiology/imaging section, test performer equivalents were the radiographers and radiologists. From government institutes, 30 (20 from DMCH and 10 from BSMMU), from BIRDEM 34, and from private diagnostic centers, another 82 test performers were included in this study. The test performers were also classified on the basis of age and education as shown below:

❖ **Table 6.5 Distribution of test performers on the basis of age, sex, level of education (N=146).**

Characteristics	**Male** n (%)	**Female** n (%)	**Total** n (%)
Age(yr.)			
20-30	48(46)	3(17)	51(35)
31-40	46(44)	10(56)	56(38)
41-50	24(23)	5(28)	29(20)
>50	10(10)	0	10(7)
Total	104(100)	18(100)	146(100)
Education			
SSC/HSC/Diploma/Training	54(42)	4(22)	58(40)
BA/B.Sc./MSc	19(15)	2(11)	21(14)
MBBS	16(13)	5(28)	21(14)
MBBS with diploma and training	8(6)	2(11)	10(7)
M Phil/PhD	11(9)	2(11)	13(9)
Specialization (MCPS, DCM, PGT)	20(16)	3(17)	23(16)
Total	128(100)	18(100)	146(100)

(Percentages are shown over respective column total)

Overall 40% were in 30-40 year age group. In most cases, the educational qualification of the test performers was diploma or training (35%) followed by MBBS doctors (33%) and postgraduate education completes in related discipline (11%). As to be expected, the overall academic qualification of the test performers was much higher than that of sample collecting or sample processing personnel.

Supervisors, head of the departments and head of laboratories

Head of a diagnostic department or a diagnostic laboratory was also interviewed for this study to evaluate the management in different type of organizations. Out of 12 diagnostic departments in government institutes (5 in DMCH and 7 in BSMMU), head of 9 different departments (4 of DMCH and 5 of BSMMU) and of 7 diagnostic departments in BIRDEM, heads from 6 departments were included in this study. In case of private laboratories, the overall laboratory-head from four laboratories was also included. Their demographic and educational attributes are shown below:

❖ **Table 6.6 Distribution of head of the departments on the basis of age, sex, level of education (N=20).**

Characteristics	Male n (%)	Female n (%)	Total n (%)
Age (yr.)			
30-40	3(17)	1(50)	4(20)
41-50	9(50)	1(50)	10(50)
>50	6(33)	0	6(30)
Total	18(100)	2(100)	20(100)
Education			
Masters degree	4(22)	0	4(20)
MBBS	2(11)	0	2(10)
M.Phill & PhD	5(28)	1(50)	6(30)
Specialization (DMRD/MRCR/FCPS)	7(39)	1(50)	8(40)
Total	18(100)	2(100)	20(100)

(Percentages are shown over respective column total)

Majority (80%) of the supervisory personnel in the diagnostic laboratory departments were above 40 years of age. In most cases, a laboratory head or supervisor was found to be male. MBBS, M.Phil/PhD or other specialization in respective basic sciences was common educational qualification of the departmental heads.

6.3. Elements of particular interest

From referring doctors, it was intended to investigate reasons for preparing certain types of diagnostic laboratory i.e. quality of laboratory service, quality of diagnostic tests, and clinical correlation with laboratory reports. From the patient's point of view with respect of quality of services, we planned to find out the problems faced by them at different type of laboratories regarding pre-investigation (registration, sample collection, advice about specific preparation etc) and post-investigation services (report delivery, presentation of reports, explaining queries about reports or problems etc). To find out the management problems in the diagnostic laboratories, from laboratory personnel, it was designed to evaluate test loads, problems in the working place, particularly with respect to sample collection and laboratory waste disposal problems and reporting problems. From the departmental heads, we intended to find out and compare the long-term objectives, planning, demand estimation, identification of barriers, productivity and training needs, cost of maintenance of laboratories, cost of tests and income generation, and finally, the longitudinal assessment of services to patients by organizations and departments.

6.4. Sampling frame and design

Sampling frame in this study utilized all the service providers of diagnostic institutions and private laboratories e.g. departmental heads, test performers, laboratory attendants and sample collecting attendants, patients attending the individual laboratories or departments, and the doctors referring the patients to different laboratories. The method of sampling used was stratified random sampling by separating the population into non-overlapping groups of elements (called strata) and selecting a random sample from each stratum.

6.5. Organizations included in the study

A. Government institutions

Dhaka Medical College Hospital (DMCH)

Dhaka Medical College Hospital is the largest public hospital in Bangladesh. It was established in 1946 and at present the number of beds in DMCH is about 1200 and the total number of working personnel is 1620. Dhaka Medical College Hospital is playing a key role in health care delivery services in Bangladesh. From all over the country, patients are referred to DMCH for treatment. In out-door services, patients are attended by duty physicians and selected cases are admitted for indoor health care.

The diagnostic laboratory service in DMCH has clinical pathology (routine pathology and hematology), biochemistry, histopathology, microbiology (bacteriology, parasitology and immunology) and endocrinology (nuclear medicine) service sections. The radiology and imaging section offers X-ray, ECG, ultrasonography, echocardiography, endoscopy and radioisotope scanning (nuclear medicine) facilities.

Bangabandhu Sheikh Mujib Medical University (BSMMU)

Former Institute of Postgraduate Medicine and Research (IPGM&R) was renamed to BSMMU in April 1998. It is a government supported autonomous institution. At present the number of beds in BSMMU are about 1000, and the total number of working personnel is 1300. It provides many types of medical services through out-door and indoor services.

The diagnostic sector of BSMMU has clinical pathology, histopathology, microbiology (bacteriology, parasitology and immunology), virology, biochemistry, and endocrinology (nuclear medicine) sections. The radiology and imaging section offers X-ray, ECG, ultrasonography, echocardiography, endoscopy, MRI, and radionuclide scanning (nuclear medicine) facilities.

B. Non-government institute

Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM)

Diabetic Association of Bangladesh (DAB) is a government aided autonomous organization, established on 28 February 1956. DAB is a non-profit voluntary socio-medical service organization registered with the Ministry of Social Welfare under the society's registration act, 1860. BIRDEM is a project of DAB, working under the supervision of its national council. BIRDEM is the central institute of the association that is now taking care of the highest number of diabetic patients (around 190,000-registered patient in June 1998) in one center in the world. About 2500 diabetic patients attend its outpatient departments everyday and their basic diabetic care is provided free of cost. Realizing its potential, in 1982, World Health Organization

(WHO) recognized it as a collaborating center for developing community oriented program for diabetes prevention and control. It is the first of its kind outside Europe. Apart from the large outpatient component (which primarily serves diabetic patients) the institute has a 550-bedded hospital which is general in nature with priorities for the diabetic patients. The resources generated by selling hospital and investigation services to non-diabetic patients are used to provide free basic care to poor diabetic patients. As a tertiary hospital, BIRDEM also serves referred patients from other projects and branches of DAB as well as from other hospitals, clinics and practitioners in the country (DAB, annual report, 1997-98).

It is well acknowledged that BIRDEM is the technological leader in the field of medical diagnostics in Bangladesh. Diagnostic laboratory services offered in BIRDEM are clinical biochemistry, immunology, endocrinology, microbiology, and histopathology/ cytology. The radiology and imaging section has X-ray, ECG, ultrasonography, echocardiography and CT scan facilities.

C. Private Diagnostic Centers included in the Study

Laboratory management aspects were studied in Popular Diagnostic Center, LaboratoryAid, Medinova Medical Services, Compath Diagnostics, Comfort Diagnostics, Samorita Hospital, Modern Diagnostics, Mina Laboratory, Microlaboratory, and City Diagnostic Center. However, practicing doctors were also included from other private centers.

Popular Diagnostic Center (Dhanmondi)

It is biggest diagnostic center among the private diagnostic laboratories in Dhaka City, which was established in 1983. Total invested capital is Tk. 1 crore 20 lacs. Total number of employees working as full timer as well as part-timer is 300. In this private center, diagnostic sections are biochemistry & endocrinology, clinical pathology & histology, microbiology, and immunology. The radiology and imaging section offers X-ray, ECG, ETT, EEG, ultrasonography, echocardiography, endoscopy and CT scan services.

LaboratoryAid (Green Road)

It is one of the modernized diagnostic centers in Dhaka. It started its services in 1985 and at present it has fixed capital of about Tk. 1 crore. Working manpower in this diagnostic center is 250, which includes both full-timers and part timers. This laboratory supports the highest number of private practicing doctors in Dhaka City. Its laboratory section includes biochemistry, clinical pathology, histology, hematology, microbiology, serology and endocrinology. The radiology and imaging section of LaboratoryAid has X-ray, ECG, ultrasonography, echocardiography, and CT scan facilities. In addition, it is only private diagnostic center that offers radionuclide imaging facilities.

Medinova Medical Services (Satmasjid Road)

Medinova started operation in diagnostic sector in 1992 and now it is one of the biggest laboratories in Dhaka City with a fixed capital of approximately Tk.1 crore. A total of 250 working personnel include both part-timers and full timers. In private sector this laboratory started its major operation in the field of radiology and imaging

with CT scan facilities. Now it has extended its facilities to all fields of laboratory medicine including biochemistry, clinical pathology, microbiology and serology.

Compath Diagnostic Center (Elephant Road)

Compath limited was established in 1988 as a private limited company. Its early initiative was in the diagnostic and pathological sector, it was one of the most prestigious and prosperous diagnostic complex in Dhaka City. Total invested capital is Tk.70 lacs. Total number of employees working as full timer as well as part-timer is 150 in number. Various laboratory tests are performed here including microbiology, biochemistry, serology, and pathology. X-ray, ECG, ultrasonography, and CT scan are also performed in the radiology and imaging section.

Comfort Diagnostic Center (Green Road)

It is a big diagnostic center in Dhaka City, which was established in1993. Total capital invested is Tk. 80 lacs. Total number of employees working as part-timer as well as full timer is 200 in number. In addition to its pathological services, Comfort has also indoor hospital services in the same building. Various clinical laboratory tests are performed in biochemistry, pathology, microbiology, and immunology sections and the radiology section offers X-ray, ECG, ultrasonography, echocardiography and endoscopy services.

Samorita Hospital (Panthapath)

It is a private hospital having 250 bed with diagnostic facilities and it was established in 1989. Total invested capital is 20 crore Tk. It has both indoor and out door facilities. Total number of employees working as full timer as well as part-timer is

275. The major sections of Samorita hospital are outpatient department & clinic, diagnostic pathology, radiology and imaging. The pathology section provides laboratory investigation facilities, including clinical pathology, biochemistry, immunology, and microbiology. The radiology and imaging section provides X-ray, ECG, echocardiography, ultrasonography, CT scan and endoscopy facilities.

Modern Diagnostics (Fakirapool)

This is one of the newly established big diagnostic center in Dhaka City. It has a fixed capital of about 1 crore Taka and 200 working personnel on part time and full time basis. Initially it opened its operation in the field of health screening for foreign bound manpower. Latter it has expanded its diagnostic facilities in all the fields. Its laboratory medicine department has biochemistry, microbiology, serology and clinical pathology services whereas the radiology and imaging section has X-ray, ECG, ultrasonography, echocardiography and CT scan facilities.

Mina Laboratory (Elephant Road)

It is a private diagnostic center in Dhaka City, which was established in1991. Total fixed capital is 80 lac taka. Total number of employees working as part-timer as well as full timer is 45. The main objective of the center is to provide quality service to the patients, laboratory section offers biochemistry, microbiology and immunology services and the radiology section provides X-ray, ECG, ultrasonography and endoscopy facilities.

Microlaboratory (Kallyanpur)

This mid level private diagnostic center was established in 1992 with a capital of Tk.36 lac. As full-timer or part-timer, total 35 employees are working in this center. The main objective of the center is to provide modern diagnostic services to the patients at low cost. Laboratory tests are performed in biochemistry, microbiology and clinical pathology sections, and whereas the radiology service includes X-ray, ECG, and ultrasonography.

City Diagnostic Center (Dhanmondi)

This private diagnostic center is one of the oldest diagnostic center in Dhaka City. It was established in 1970 and at present has a fixed capital of Tk. 45 lac. It has 38 working personnel on full- time or part-time basis. The diagnostic center has a radiology and imaging section with X-ray, ECG and ultrasonography facility whereas laboratory section has biochemistry, microbiology and serology section.

6.6. Size of the sample

Although the sample units of the study were heterogeneous in nature, they were considered homogenous in terms of each stratum. The samples were determined on the basis of non-probability and probability design e.g. quota sampling →stratified cluster sampling→ judgement/convenience sampling. First the population was classified into three categories as government institutions, non-government institution and private laboratories. From these categories, leading institutes or laboratories were selected with judgement that they represented the desired population. The service providers (doctors or laboratory personnel) as well as the beneficiaries (patients) were selected randomly from each sampling unit. Each stratum was formed from sampling

units and collected information interviewing a sub sample from each group. As shown in the following table, a total of 196 doctors, 190 patients, and 352 laboratory personnel from DMCH, BSMMU, BIRDEM and private diagnostic centers were interviewed using preformatted questionnaires. Details about service providers of different organization, the referring doctors and the patients included in this study are discussed in the *Respondent Profile* section and a brief distribution of the respondents are shown below:

❖ **Table 6.7 Respondent distribution in different organizations**

Organizations	Doctors	Patients	SCA	LA	TP	Head	Total
Govt. Institute	44	77	20	36	30	7	214
Non-govt. Institute	61	66	33	22	34	7	223
Private Laboratories	91	47	36	39	82	6	301
Total	196	190	89	97	146	20	738

Govt. Institute: DMCH and BSMMU, Non-govt. Institute: BIRDEM, SCA: Sample Collection Attendants, LA: Laboratory Attendants, TP: Test Performers, Head: Head of the Departments/ Laboratories.

6.7. Data Collection and Analysis

6.7.1. Data sources

Data were collected from *primary* as well as from *secondary* sources. Primary data were collected interviewing the respondents administering preformatted questionnaire forms (Appendices-1). Whereas, secondary data were retrieval methods through searching bibliographies, indexes, journals or any printed documents available within or outside the organizations. As mentioned earlier, 196 referring physicians, 190 patients and 352 laboratory personnel including the head of the laboratory or departments, were the respondents of this study.

6.7.2. Pre-analytical Process:

i. *Data Editing:* Here data were edited according to whether data are primary, secondary or mixed. In this study data were mainly primary which were collected on a time continuum with the help of questionnaire method.

ii. *Element Development:* Variables of the study were- reasons for preferring a diagnostic laboratory by referring doctor or by the patient, quality of laboratory services, problems and errors in laboratory works, work load, safety measures of laboratory personnel, and management of the laboratories in different organization.

iii. *Data Coding:* Numerical codes were used for data entry, e.g.: 1= yes, 2=no. Most collection instruments were planned with the pre-designed coding.

iv. *Error Checking:* It was done in two ways; first it was ensured that all the pre-analytical steps had been performed correctly. Secondly, the coded data were re-checked visually for the detection of any clerical errors

6.7.3. Data Analysis:

All data are expressed in frequencies, percentages and mean ± SEM. Comparison between groups are done by Chi-square, Student's t-test and one-way ANOVA for more than two groups for tests of hypothesis. Longitudinal analysis for population served as well as departmental income and interaction between time and organizations were analysed by two-way ANOVA. P values less than 0.05 were considered as statistically significant.

7. Results

The overall performance of the diagnostic organizations can be assumed to a greater extent from the view of referring physicians and the patients receiving the laboratory service. In this section, the performances of various laboratories have been compared from the information collected from *referring physicians and patients*.

7.1. Views of referring physicians

❖ **Table-7.1. Patients referred by physicians to various laboratories**

Physicians Working in	Tests referred to labs			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
BIRDEM	13 (14.3)	40 (44.0)	38 (41.8)	49.663	0.000
Govt. Inst.	19 (70.4)	01 (3.7)	07 (25.9)		
Private	12 (15.6)	20 (26.0)	46 (58.4)		

(Analysis by chi-square test; within parenthesis are percentages)
(Govt. Inst.: government institute)

It was found (*Table-7.1.*) that majority (70%) of government physicians referred the diagnostic tests to the same government institutes but only 14% of BIRDEM physicians and 16% of private physicians referred tests to government institutes (p=0.000). On the other hand, 44% of BIRDEM physicians, 26% of private physicians and only 4% of government physicians advised tests are done at BIRDEM (p=0.000). However, it was remarkable that 26% of the government physicians as well as 42% of BIRDEM physicians were referring tests to be done in private diagnostic centers.

Reasons for such referral *(Table-7.2)* was indicated as higher rate of accuracy in respective laboratories (govt. institute vs. BIRDEM vs. private labs: 75% vs. 69% vs. 69%; p=0.750). Timely report delivery in private diagnostics was indicated by 73%

physicians (p=0.000). Preference of patients for BIRDEM or private laboratories were also indicated by 36% and 28% physicians respectively (p=0.003).

❖ **Table 7.2. Reasons behind referring patients to various laboratories**

Reasons for Referring	Organization				
	Govt. (%)	BIRDEM (%)	Private (%)	$\chi 2$	p
Report accuracy	33 (75.0)	42 (68.9)	63 (69.2)	0.577	0.750
Early delivery	23 (52.3)	21 (34.4)	66 (72.5)	21.871	0.000
Pt. Preference	03 (6.8)	22 (36.1)	25 (27.5)	11.851	0.003
Economical	18 (40.9)	19 (31.1)	07 (7.7)	22.646	0.000
Obliged to refer	0	21 (34.4)	01 (1.1)	47.881	0.000

(Analysis by chi-square test; within parenthesis are percentages) (Pt: patient)

As a reason for patient referral, 41% and 31% physicians also considered a comparatively lower test prices in government institutes and BIRDEM respectively (government institutes vs. BIRDEM vs. private labs = 41% vs. 31% vs. 8%; p=0.000). However, 34% of BIRDEM physicians mentioned that as per the instruction by the authority, they were obliged to refer diagnostic tests to BIRDEM labs.

Among the referring physicians *(Table 7.3.)*, 73% considered laboratory tests in government institutes to be good, 16% considered average, 9% considered excellent, but 2% considered the quality of test to be poor. Regarding BIRDEM, 56% considered good, 13% considered excellent and 31% average, and about the test quality in private laboratories, 60% evaluated it as good, 25% excellent and 14% average (p=0.015).

❖ **Table 7.3. Quality assessment of various laboratories by physicians**

Variable (s) Quality	Organization			χ2	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Excellent	4 (9.1)	8 (13.1)	23 (25.3)	15.833	0.015
Good	32 (72.7)	34 (55.7)	55 (60.4)		
Average	07 (15.9)	19 (31.1)	13 (14.3)		
Poor	1 (2.3)	0	0		

(Analysis by chi-square test; within parenthesis are percentages)

However, it is important to note that quality of specific laboratory techniques *(Table 7.4.)* for certain tests in government institutes, BIRDEM and private laboratories were known to 82%, 59%, and 76% of the physicians respectively (p=0.020). Although the level of clinical correlation was considered much higher in all the labs, (govt. institutes vs. BIRDEM vs. private labs: 98% vs. 90% vs. 99%; p=0.002), according to referring physicians, report variations were also quite high in all the laboratories (89% vs. 79% vs. 87%; p=0.281).

❖ **Table 7.4. Physicians view on technical quality, clinical correlation and variation**

Variable (s)	Organization			χ2	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Tech. Qual .known	36 (81.8)	36 (59.0)	69 (75.8)	7.854	0.020
Clinical correln.	43 (97.7)	55(90.2)	90 (98.9)	7.595	0.022
Report variation	39 (88.6)	48(78.7)	79 (86.8)	2.540	0.281

(Analysis by chi-square test; within parenthesis are percentages)
(Tech qual : technical quality; correln: correlation)

7.2. Factors related to patients

Majority of the patients included in this study were either service holders or housewives. Profession of patients who go to various diagnostic centers vary significantly (p=0.000). It was found that only a few businessmen going to government institutes and only a few students to BIRDEM *(Table 7.5)*.

❖ **Table 7.5.Profession and monthly income of patients**

Variable (s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Profession					
House wife	16 (20.8)	11 (16.7)	10 (21.3)	36.448	0.000
Service	35 (45.5)	27 (40.9)	16 (34.0)		
Businessman	2 (2.6)	10 (15.2)	5 (10.6)		
Student	10 (13.0)	2 (3.0)	12 (25.5)		
Others	14 (18.2)	16 (24.2)	4 (8.5)		
Monthly family income (Tk.)				36.624	0.000
<5,000	15 (19.5)	0	0		
5,001-10,000	49 (63.6)	26 (39.4)	7 (14.9)		
10,001-15,000	1 (1.3)	4 (6.1)	6 (12.8)		
15,001-20,000	9 (11.7)	13 (19.7)	20 (42.6)		
>20,000	3 (3.9)	23 (34.8)	14 (29.8)		

(Analysis by Chi-square test; within parenthesis are percentages)

Monthly income assessment revealed that majority of the patient fell under the group of monthly income of less than Tk.10, 000 *(Table 7.5)*. There was also a significant statistical difference for the income groups of patients among the various laboratories (p=0.000). It was found that high-income group rarely go to the diagnostic laboratories of government institutes.

There was a significant difference (p=0.000) in preference for specific diagnostic centers among the patients attending various labs (Table7.6). 77% of the patients attending private laboratories had no lab preference, which was 58% for the patients attending government institutes, while most of the patients (62%) attending BIRDEM

opined their preference for BIRDEM. About 29% patients attending government institutes, 14% of BIRDEM and 21% of private practitioners' chambers indicated their preference for private laboratories. 12% of patients from government institutes also indicated their preference for BIRDEM. However, patients rarely mentioned their preference for government laboratories.

❖ **Table7.6. Lab preference and ultimate selection of test centers by patients**

Variable (s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Lab preference					
None	45 (58.4)	14 (21.2)	36 (76.6)	71.908	0.000
BIRDEM	9 (11.7)	41 (62.1)	1 (2.1)		
Govt. laboratory	1 (1.3)	2 (3.0)	0		
Private	22 (28.6)	9 (13.6)	10 (21.3)		
Why a lab is chosen					
Consultant sent	65 (84.4)	31 (47.0)	39 (83.0)	29.141	0.000
On own choice	12 (15.6)	35 (53.0)	8 (17.0)		

(Analysis by chi-square test; within parenthesis are percentages)

Regarding the reason for attending any specific type of diagnostic center, it was found that 84% patients in government institutes and 83% in private diagnostic centers came to those labs on being advised by the consultants compared to 47% in BIRDEM, however, a good number of patients (53%) came to BIRDEM on their own choice (table-2b).

As judged by the patients *(Table 7.7.)*, quality of diagnostic service was excellent in 14%, good in 71% and poor in 8% events in BIRDEM, which were 7%, 56% and 35% in government institutes, whereas 11%, 72% and 6% in private labs (p=0.000). According to patients' opinion, overall frequency of good quality service was higher in BIRDEM and private diagnostic centers.

❖ **Table 7.7. Patients' view on service quality, problems encountered and test price in different laboratories**

Variable (s)	Organization			χ2	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Quality of service					
Excellent	5 (6.5)	9 (13.6)	5 (10.6)	33.115	0.000
Good	43 (55.8)	52 (78.8)	34 (72.3)		
Bad	27 (35.1)	5 (7.6)	3 (6.4)		
None	2 (2.6)	0	5 (10.6)		
Collection prob.	43 (55.8)	25 (37.9)	5 (10.6)	25.222	0.000
Misbehave	23 (29.9)	4 (6.1)	3 (6.4)	19.307	0.000
Irregularity	33 (42.9)	8 (12.1)	2 (4.3)	31.217	0.000
Loss of time	39 (50.6)	24 (35.3)	4 (8.5)	24.822	0.000
Lack of courtesy	21 (27.3)	2 (3.0)	3 (6.4)	20.501	0.000
Report deliv.prob.	44 (57.1)	4 (6.1)	5 (10.6)	55.351	0.000
Test price					
Very high	9 (11.7)	19 (28.8)	14 (29.8)	11.327	0.023
Considerably high	34 (44.2)	22 (33.3)	22 (46.8)		
Appropriate	34 (44.2)	25 (37.9)	11 (23.4)		

(Analysis by chi-square test; within parenthesis are percentages)
(deliv prob: delivery problem)

Regarding service problems encountered in diagnostic centers, problems during sample collection, misbehavior, irregularity, loss of time and lack of courtesy varied significantly (p=0.000) among the diagnostic organizations as stated by the patients. Collection problem was most frequent in government institutes (59%), followed by BIRDEM (38%) and only 11% mentioned about the private laboratories (p=0.000). However, a relatively higher number of patients (35.3%) also indicated the loss of time in BIRDEM during diagnostic processes. Price of laboratory investigations were considered appropriate by the patients in 37.9% cases for BIRDEM, 44.2% in government institutes and 23.4% in private laboratories *(Table 7.7)*. The rests fell into the groups of either considerably high or very high categories of test price (p=0.023). The frequency of very high test-price was lowest in government institutes (12%) compared to that in BIRDEM (29%) and private labs (30%).

7.3. Factors attributing to laboratory personnel practices:

Effective laboratory service is dependent on the activities of laboratory staff. Moreover, integrated efforts regarding maintenance of test quality, frequent checking of activities and technical skills of test performers and other subordinate staffs as well as periodic review of the overall drawbacks of the laboratory service is very important for improving the service system. Internal activities of different diagnostic organizations have been compared and analyzed in this section.

7.3.1. Factors attributable to sample collection attendants

Level of education *(Table 7.8)* was S.S.C/Diploma in most instances (government institutes vs. BIRDEM vs. private laboratories: 55% vs. 60% vs. 64%) followed by H.S.C and graduation. However, a small number were also in the group of below the S.S.C. level.

❖ **Table 7.8. Education and job experience of sample collection attendants**

Variable (s)	**Organization**			χ^2	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Education					
Diploma/SSC	12 (60.0)	18 (54.5)	23 (63.9)	8.667	0.371
HSC	4 (20.0)	5 (15.2)	6 (16.7)		
Below SSC	3 (15.0)	4 (12.1)	2 (5.6)		
Graduate	0	6 (18.2)	5 (13.9)		
Post graduate	1 (5.0)	0	0		
Experience (yr)	16.75±8.23	5.89±0.67	3.78±0.65	43.155	0.000

(Analysis by Chi-square test; within parenthesis are percentages)

There was no statistical difference for education level of the sample collection attendants among the laboratories (p=0.371). Working experience was highest in government institutes (16.8±8.2 yr), followed by BIRDEM (5.9±0.7 yr.) and private laboratories (3.8+0.7 yr.) (p=0.000).

All the sample collection attendants *(Table 7.9)* in government and private labs were found involved in regular sample collection compared to BIRDEM (p=0.000). Sample collection problems, as stated by sample collecting attendants were prevalent in about 39% instances in BIRDEM, 60% in government institutes and 8% in private laboratories (p=0.000).

❖ **Table 7.9. Sample collection problems, precautions and waste disposal**

Variable (s)	Organization			$\chi 2$	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Collection practice					
Regular	20 (100)	21 (63.4)	36 (100)		
Occasionally	0	12 (36.6)	0	29.724	0.000
Collection problems	12 (60.0)	13 (39.4)	3 (8.3)	17.448	0.000
Precautionary measures					
Both syr. + glov.	9 (45.0)	16 (48.5)	18 (50.0)		
Dis. syr. only	6 (30.0)	1 (3.0)	18 (50.0)		
Dis. gloves only	0	16 (48.5)	0	58.024	0.000
None	5 (25.0)	0	0		

(Analysis by Chi-square test; within parenthesis are percentages)

(syr: syringe, glov: gloves)

There was significant statistical difference among the laboratories for various modes of precautions taken during sample collection (p=0.000). Regarding the precautions practiced in government institutes, BIRDEM and private laboratories, 45%, 49%, and 50% of the sample collection attendants respectively mentioned about use of both disposable syringe and gloves or use of only disposable syringe by 30%, 3%, and 50%. Use of only disposable gloves was also mentioned by 49% of attendants in BIRDEM, however, 25% of the collection attendants in government institutes mentioned about availability of no precautionary measures.

7.3.2. Factors related to laboratory attendants

Most of the lab attendants in diagnostic centers *(Table 7.10)* were educated up to S.S.C level (govt. vs. BIRDEM vs. private: 42% vs 77% vs. 54%). However, a good number of lab attendants were below S.S.C level in government institutes (29%), while a good number had H.S.C or graduation in BIRDEM and private laboratories (p=0.002). Period of service of lab attendants were highest in government institutes (14.5±2yr) followed by BIRDEM (6.8±0.6) and private labs (4.4±0.6) (p=0.000).

❖ **Table 7.10. Qualification and experience of lab attendants in various organizations**

Variable(s)	Organization			$\chi 2$ or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Education					
Graduate	13 (36.1)	2 (9.1)	7 (17.9)	20.747	0.002
HSC	1 (2.8)	3 (13.6)	9 (23.1)		
SSC	15 (41.7)	17 (77.3)	21 (53.8)		
Below SSC	7 (29.4)	0	2 (5.1)		
Year of service	14.52±1.18	6.79±0.60	4.42±0.58	43.219	0.000

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables) (Within parenthesis are percentages)

About the sample collection errors *(Table 7.11)* in BIRDEM, 73% laboratory attendants indicated about the labelling error, 50% indicated about sample collection errors and 46% also indicated receipts mistakes which were 17%, 19%, and 11% in government institutes and 5.1%, 10%, and 5% respectively in private laboratories. These problems were not mutually exclusive. Statistical difference for all of these problems were significant (p ranging from 0.004 to 0.000) among the laboratories.

❖ **Table 7.11 Sample collection and report delivery problems in various laboratories**

Variable(s)	Organization			$\chi 2$ or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Collection problems					
Irregularity	4 (11.1)	7 (31.8)	1 (2.6)	11.188	0.004
Receipt mistake	4 (11.1)	10 (45.5)	2 (5.1)	17.811	0.000
Collect. error	7 (19.4)	11 (50.0)	4 (10.3)	13.011	0.001
Labeling error	6 (16.7)	16 (72.7)	2 (5.1)	36.523	0.000
Report problems					
Not in time	7 (19.4)	6 (27.3)	12 (30.8)	1.288	0.525
Deliv. mistake	2 (5.6)	11 (50.0)	12 (30.8)	14.950	0.001
Report lost	5 (13.9)	16 (72.7)	4 (10.3)	32.920	0.000
Test withheld	9 (25.0)	4 (18.2)	0	10.641	0.005
Disposal problems					
Dustbin	14 (38.9)	22 (100)	20 (51.3)	46.206	0.000
Wash in basin	7 (19.4)	0	0		
Burn	4 (11.1)	0	13 (33.3)		
Dustbin + burn	11 (30.5)	0	6 (15.4)		

(Analysis by Chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

Regarding the problem related to report delivery in BIRDEM, 73% of the laboratory attendants indicated that loss of report was the most frequent, followed by delivery mistakes (50%), mismatch of time (27%) and withholding of test (18%). These report delivery problems were 14%, 56%, 19% and 25% in government institutes, and 10%, 31% and 0%, in private laboratories, respectively. These problems are not mutually exclusive and the difference in report delivery problems among the laboratories were also statistically significant (lost report and delivery mistakes, p=0.000 for both and for test withholding, p=0.005).

These problems *(Table 7.12)* could be informed to authorities in all cases for private diagnostic labs, in 97% cases for government laboratories and in 81% in BIRDEM (p=0.006). In most cases, the responsible authority for complaining was either an immediate senior or the departmental head in all the laboratories with near equal frequencies (p=0.248).

❖ **Table 7.12 Complaining authority and discussion of problems in laboratories**

Variable(s)	Organization			$\chi 2$ or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Inform to Auth.	35 (97.2)	18 (81.1)	39 (100)	10.172	0.006
Central	1 (2.8)	0	1 (2.6)		
Immed. seniors	20 (55.6)	9 (40.9)	21 (53.8)		
Departmental head	14 (38.9)	9 (40.9)	16 (41.0)	7.872	0.248
None	1 (2.8)	4 (18.2)	1 (2.6)		
Discuss problem					
Monthly	0	4 (18.2)	0		
Fortnightly	22 (61.1)	5 (22.7)	8 (20.5)	29.038	0.000
Weekly	11 (30.6)	9 (40.9)	22 (56.4)		
None	3 (8.3)	4 (18.2)	9 (23.1)		

(Analysis by Chi-square test for non-parametric and one-way ANOVA for parametric variables) (Within parenthesis are percentages).

Problems encountered by lab attendants could be discussed with respective personnel more frequently in private laboratories followed by BIRDEM and government institutes (p=0.000). However, a small number of lab attendants in government institutes and private laboratories and about 18% in BIRDEM opined that the problems could not be discussed at all with their laboratory authorities.

Regarding *(Table 7.13)* the existing waste disposal practices, all of laboratory attendants in BIRDEM mentioned that waste was disposed into dustbin, which was 39% in government institutes and 51% in private laboratories. However, 31% of the attendants in government institutes and 15% in the private laboratories used both dustbin and burning whereas 11% and 33% mentioned by burning only; however, 19% of lab attendants in government institutes also mentioned about disposal of lab wastes in washing basins.

❖ **Table 7.13 Waste disposal practices in various laboratories**

Disposal method	**Organization**			**χ2 or F**	**p**
	Govt. (%)	BIRDEM (%)	Private (%)		
Dustbin	14 (38.9)	22 (100)	20 (51.3)	46.206	0.000
Wash in basin	7 (19.4)	0	0		
Burn	4 (11.1)	0	13 (33.3)		
Dustbin + burn	11 (30.5)	0	6 (15.4)		

(Analysis by Chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

7.3.3. Factors related to test performers

About *(Table 7.14)* 50% of the test performers in government were undergraduates, 37% were specialists, and 13% were post-graduates. These frequencies in BIRDEM were 32%, 5% and 50% and in private laboratories were 44%, 24%, and 31%, respectively (p=0.000). 13% of test performers in BIRDEM, and 1% in private labs were graduates.

❖ **Table 7.14 Qualification of test performers in various organizations**

Variable(s)	Organization			χ2 or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Qualification					
Specialist	11 (36.7)	02 (5.3)	21 (23.9)		
MBBS/MSc/Postgrad.	4 (13.3)	19 (50.0)	27 (30.7)		
Graduate	0	05 (13.2)	01 (1.1)	28.071	0.000
H.S.C	none	none	none		
S.S.C or Diploma	15 (50.0)	12 (31.6)	39 (44.3)		
Below SSC	none	none	none		

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

Number of samples tested *(Table 7.15)* by each laboratory personnel in each day was 22±3 in BIRDEM, 187±25 in government institutes and 107±9 in private laboratories (p=0.000). Among the test performers, 40% reported overload in government institutes, followed by only 5% in BIRDEM and 3% in private laboratories (p=0.000).

❖ **Table 7.15 Workload of test performers in various organizations**

Variable(s)	Organization			χ2 or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
No of tests done	187±25	22±3	107±9	27.089	0.000
Load of tests					
Overload	12 (40.0)	02 (5.3)	3 (3.4)	32.492	0.000
appropriate	18 (60.0)	30 (78.9)	80 (90.9)	14.842	0.001
Less	0	04 (10.5)	06 (6.8)	3.152	0.207

(Analysis by Chi-square test for non-parametric and one-way ANOVA for parametric variables) (Within parenthesis are percentages)

However, 79% of the test performers in BIRDEM stated that workload was appropriate to the capacity, while 60% in government institutes and 91% in private laboratories (p=0.001) were of that opinion.

Quite a high number of test performers stated *(Table 7.16)* about various problems in performing tests (govt. institutes vs. BIRDEM vs. private laboratory: 100%vs. 90% vs.77%; p=0.007). Sampling errors were 70% vs. 82% vs. 66% (p=0.208)

respectively; space problem: 47% vs. 55% vs. 9% (p=0.000); environment problems: 80% vs. 45% vs. 9% (p=0.000); administrative problems: 77% vs. 32% vs. 14% (p=0.000); instrumental problems: 87% vs. 61% vs. 34% (p=0.000) and reagents problems were 67% vs. 42% vs. 68% (p=0.000) respectively. Overall sampling error, space and instrumental problems were main difficulties in BIRDEM, while sampling error and reagent problems were major difficulties in private laboratories whereas all the problems were prevalent at higher frequencies in government laboratories.

❖ **Table 7.16 Test checking, signing and test problems in laboratories**

Variable(s)	Organization			χ2 or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Problems of tests	30 (100.0)	34 (89.5)	68 (77.3)	9.788	0.007
Sample error	21 (70.0)	31 (81.6)	58 (65.9)	3.139	0.208
Space	14 (46.7)	21 (55.3)	08 (9.1)	35.126	0.000
Environment	24 (80.0)	17 (44.7)	08 (9.1)	56.356	0.000
Administrative	23 (76.7)	12 (31.6)	12 (13.6)	42.273	0.000
Instrumental	26 (86.7)	23 (60.5)	30 (34.1)	26.705	0.000
Reagent	20 (66.7)	16 (42.1)	21 (66.7)	18.348	0.000

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

Quality of laboratory investigations *(Table 7.17)* was checked by the respective head of departments in 94% cases of private laboratories compared to 43% in government institutes and 24% in BIRDEM. In later two types of laboratories, tests were checked

by immediate senior laboratory personnel (govt. institutes: 57%; BIRDEM: 53%). In most cases, reports were signed by postgraduates in the private laboratories (94%) and government institutes (83%), whereas that was only 58% in BIRDEM; while 37% test reports were signed by graduates in BIRDEM compared to only 17% in government institutes and 6% in private laboratories (p=0.000).

❖ **Table 7.17 Test checking and signing practices in the diagnostic laboratories**

Variable(s)	Organization			χ2 or F	p
	BIRDEM (%)	Govt. (%)	Private (%)		
Test checker					
Head of dept.	13 (43.3)	09 (23.7)	83 (94.3)	81.705	0.000
Immed. seniors	17 (56.7)	20 (52.6)	02 (2.3)		
Colleagues	0	09 (23.7)	03 (3.4)		
Test signer					
Postgraduate	25 (83.3)	22 (57.9)	83 (94.3)	27.225	0.000
Graduate	05 (16.7)	14 (36.8)	05 (5.7)		
Others	0	02 (5.3)	0		

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

Frequency of checking *(Table 7.18)* the works of test performers in private laboratories were weekly in most cases (65%). Whereas it was daily (68%) in BIRDEM while monthly in government institutes (50%) (p=0.000). Quality control check by using QC samples was done mostly for every batch of tests in BIRDEM (92%), for each kit in government institutes (50%) and private labs (50%); however, overall quality control system was found inadequate in government labs (p=0.000).

❖ **Table 7.18 Activity checking and quality control practices in the diagnostic laboratories**

Variable(s)	Organization			χ2 or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Freq. Checking					
Monthly	15 (50.0)	0	5 (5.7)	125.90	0.000
Fortnightly	11 (36.7)	0	19 (21.6)		
Weekly	4 (13.3)	11 (28.9)	57 (64.8)		
None	0	1 (2.6)	0		
QC system					
Every batch	5 (16.7)	35 (92.1)	43 (48.9)	72.898	0.000
Each kit	15 (50.0)	02 (5.3)	44 (50.0)		
Occasionally	10 (33.3)	0	1 (1.1)		
Daily	0	26 (68.4)	7 (8.0)		
None	0	1 (2.6)	0		

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

7.4. Objectives setting, demand estimation and barrier identification

Long-term planning and identification of specific problems in running a diagnostic laboratory is dependent on the respective departmental heads and central authority of the organization. Intimate supervision of overall activities of the laboratory personnel and estimation of demands of various services of the laboratory is the responsibility of the head of the department. In this study, it has been tried to unify the role of the heads of various departments in diagnostic laboratories to assess the impact of objectives setting, planning, demand estimation and barrier identification in their laboratories and a comparison among laboratories has been done for individual variables.

7.4.1 Objectives setting and making plan in various departments

As stated by head of the department *(Table 7.19)*, the objectives were set yearly in BIRDEM (67%), 5 yearly in government institutes (90%) whereas in 50% of the private labs, objectives were set 2 yearly and in the rest, 5 yearly (p=0.005).

❖ **Table 7.19 Long-term objectives in various organizations**

Variable(s)	Organization			χ2	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Objectives updated					
None	1(10.0)	0	0	18.556	0.005
Yearly	0	4 (66.7)	0		
Two yearly	0	1 (16.7)	2 (50.0)		
Five yearly	9 (90.0)	1 (16.7)	2 (50.0)		
Long-term objectives					
Policy formulation	3 (30.0)	6 (100)	2 (50.0)	7.475	0.024
Resource allocation	8 (80.0)	6 (100)	4 (100.0)	2.222	0.329
Int. collaboration	6 (60.0)	4 (66.7)	1 (25.0)	1.886	0.390
Academic courses	6(60.0)	5 (83.3)	1(25.0)	3.403	0.182

(Analysis by Chi-square test; within parenthesis are percentages) (Int.: international)

About the long-term objectives setting, policy formulation (BIRDEM vs. govt. institutes vs. private labs: 100% vs. 30% vs. 50%; p=0.004), resource allocation (100% vs. 50% vs. 100%, p=0.339), international collaboration (67% vs. 56% vs. 25%, p=0.390) and academic courses (83% vs. 60% vs. 25%, p=0.182) varied among different organizations.

All the laboratories *(Table 7.20)* were found to institute their operational plan for laboratory activities. Prior identification of a test method was found in all the laboratories. However, with respect to planning manpower through training for operation, it was mentioned by 83% in BIRDEM, 100% in government institutes and 50% in private laboratories (p=0.060) which were100%, 20% and 25% for activity assigned (p=0.005) and 67%, 30% and 50% for doctors referral (p=0.352) respectively. In government institutes and private laboratories, central authority was found to be the plan maker in all cases, but in BIRDEM, it was the departmental head in 83% cases (p=0.000). However, participation of the head of the department in plan making was found to be similar in different laboratories (p=0.293).

❖ **Table 7.20 Long-term planning in the various organizations**

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Operational plan	10 (100)	6 (100)	4 (100.0)		
Method Identification	10 (100)	6 (100)	4 (100.0)		
Training	10 (100)	5 (83.3)	1 (50.0)	5.621	0.060
Activity assigning	2 (20.0)	6 (100.0)	1 (25.0)	10.505	0.005
Doctors referral	3 (30.0)	4 (66.7)	2 (50.0)	2.088	0.352
Plan maker					
Central authority	10(100)	1(16.7)	4(100)	15.556	0.000
Dept. Head	0	5(83.3)	0		
Participation in plan	10(100)	5(83.3)	4(100)	2.456	0.293

(Analysis by Chi-square test: within parenthesis are percentages) (Dept: departmental)

(Table 7.21) shows that plans were developed in a way for mid-stream corrections in 33%, fall back situation in 17% and corrective action in 50% in cases of BIRDEM laboratories, which were 0%, 20% and 80% in government institutes whereas 25%, 75% and 0% in private laboratories (p=0.043). In 90% cases head of the department of the government institutes could not inform any particular basis of objectives setting, but in BIRDEM, objectives were set on the basis of doctors' referral or patients demand for the service in 83% cases which was 75% in the private laboratories. The basis of objective setting was also dependent on the cost of service in 17% cases in BIRDEM and 25% in private laboratories (p=0.002).

❖ **Table 7.21 Objectives and planning of various departments in the organization**

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Plan developed for					
Mid-stream correction	0	2(33.3)	1(25.0)	9.864	0.043
Fall-back situation	2(20.0)	1(16.7)	3(75.0)		
Corrective action	8(80.0)	3(50.0)	0		
Basis of object. setting					
None	9(90.0)	0	0	16.648	0.002
Doctors/Pts' demand	1(10.0)	5(83.3)	3(75.0)		
Cost of service	0	1(16.7)	1(25.0)		
Central policy exist	10(100)	6(100)	4(100)		
Extent of central policy					
>90 %	8(80.0)	0	4(100)	13.714	0.008
50 - 90 %	2(20.0)	5(83.3)	0		
<50 %	0	1(16.7)	0		
Inter-dept. co-ordination	10(100)	3(50.0)	3(75.0)	5.938	0.051

(Analysis by Chi-square test; within parenthesis are percentages) (Object: objective, Pts: patients)

Compliance with the plan making central policy existed in all the three types of organizations. However, the extent of central policy interfering individual departmental activities was more than 90% in all the private laboratories, 80% in government institutes and 83% in BIRDEM laboratories. Whereas the extent of central policy ranged from 50 to 90% (p=0.008). Inter-departmental coordination was found among all the labs of government institutes, 75% in private laboratories whereas in only 50% in BIRDEM (p=0.051).

7.4.2. Responsibilities of head of the department in organizations

Table 7.22 shows that 83% of departmental heads in BIRDEM were found to supervise the activities of subordinates on daily basis, which were only 30% in government institutes and 25% in private laboratories. In 40% cases of government institutes and 75% of private laboratories, they were found to supervise activities of subordinates weekly and whereas in 17% of BIRDEM laboratories and 30% cases of government institutes the supervision was done monthly (p=0.086).

❖ **Table 7.22 Supervision and task allocation by departmental heads**

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Supervis.of subordinates					
Daily	3(30.0)	5(83.3)	1(25.0)		
Weekly	4(40.0)	0	3(75.0)	8.148	0.086
Monthly	3(30.0)	1(16.7)	0		
Checking various activities	2(20.0)	5(83.3)	0	9.304	0.010
Allocation of task on					
Background	4(40.0)	5(83.3)	4(100)		
Time involved	0	0	0	5.788	0.055
Seniority	6(60.0)	1(16.7)	0		

(Analysis by Chi-square test; within parenthesis are percentages) (Supervis: supervision)

Responsibility of report checking by departmental heads was 83% in BIRDEM, which were 30% in government institutes but 25% in private laboratories (p=0.010). Allocation of tasks to the laboratory personnel destined by the departmental heads were based on background information in 83% cases in BIRDEM, 40% in government institutes, but 100% in private laboratories. Task allocation was based on seniority in 60% cases in government institutes and 17% in BIRDEM, but none in all private laboratories whereas time involvement was not considered (p=0.055).

Feedback of the laboratory *(Table 7.23)* activities were assessed on the basis of documents in 50% cases of BIRDEM, 20% in government institutes and 25% in private laboratories; which were 33%, 10%, and 50% through discussions; and 17%, 40% and 25% through meetings. However, in 30% cases of government institutes had no feedback (p=0.325).

❖ **Table 7.23 Activities of departmental head in various organizations**

Variable(s)	**Organization**			**χ2**	**p**
	Govt. (%)	BIRDEM (%)	Private (%)		
Collection of feed-back					
Documents	2(20.0) 1	3(50.0)	1(25.0)		
Discussion	1(10.0)	2(33.3)	2(50.0)	6.956	0.325
Meeting	4(40.0)	1(16.7)	1(25.0)		
None	3(30.0)	0	0		
Standard set for test					
Organizations own	10(100)	4(66.7)	0		
WHO or others method	0	0	4(100)	24.76	0.000
Manufacturers (with kits)	0	2(33.3)	0		

(Analysis by chi-square test; within parenthesis are percentages)

Setting standards for tests were carried out by internal arrangement in 67% cases in BIRDEM, and in all cases of government institutes. On the other hand, all the private laboratories set their standard by external control procedure. However, in 33% cases in BIRDEM standard were set as described by the test reagent manufacturer (p= 0.000).

7.4.3. Demand estimation and barrier identification by dept. heads (shown in table7.24.)

For demand estimation of the services was mainly related to doctors' referral, cost of service and patients response. In all the private laboratories and 83% in BIRDEM, doctors referral was the main factor but not in government institutes (p=0.000). Cost of service also a factor in the assessment of demand estimation in high frequency in BIRDEM (83%) and in private laboratories (100%), but not in government institutes (50%) (p=0.127). On the other hand, in demand estimation, patients' response was considered in 100% of the departments of BIRDEM but none for government institutes or private laboratories. This is so because of excess demand for services and limited choice on the part of the patient.

❖ **Table 7.24 Estimation of demand and identification of barriers in the departments**

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Demand estimation by					
Doctors referral	0	5(83.3)	4(100)	16.633	0.000
Cost of service	5(50.0)	5(83.3)	4(100)	4.127	0.127
Patients' response	0	6(100)	0	20.00	0.000
Service barriers					
Lack of expertise	6(60.0)	5(83.3)	0	6.936	0.031
Lack of instr/ material	10(100)	6(100)	0	20.00	0.000
Financial problem	7(70.0)	5(83.3)	3(75.0)	0.356	0.837

(Analysis by Chi-square test; within parenthesis are percentages) (Instr: instrument)

Major contributing factors for service barriers were lack of expertise, lack of instruments or materials and financial problems. In BIRDEM, a high percentage of respondents mentioned that lack of expertise (83%), lack of instruments and materials (100%) as well as lack of finance (83%) contributed to service barrier which were 60%, 100% and 70% in government institutes; 0%, 0% and 75% in private laboratories. Although lack of expertise and materials (p=0.031) and lack of instruments (p=0.000) were statistically different among the three categories of organizations, financial problem (p=0.837) was common.

7.5. Productivity and training needs of laboratory personnel in various departments

For updating the services in laboratories, training of laboratory personnel over pertinent areas is essential. Overall productivity (input-output ratio of an activity of a man) of the laboratory service is reflected by the individual performance and working efficiency as well as workload that are carried out by individual staffs in an error free manner. These were assessed by asking the workload of the laboratory personnel in various diagnostic organizations.

7.5.1. Productivity of departmental heads in different organizations (shown in table 7.25.)

In radiology and imaging section of all the organizations productivity was cent percent (p=0.722). In biochemistry department of government institutes productivity was 135±15%, in BIRDEM 80%, and in private laboratories 135±6% (p=0.072). In clinical pathology/ histopathology department it was 95±5%, 80% and 133±11% (p=0.102); whereas in microbiology department, it was 80%, 140%, and 123±13% respectively. Overall there was an overload of work in government institutes and

private laboratories for all the departments indicating excess workload on the head of the departments, which were adjusted in BIRDEM except in microbiology.

❖ **Table 7.25 Productivity of head of departments in various organizations**

Variable(s)	Organization			χ2 or F	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Produc. Head of dept.					
Imaging	105±15	110	123±13	0.354	0.722
Immunol / Serology	-	90	123±13	1.222	0.350
Biochemistry	135± 15	80	135± 6	5.459	0.072
Clin. Path/ Histopath.	95±5	80	133±11	4.258	0.102
Microbiology	80	140	123±13	1.452	0.362
Endocrinology	-	70	60±10	.333	0.667

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)

7.5.2. Productivity of test performers (shown in table 7.26.)

Similar to those for heads of the departments, in case of test performers the productivity (number of test done by each employee) was much higher in government institutes and private laboratories for all the departments, which were more adjusted in BIRDEM.

❖ **Table 7.26 Productivity of test performers in various organizations**

Variable(s)	Organization			χ2 or F	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Produc. of test performers					
Imaging	170±30	100	133±19	1.189	0.393
Immunology/ Serology	-	85	145±12	5.082	0.109
Biochemistry	165±35	85	150±11	2.338	0.213
Clin. Path/ Histopath	108±13	85	135±16	1.518	0.323
Microbiology	85	80	143±15	2.511	0.229
Endocrinology	-	80	60±10	1.333	0.454

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)

However, the differences in productivity of test performers were not statistically significant among the laboratories (imaging: p=0.393; immunology: p=0.109; biochemistry: p=0.312; clinical pathology/histopathology: p=0.323; microbiology: p=0.229 and endocrinology: p=0.455).

7.5.3. Productivity of laboratory attendants (shown in table 7.27.)

It was also observed that in government institutes and private laboratories productivity (total daily activities) of lab attendants was much higher than expected, indicating over-load, which might decrease the quality. Although it was not significantly different in each, overload of works was observed in all the departments (imaging: p=0.705; immunology: p=0.177; biochemistry: p=0.099; clinical pathology/histopathology: p=0.036, microbiology: p=0.290).

❖ **Table 7.27 Productivity of lab-attendants of various organizations**

Variable(s)	Organization			χ2 or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Produc. Lab-attendant					
Imaging	150±30	100	143±25	.382	0.705
Immunol / Serology	-	90	167±20	3.083	0.177
Biochemistry	175±25	70	180±17	4.341	0.099
Clin. Path/ Histopath	110±10	70	175±14	8.582	0.036
Microbiology	100	80	170±24	1.926	0.290
Endocrinology	-	100	60		-

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)

7.5.4. Training needs assessment (table-7.28.)

About the training needs, it was agreed that need for such training for the head of department was cent percent in government institutes and BIRDEM but none for private laboratories (p=0.000). Training need for the test performers were 25%, 100%, and 0% (p=0.005) and for lab attendants 13%, 100%, and 0% (p=0.001) in government institutes, BIRDEM and private diagnostic centers respectively.

❖ **Table 7.28 Training need assessment of employees in various organizations**

Variable(s)	**Organization**			**χ2 or F**	**p**
	Govt. (%)	BIRDEM (%)	Private (%)		
Training need assessment					
Head of departments	8(100)	5(100)	0	17.00	0.000
Test-performers	2(25.0)	5(100)	0	10.807	0.005
Lab attendants	1(12.5)	5(100)	0	13.16	0.001

(Analysis by chi-square test for non-parametric and one-way ANOVA for parametric variables)

7.6. Longitudinal assessment of diagnostic service to patients

For longitudinal assessment of laboratory activities, population served by various departments and organizations over last 10 years' period of time has been compared among the departments as well as organizations (*Table: 7.29.*). This reflects the relative performance of services by an organization in course of time though due to variation of space and capacity of the organizations, amount of service may vary among the organizations.

❖ **Table: 7.29. Longitudinal assessment of relative difference of population served (±SEM) by various organizations**

Year(s)	**Organization**		
	Govt.	BIRDEM	Private
1989	221907	1851954	17409±7618
1990	233816±46705	1861545	20475±8737
1991	246122±46029	1875680	23309±9793
1992	250492±42690	1899891	24400±10473
1993	256603±43158	1932855	25427±10897
1994	263983±40030	1991071	28391±11808
1995	269642±39832	2048598	29907±12524
1996	274322±42841	2117463	47582±21681
1997	280574±43397	2125377	50391±23945
1998	289597±42542	2141503	51497±24311
F	0.226	-	0.641
P	0.982	-	0.757
Yr. x org.	2.359		
P	0.264		

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)

Longitudinal assessment of population served by various labs for the period of 1989-1998 is shown in (*Table: 7.29.*) and Figure-1 and Figure-2. It was observed that a relatively higher number of populations were served by BIRDEM labs in comparison to government institutions and private laboratories (F=5493.815; p=0.000). However, over elapse of time there was no significant relative increment of population served by any of the laboratories (government institute: F=0.226, p=0.982; and private laboratories: F=0.641, p=0.757) excepting a very little in BIRDEM for the last four years. Trend of population service by the laboratories was also observed statistically indifferent (F=2.359; p=0.264).

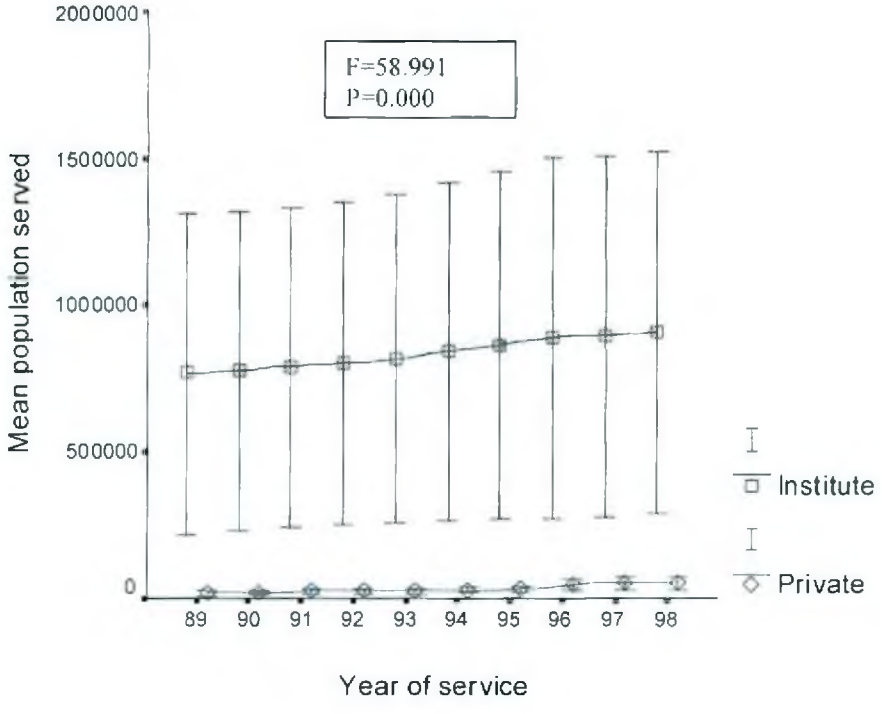


Figure-1. Population served by institutional and private laboratories

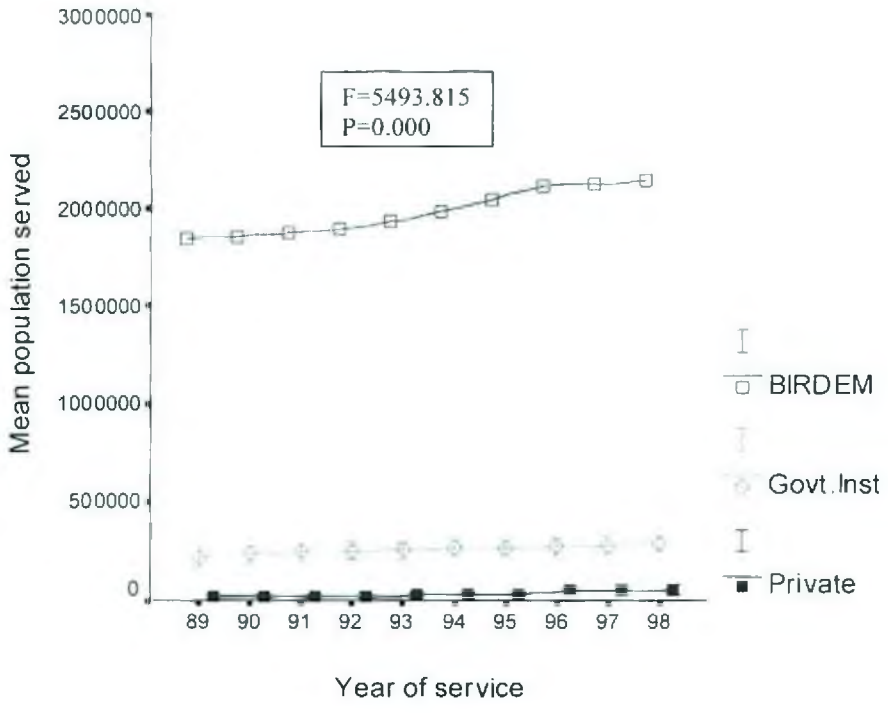


Figure-2. Population served by BIRDEM, Govt. and Private Diagnostic centers

Assessment of population served by the radiology and imaging department of BIRDEM and government institutions is shown in (*Table: 7.30*) and Figure-3. It was observed that number of population served by government institutions in this department were significantly higher (F=5.569; p=0.0025) than BIRDEM, however there was gradual increment of population served over period of time in BIRDEM which was not significant in government institutions (F=0.010, p=1.000). Statistically there was no relative difference between the population served by BIRDEM and government institutions (F=25.45; p=0.124).

❖ **Table 7.30. Longitudinal assessment of relative difference of population served (±SEM) by Department of Imaging**

Year(s)	**Organization**	
	Govt. institutions	BIRDEM
1989	65800±29300	40000
1990	67110±29110	41099
1991	67884±29696	41055
1992	69060±29560	44050
1993	69580±29580	44500
1994	70229±29729	47050
1995	70569±29481	49099
1996	71864±29676	52500
1997	73354±29866	54100
1998	75587±29412	56375
F	0.010	-
P	1.000	-
Yr. x org.	25.645	
P	0.124	

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations).

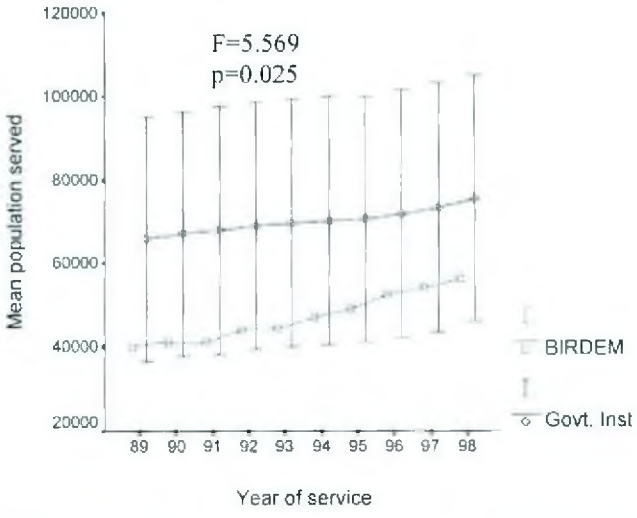


Figure-3. Mean population served by the Department of Imaging of BIRDEM and Govt. Institutions

❖ **Table: 7.31. Longitudinal assessment of relative difference of population served (±SEM) by Department of Biochemistry**

Year(s)	**Organization**	
	Govt. Institute	BIRDEM
1989	96503±12498	1745454
1990	105280±20269	1788546
1991	112450±23438	1799643
1992	113683±24371	1824243
1993	115378±24876	1854546
1994	119360±25854	1899485
1995	118717±24513	1942824
1996	118708±23605	1998854
1997	120806±24304	2000124
1998	124502±25922	2013542
F	0.126	-
p	0.998	-
Yr. x org.	1.275	
p	0.461	

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)

Population served by the department of biochemistry is shown in Figure-4 and *(Table 7.31)*. Service provided by BIRDEM during last ten years was significantly higher (F=5921.292; p=0.000) than government institutions. There was little increment of service over time in BIRDEM, but not in government institutions (F=0.126; p=0.998). Moreover, there was no statistical difference between the two organization (F=1.275; p=0.461) for relative difference in the population served.

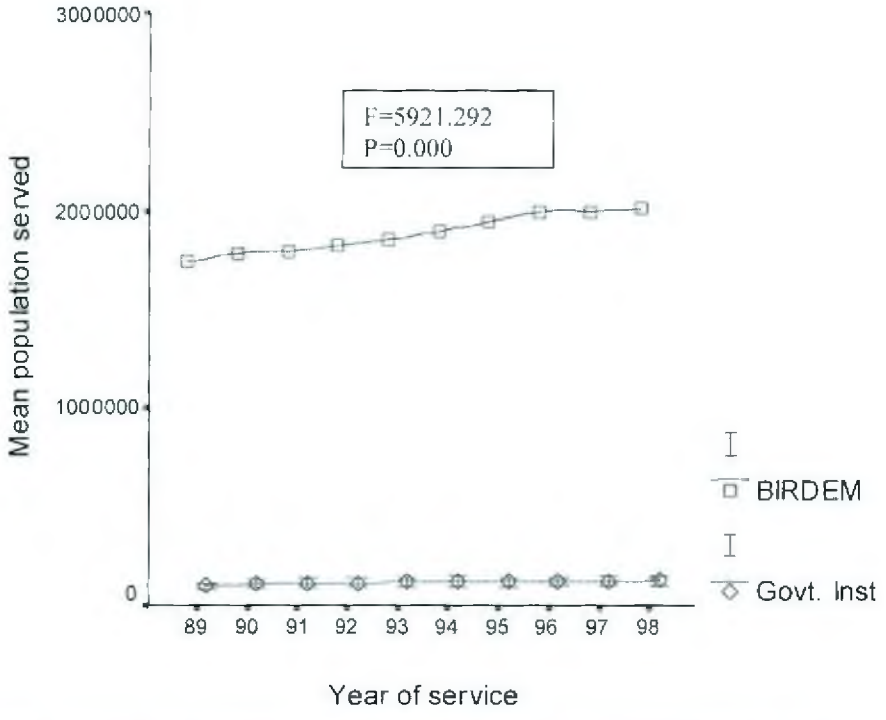


Figure-4. Mean population served by the Department of Biochemistry of BIRDEM and Govt. Institutions.

(Table 7.32) and Figure-5 shows the longitudinal assessment of population served by Microbiology, Histopathology, Endocrinology and Clinical Pathology departments combinedly. It was observed that population served by these departments were significantly higher in government institutions than BIRDEM (F=6.764; p=0.018). There was a small but insignificant increment of the service over time in both the organizations. Interaction between time and population served by the organizations in these departments were not also significant (F=4.001; p=0.295).

❖ **Table 7.32. Longitudinal assessment of relative difference of population served (±SEM) by the Departments of Micro-Histo-Endo-ClinPathology**

Year(s)	Organization	
	Govt. Institute	BIRDEM
1989	57592±40688	16500
1990	58898±40392	19845
1991	62260±43299	21727
1992	63211±42039	17573
1993	66120±43980	18754
1994	68167±42383	19481
1995	71855±43364	21625
1996	75022±45498	27609
1997	77187±47063	32098
1998	79800±48760	31522
F	0.031	-
p	1.000	-
Yr. x org.	4.001	
p	0.295	

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)

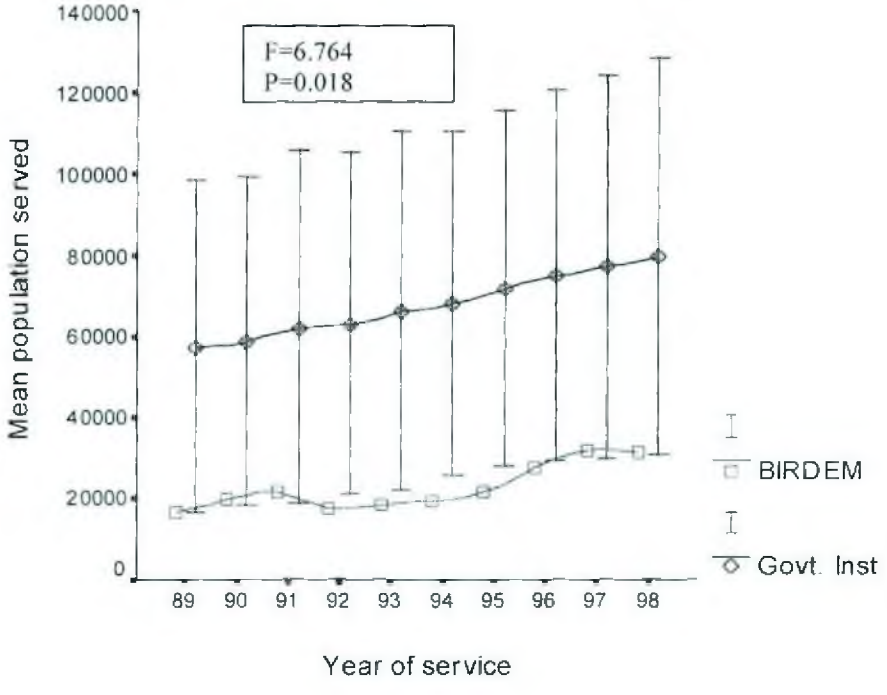


Figure-5. Population served by Departments of Microbiology, Histopathology, Endocrine and Cline. Pathology of BIRDEM and Govt. Institutions

(Table7.33) and Figure-6 shows the population served by the Department of Immunology/ Serology. It was observed that population served by BIRDEM was significantly higher than government institutions (F=7.545; p=0.013). In both the organizations there were some rapid increment of population served following 1993 till 1996 (relatively more in BIRDEM) and again coming to a steady level. However, level of interaction between time of service and population served by the organizations in this department was not significant (F=8.996; p=0.205).

❖ **Table 7.33 Longitudinal assessment of population served (±SEM) by the Department of Serology and Immunology**

Year(s)	Organization	
	Govt. Institute	BIRDEM
1989	4023	100000
1990	5055	12055
1991	7055	13255
1992	9075	14025
1993	11050	15055
1994	12455	25055
1995	17000	35050
1996	17455	38500
1997	18455	39055
1998	19416	40064
Year X Organization	8.996	
p	0.205	

(Analysis by two-way ANOVA)

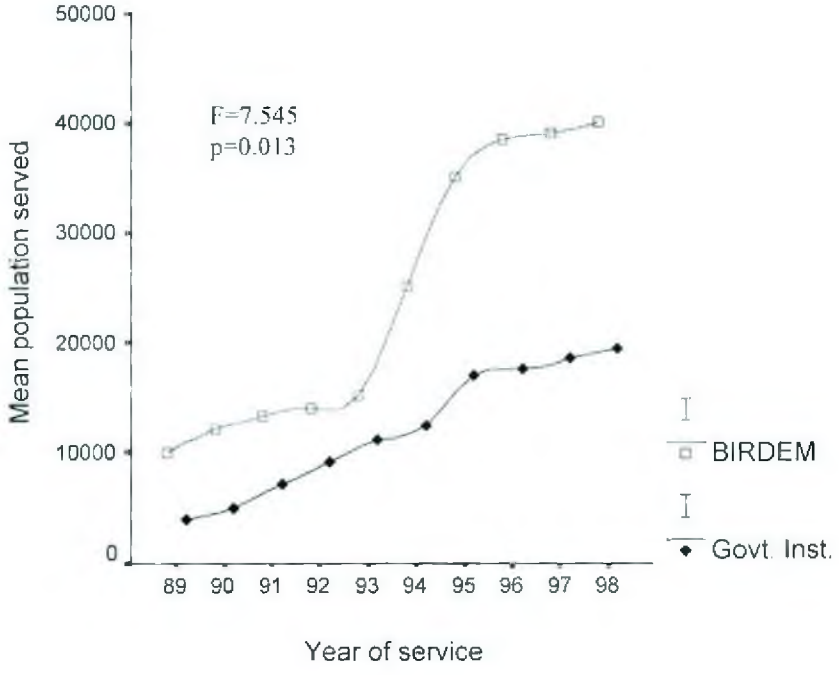


Figure-6. Mean population served by Departments of Immunology and Serology of BIRDEM and Govt. Institutions

7.7. Cost-benefit assessment in different organizations

Cost of establishment, instruments and furniture were considered as fixed assets, these varied according to the size, extent of test facilities, number of departments and the space of the organizations. Therefore, those expenses could only reflect the size of the establishment. But monthly cost of reagents, electricity-water-gas uses and employees' salaries etc. could be deducted from total monthly income through diagnostic tests to assess the overall profit of various departments and organizations.

7.7.1. Total and monthly costs and income (shown in table-7.34)

Total instrument cost as well as furniture cost was observed to be highest in BIRDEM (p=0.000, for both) followed by government institutions and private laboratories. Similarly, monthly gas, electricity and water cost (p=0.000), and employee cost (p=0.000) were highest in BIRDEM followed by government institutions and private laboratories. However, it was interesting to observe that monthly test generated income was lower in government institutions (Tk.1468000±258800) compared to BIRDEM (Tk.4401250±102524) and private laboratories (Tk.919752±282545) which is statistically significant (p=0.006). This is due to differences in pricing of services.

❖ **Table-7.34. Assessment of costs (±SEM) for instrument, furniture, reagents, space, electricity-water-gas and employees of various organizations**

Variable(s)	Organization			F	p
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)		
Total Instrument cost	700000000 ±50000000	1000000000	19778571 ±7223522	227.586	0.000
Total furniture cost	7750000 ±250000	10000000	844959 ±436627	85.554	0.000
Monthly cost					
Space	450000 ±150000	500000	54214 ±17119	48.460	0.001
Elect, gas, water	146000 ±36000	220000	17077 ±5304	53.377	0.000
Reagent	675000 ±125000	700000	103571 ±22879	105.249	0.000
Employee cost	690000 ±10000	1050000	92857 ±29172	70.622	0.000
Monthly income	1468000 ±258800	4401250± 102524	919752 ±282545	0.271	0.006

[Monthly income is calculated by deducting monthly cost from monthly total test-income; (excluding total instrument and furniture cost)]
(Analysis by one-way ANOVA)

7.7.2. Test price and income in the Department of Imaging (shown in table-7.35.)

Monthly income in this department was highest in BIRDEM followed by government institutions and private laboratories (p=0.002). CT price was highest in BIRDEM followed by private laboratories and government institute (p=0.212). Number of CT done was highest in government institute followed by private diagnostics and BIRDEM (p=0.333).

❖ **Table-7.35. Assessment of test price (±SEM) and income (±SEM) in Imaging**

Variable(s)	Organization			F	p
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)		
Monthly total income	973800 ±71800	1160000	181714 ±81665	18.743	0.002
Daily total income	48690 ±3590	46400	6135 ±2698	38.744	0.000
CT done each day	7±1	4	6±1	3.000	0.333
Price- each CT brain	2250 ±250	3500	2666 ±440	8.333	0.212
Daily income by CT	15500 ±500	14000	20500 ±6500	3.000	0.333
X-ray chest done / day	183±17	100	20±8	46.064	0.000
Price- each X-ray chest	80	90	100		
Daily income by X-ray	14640 ±1360	9000	2016 ±836	30.603	0.001
USG each day	55±5	40	12±5	15.347	0.007
Price- each USG test	225±75	460	533±16	13.490	0.032
Daily income by USG	12750 ±5250	18400	6750 ±2982	1.583	0.339
ECG done each day	65±5	50	8±3	44.533	0.000
Price- each ECG	90±10	100	200	342.33	0.000
Daily income by ECG	5800 ±200	5000	1766 ±645	6.861	0.028

(Analysis by one-way ANOVA)

On the other hand, price of X-ray, ultrasonography as well as ECG was highest in private laboratories followed by BIRDEM and government institute (USG: p=0.007; ECG: p=0.000). But daily income through X-ray was highest in government institutions followed by BIRDEM and private laboratories (p=0.001) owing to higher number of X-ray done in those institutions (p=0.000). On the contrary, highest income through ECG in government institutions (p=0.028) was related to high number of

ECG done in government institutions (p=0.000) compared to other two organizations; but in BIRDEM, USG related income (p=0.339) was high due to higher price than government institute (p=0.032).

7.7.3. Test price and income in the Department of Biochemistry (shown in table-7.36)

Monthly total income of biochemistry department was highest in BIRDEM followed by government institutions and private laboratories (p=0.000). This was attributable to the factors that number of all the tests i.e. glucose (p=0.000), lipid profile (p=0.000), bilirubin (p=0.000), urea (p=0.000) and creatinine (p=0.000) done in BIRDEM were significantly higher than government institutions and private laboratories. The price for lipid profile (p=0.155), bilirubin (p=0.004), urea (p=0.004) and creatinine (p=0.003) in BIRDEM were also higher than government institutions but similar to that of private laboratories. Thus, higher income in BIRDEM was due to both higher test price and number of tests; on the contrary, lower income in government institutions was due to low price of the tests.

❖ **Table-7.36. Assessment of test price (±SEM) and income (±SEM) in Biochemistry**

Variable(s)	Organization			F	p
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)		
Monthly total income	347000 ±19000	2949000	153264 ±48788	4.099	0.000
Daily total income	17350 ±950	117960	5380 ±1597	5.074	0.000
Bilirubin done each day	40	50	6±2	67.020	0.000
Price- each bilirubin test	47±12	100	101±4	7.344	0.004
Daily income by bilirubin	1900 ±500	5000	750 ±293	7.609	0.004
SGPT done each day	42±7	188	7±2	8.113	0.000
Price- each SGPT	62±17	125	113±5	3.570	0.011
Daily income by SGPT	2525 ±275	23500	875 ±359	4.197	0.000
SGOT done / day	40±10	86	6±2	21.055	0.000
Price- each SGOT	62±17	125	114±5	3.753	0.010
Daily income by SGOT	2325 ±75	10750	785 ±338	6.091	0.000
Glucose done each day	65±15	616	12±4	4.621	0.000
Price- each glucose test	32±7	60	80±6	10.956	0.021
Daily income by gluc.	1425 ±175	36960	922 ±345	3.024	0.000
Lipid profile done / day	22±7	100	5±1	7.426	0.000
Price- each lipid profile	335±35	520	517±41	2.473	0.155
Daily income by lipid	7275 ±1725	52000	2907 ±845	4.558	0.000
Urea done each day	55±5	120	4±1	29.916	0.000
Price- each Urea	57±12	100	103±3	8.332	0.004
Daily income by Urea	3225 ±975	12000	464 ±161	9.997	0.000
Creatinine done each day	57±7	120	3±1	34.312	0.000
Price- each Creatinine	60±10	100	103±3	8.523	0.003
Daily income by Creat.	3525 ±1025	12000	335 ±156	11.913	0.000

(Analysis by one-way ANOVA)

7.7.4. Test price and income in Immunology Department (shown in table-7.37)

Monthly total income of immunology department was highest in BIRDEM followed by government institutions and private laboratories (p=0.081). It was observed that number of tests for, HBsAg (p=0.040), AFP (p=0.332) and PSA (p=0.210) were higher in BIRDEM compared to government institutions and private laboratories.

❖ **Table-7.37. Test price and income (±SEM) in the Dept. of Immunology**

Variable(s)	Organization				
	Govt. (Tk.)	BIRDEM(Tk.)	Private (Tk.)	F	p
Monthly total income	362750±31250	1349750	360535±140804	1.242	0.081
Daily total income	18137±1562	53990	12390±4583	3.017	0.031
Widal done each day	25	10	5±2	10.801	0.005
Price- each Widal	125±25	160	168±12	2.098	0.306
Daily income by Widal	3125±625	1600	1070±417	4.166	0.125
ASO-titer done each day	17±2	4	3	10.500	0.000
Price- each ASO-titer	77±22	120	188±23	6.439	0.106
Daily income by ASO	1300±200	480	651±220	0.921	0.349
HBsAg done each day	32±17	35	7±2	11.988	0.040
Price- each HBsAg	182±117	300	471±62	5.211	0.147
Daily income by HBsAg	3875±625	10500	4271±1810	0.329	0.444
VDRL done each day	13±6	6	3	7.265	0.037
Price- each VDRL	85±15	100	110±4	4.335	0.154
Daily income by VDRL	1050±350	600	350±102	6.163	0.072
RA-test done each day	22±7	7	4	9.552	0.005
Price- each RA-test	82±17	120	141±33	0.742	0.685
Daily income by RA-test	1725±325	840	540±129	10.057	0.010
Pregnancy-test each day	32±12	6	4±1	7.049	0.007
Price- each Preg-test	62±17	120	144±11	7.901	0.031
Daily income by Preg.	1812±1212	720	767±255	2.144	0.183
AFP done each day	2	5	2	0.686	0.322
Price- each AFP	500	500	564±30	1.167	0.630
Daily income by AFP	1000	2500	1442±400	0.130	0.596
PSA done each day	1	5	2	0.495	0.210
Price- each PSA	500	500	707±84	1.546	0.549
Daily income by PSA	500	2500	1650±651	0.012	0.723

(Analysis by one-way ANOVA) (Preg: pregnancy)

Overall, these tests were much lower in number in private laboratories. However, price of these tests was higher in private laboratories than government institutions,

which contributed to equalization of monthly income of the private laboratories to that of government institutions. On the other hand, Widal (p=0.005), ASO-titer (p=0.000), VDRL (p=0.0037), RA test (p=0.005), and pregnancy test (p=0.007), were much higher in number in government institutions compared to those of BIRDEM and private laboratories. But price of these tests were lower (Widal: p=0.306; ASO-titer: p=0.0106; VDRL: p=0.154), RA test: p=0.685; and Pregnancy test: p=0.031) in government institutions compared to those of BIRDEM and private laboratories. Hence, the monthly total income of government institutions fell down despite of higher number of tests in many instances.

7.7.5. Test price and income in the Departments of Clinical Pathology, Endocrinology, Microbiology and Histopathology

Monthly income in Clinical Pathology was highest in BIRDEM followed by government institutions and private laboratories (p=0.000) *(Table-7.38)*. This high income of BIRDEM was contributed by both higher number of tests (CPB: p=0.000; Urine R/E: p=0.000; Stool R/E: p=0.010) as well as high price for Urine R/E: p=(0.050); and Stool R/E: p=0.066). However, though the price in private laboratories for these tests were much higher than government institutions, income of private laboratories through these tests were much lower than government institutions due to minimum number of tests.

❖ **Table7.38. Test price and income (±SEM) in the Department of Clinical Pathology**

Variable(s)	Organization			F	p
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)		
Monthly total income	112250±37750	893750	32085±12489	4.680	0.000
Daily total income	5612±1887	35750	1107±405	5.742	0.000
CPB done each day	37±7	250	5±2	5.903	0.000
Price- each CPB	120±80	125	138±6	0.327	0.866
Daily income by CPB	3900±2100	31250	641±233	5.047	0.000
Urine-R/E done / day	40±10	76	6±2	25.287	0.000
Price- each Urine-routine	27±2	50	44±2	2.008	0.050
Daily income by Urine	1075±175	3800	271±109	8.931	0.000
Stool-R/E done each day	32±12	14	4±1	11.625	0.010
Price- each Stool-routine	22±7	50	41±3	1.425	0.066
Daily income by Stool	637±37	700	194±74	15.201	0.023

(Analysis by one-way ANOVA)

In the department of endocrinology *(Table 7.39)*, monthly income was again higher in BIRDEM though not significant (p=0.647). Number of tests is highest in government institutions (p=0.007) but the price was lowest (p=0.000). The highest price observed in private laboratories followed by BIRDEM and government institutions. Therefore highest income in BIRDEM was related to high price and lowest income in private laboratories was due to minimum number of tests.

❖ **Table7.39. Test price and income (±SEM) in the Department of Endocrinology**

Variable(s)	Organization			F	p
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)		
Monthly total income	147000 ±3000	250000	141700 ±51295	0.296	0.647
Daily total income	7350 ±150	10000	4890 ±1653	2.117	0.383
T_3, T_4, TSH done / day	11±1	8± 3	3±1	25.010	0.007
Price of T3, T_4, TSH test	675±75	1250	1720±25	33.482	0.000
Daily income from T3, T_4, TSH	7350 ±150	10000	4890 ±1653	2.117	0.383

(Analysis by one-way ANOVA)

Similar to other departments, monthly total income of microbiology was highest in BIRDEM (p=0.015) followed by government institutions and private laboratories *(Table 7.40)*. Test price for culture and sensitivity (C/S) was highest in private laboratories (p=0.002), and minimum in government institutions. But number of C/S done in BIRDEM was highest (p=0.000) followed by government institutions and private laboratories.

Histopathology test price (Table 7.40) was higher in BIRDEM and government institutions than private laboratories (p=0.678) but the number of tests was highest in government institutions followed by private laboratories and BIRDEM (p=0.467) (table-7.5d). Therefore, only higher number of histopathological tests contributed main income of government institutions in this department.

❖ **Table-7.40. Test Price and income (±SEM) in the Dept. of Microbiology and Histopathology**

Variable(s)	Organization			F	p
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)		
Monthly total income	165000±45000	268750	12950±9205	5.541	0.015
Daily total income	8250±2250	10750	4828	10285	0.033
C/S done each day	27±2	35	6±1	94.871	0.000
Price- each C/S	90±10	200	471±35	31.923	0.002
Daily income by C/S	2450±50	7000	2671±419	1.329	0.015
Histopath each day	30±10	15	17±4	0.744	0.467
Price- each Hist. test	245±155	250	178±28	0.946	0.676
Daily Hist income	5800±2200	3750	2414±337	7.106	0.058

(Analysis by one-way ANOVA)

7.7.6. Relative differences of income of various departments

Comparison of income by various departments is shown in *(Table-7.41)*, Figure-7 and Figure-8. Monthly income of BIRDEM was highest in the department of biochemistry followed by serology, imaging, pathology, microbiology and endocrinology. In the government institutions highest income was in the imaging department followed by serology, biochemistry, microbiology, endocrinology and pathology (F=62.852; p=0.000). On the other hand highest income in private laboratories was in the department endocrinology followed by serology, imaging, biochemistry and pathology (F=0.962; p=0.468). Overall income of BIRDEM was higher (F=4.874; p=0.014) compared to government institutions and private laboratories. There was interaction between the departmental income and organization which was significant (F=8.396; p=0.094).

❖ **Table-7.41. Assessment of relative difference of monthly income (in thousands ±SEM) by various departments**

Departments	**Organization**		
	Govt. (Tk.)	BIRDEM (Tk.)	Private (Tk.)
Dept of Imaging	973±71	1160	396±78
Dept of Biochemistry	347±19	2949	238±51
Dept of Imm/ Serology	362±31	1349	570±187
Dept of Microbiology	165±45	268	131±13
Dept of Pathology	112±37	893	49±17
Dept of Endocrinology	147±3	250	757±624
F	62.852	-	0.962
p	0.000	-	0.468
Dept. x organ.	8.396		
p	0.094		

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)

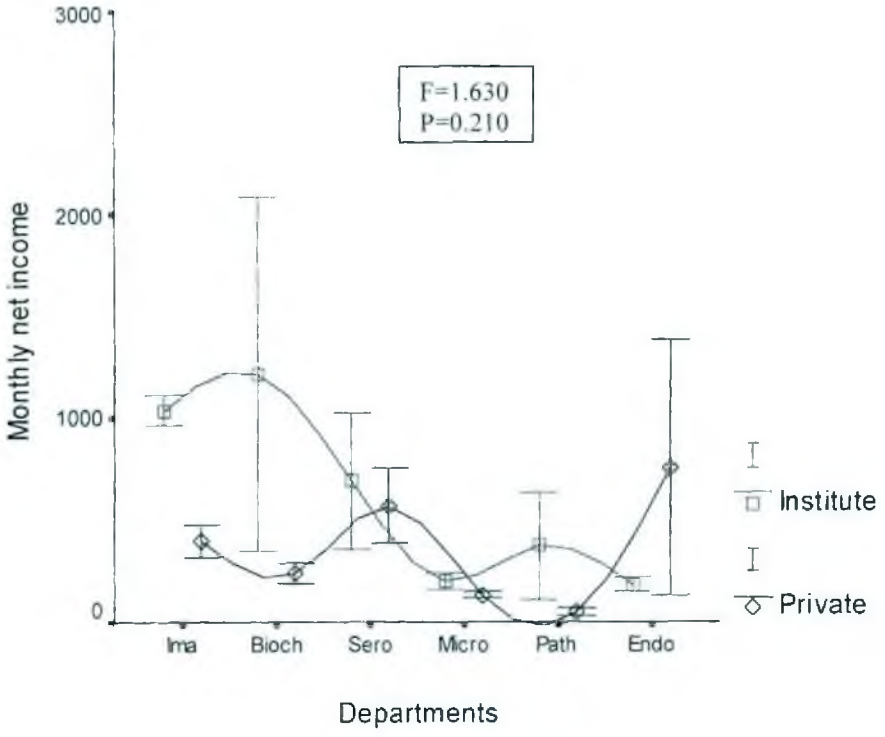


Figure-7. Monthly income of various departments in different organizations

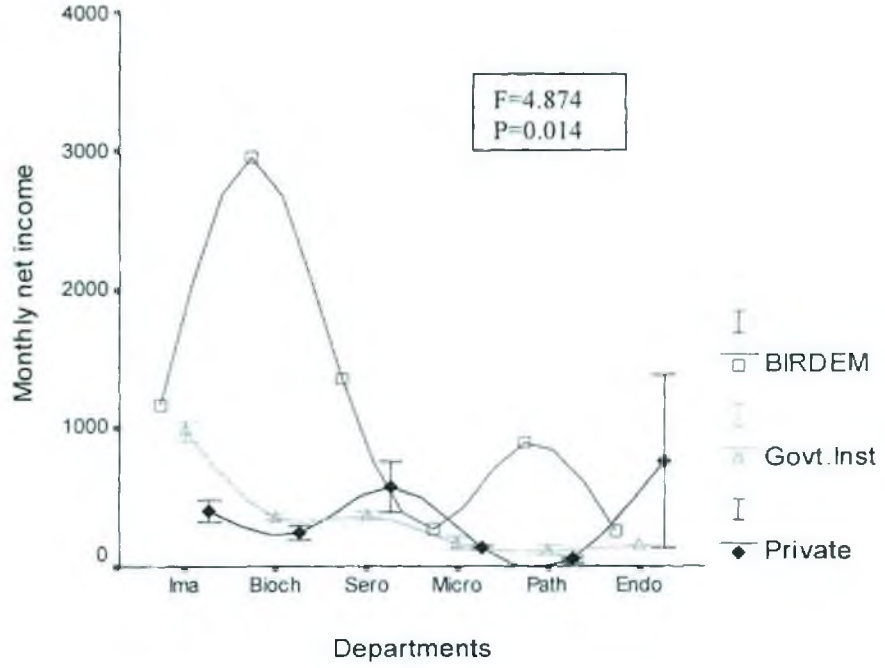


Figure-8. Monthly test income of various departments in BIRDEM, Govt. Inst. and Private Laboratories

In conclusion it was found that doctors mainly determined where tests to be done though patients' preference did not always fit with that of doctors. Loss of time was a major factor for patients' dissatisfaction. Compared to government institutions, price of laboratory tests was higher in private laboratories and BIRDEM. Although population served in BIRDEM was more than that of government or private laboratories, workload on diagnostic personnel was more in government and private laboratories. Central authority in government institutions and private laboratories usually made long-term plans of the laboratory service sections. Barriers of the various sectors equally affected all categories of laboratories in Dhaka City.

8. Hypotheses Testing

Results of the present study, in light of the aforementioned hypotheses, are presented below in tabulated form to show their level of significance for acceptance or rejection. Though many a number of variables were compared, for justifying the hypotheses, most important variables were selected without liquefying the importance of other variables, which were considered in a cumulative manner.

Hypothesis (1):

Doctors do not determine the laboratory where the tests are to be done.

Results: (described in Tables-7.6)

Variable (s)	Organization			$\chi 2$	p
	BIRDEM (%)	Govt. (%)	Private (%)		
Why a lab is chosen					
Consultant sent	31 (47.0)	65 (84.4)	39 (83.0)	29.141	0.000
On own choice	35 (53.0)	12 (15.6)	8 (17.0)		

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: Hypothesis (1) is rejected. i.e. doctors determine where the tests are to be done.

Hypothesis (2). Doctors send patients to different laboratories because they know about the quality of laboratories.

Results: (described in Tables-7.1 and 7.4)

Variable (s)	Organization			$\chi 2$	p
	BIRDEM (%)	Govt. (%)	Private (%)		
Patients referred to					
BIRDEM	40 (44.0)	13 (14.3)	38 (41.8)		
Govt. Institute	01 (3.7)	19 (70.4)	07 (25.9)	49.663	0.000
Private	20 (26.0)	12 (15.6)	46 (58.4)		
Tech quality known	36 (59.0)	36 (81.8)	69 (75.8)	7.854	0.020

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: *Hypothesis (2) is rejected, i.e. doctors send patients laboratories for quality of services.*

Hypothesis (3). *Patients have no preference of labs for tests purpose*

Results: (described in Tables-7.6).

Variable (s)	Organization				
	BIRDEM (%)	Govt. (%)	Private (%)	$\chi 2$	p
Lab preference					
None	14 (21.2)	45 (58.4)	36 (76.6)		
BIRDEM	41 (62.1)	9 (11.7)	1 (2.1)	71.908	0.000
Govt. institute	2 (3.0)	1 (1.3)	0		
Private	9 (13.6)	22 (28.6)	10 (21.3)		

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: *Hypothesis (3) is rejected, i.e. Patients do have preference but as shown earlier they abide by doctors preference.*

Hypothesis 4. *Quality of service is better in government laboratories than BIRDEM and private laboratories.*

Results: (described in Tables-7.7).

Variable (s)	Organization			$\chi 2$	p
	BIRDEM (%)	Govt. (%)	Private (%)		
Quality of service					
Excellent	9 (13.6)	5 (6.5)	5 (10.6)		
Good	52 (78.8)	43 (55.8)	34 (72.3)	33.115	0.000
Bad	5 (7.6)	27 (35.1)	3 (6.4)		
None	0	2 (2.6)	5 (10.6)		

(Analysis by chi-square test; within parenthesis are percentages)

Inference: *Hypothesis (4) is rejected, i.e. service are better outside government laboratories.*

Hypothesis 5. *Test price is higher in private laboratories and BIRDEM than government laboratories*

Results: (described in Tables-7.7).

Variable (s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Test price					
Very high	9 (11.7)	19 (28.8)	14 (29.8)		
Considerably high	34 (44.2)	22 (33.3)	22 (46.8)	11.327	0.023
Appropriate	34 (44.2)	25 (37.9)	11 (23.4)		

(Analysis by chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 5 is accepted i.e. prices charged for tests are higher in non-government institution.*

Hypothesis 6. *Sample collection is satisfactory in BIRDEM and private laboratories than government institutions.*

Results: (described in Tables-7.9).

Variable (s)	Organization			$\chi 2$	P
	Govt. (%)	BIRDEM (%)	Private (%)		
Sampling problems	43 (55.8)	25 (37.9)	5 (10.6)	25.222	0.000

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: Hypothesis 6 is accepted, i.e. sample collection is satisfactory in non-government institutions.

Hypothesis 7. *Timely report delivery is better in private laboratories.*

Results: (described in Table-7.7)

Variable (s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Loss of time experienced	39 (50.6)	24 (35.3)	4 (8.5)	24.822	0.000
Report delivery problem	44 (57.1)	4 (6.1)	5 (10.6)	55.351	0.000

(Analysis by chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 7 is accepted, i.e. private laboratories delivery reports on time.*

Hypothesis (8): *Problems are better discussed in private laboratories than BIRDEM and government institutes.*

Results: (described in Table-7.12)

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Discuss problem					
Weekly	11 (30.6)	9 (40.9)	22 (56.4)		
Fortnightly	22 (61.1)	5 (22.7)	8 (20.5)	29.038	0.000
Monthly	0	4 (18.2)	0		
None	3 (8.3)	4 (18.2)	9 (23.1)		

(Analysis by chi-square test; within parenthesis are percentages)

Inference: Hypothesis (8) is rejected i.e. problems are not discussed well in private laboratories.

Hypothesis (9): *Test problems are higher in government institutes than and private laboratories.*

Results: (described in Table-7.16)

Variable(s)	Organization			χ^2	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Problems of tests	30 (100)	34 (89.5)	68 (77.3)	9.788	0.007
Sample error	21 (70.0)	31 (81.6)	58 (65.9)	3.139	0.208
Space	14 (46.7)	21 (55.3)	08 (9.1)	35.126	0.000
Environment	24 (80.0)	17 (44.7)	08 (9.1)	56.356	0.000
Administrative	23 (76.7)	12 (31.6)	12 (13.6)	42.273	0.000
Instrumental	26 (86.7)	23 (60.5)	30 (34.1)	26.705	0.000
Reagent	20 (66.7)	16 (42.1)	21 (66.7)	18.348	0.000

(Analysis by Chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

Inference: *Hypothesis 9 is accepted, i.e. test problems are less in non-government institution.*

Hypothesis (10): *Supervision of the internal activities and problem discussion are better in government laboratories than BIRDEM and private laboratories*

Results: (described in Table-7.12 & 7.22)

Variable(s)	Organization			χ^2	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Supervis. of subordinates					
Daily	3(30.0)	5(83.3)	1(25.0)		
Weekly	4(40.0)	0	3(75.0)	8.148	0.086
Monthly	3(30.0)	1(16.7)	0		
Discuss problem					
Weekly	11 (30.6)	9 (40.9)	22 (56.4)		
Fortnightly	22 (61.1)	5 (22.7)	8 (20.5)	29.038	0.000
Monthly	0	4 (18.2)	0		
None	3 (8.3)	4 (18.2)	9 (23.1)		

(Analysis by chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 10 is rejected, i.e. supervision of the internal activities and problem discussion are not satisfactory in government laboratories.*

Hypothesis 11. *QC and test-checking is better in BIRDEM and private laboratories than governmental laboratories*

Results: (described in Table-7.18)

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Freq. of checking					
Weekly	4 (13.3)	11 (28.9)	57 (64.8)		
Fortnightly	11 (36.7)	0	19 (21.6)	125.90	0.000
Monthly	15 (50.0)	0	5 (5.7)		
None	0	1 (2.6)	0		
QC system					
Every batch	5 (16.7)	35 (92.1)	43 (48.9)		
Each kit	15 (50.0)	02 (5.3)	44 (50.0)	72.898	0.000
Occasionally	10 (33.3)	0	1 (1.1)		
Daily	0	26 (68.4)	7 (8.0)		
None	0	1 (2.6)	0		

(Analysis by chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 11 is accepted* i.e. *QC and test checking is poor in governmental laboratories.*

Hypothesis 12. *Workload is more in government institutes than BIRDEM and private laboratories.*

Results: (described in Table-7.15)

Variable(s)	Organization			$\chi 2$ or F	p
	Govt. (%)	BIRDEM (%)	Private (%)		
No of tests done	187±25	22±3	107±9	27.089	0.000
Load of tests					
Overload	12 (40.0)	02 (5.3)	3 (3.4)	32.492	0.000
Appropriate	18 (60.0)	30 (78.9)	80 (90.9)	14.842	0.001
Less	0	04 (10.5)	06 (6.8)	3.152	0.207

(Analysis by Chi-square test for non-parametric and one-way ANOVA for parametric variables)
(Within parenthesis are percentages)

Inference: Hypothesis (12) is accepted, i.e. workload is less in non-government institutions.

Hypothesis 13. *Precautionary measures for sampling and disposal are better in private laboratories than BIRDEM and government institutes.*

Results: (described in Tables-7.9&7.11)

Variable (s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Precaution taken					
Disposable syringe	6 (30.0)	1 (3.0)	18 (50.0)		
Use of gloves	0	16 (48.5)	0	58.024	0.000
Both	9 (45.0)	16 (48.5)	18 (50.0)		
None	5 (25.0)	0	0		
Disposal system					
Dustbin	8 (40.0)	33 (100)	18 (50.0)		
Wash in basin	4 (20.0)	0	0	46.206	0.000
Burn	2 (10.0)	0	13 (36.1)		
Dustbin and burn	6 (30.0)	0	5 (13.9)		

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 13 is rejected, i.e. Precautionary measures are practiced well in BIRDEM and government institutes.*

Hypothesis 14. *Government laboratories serve more population than BIRDEM and private laboratories.*

Results: (described in Table-7.29)

Year(s)	Organization		
	Govt. institutes	BIRDEM	Private
1989	221907	1851954	17409±7618
1990	233816±46705	1861545	20475±8737
1991	246122±46029	1875680	23309±9793
1992	250492±42690	1899891	24400±10473
1993	256603±43158	1932855	25427±10897
1994	263983±40030	1991071	28391±11808
1995	269642±39832	2048598	29907±12524
1996	274322±42841	2117463	47582±21681
1997	280574±43397	2125377	50391±23945
1998	289597±42542	2141503	51497±24311
F	0.226	-	0.641
p	0.982	-	0.757
Year X Org. (F)	2.359		
p	0.264		

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)

Inference: Hypothesis 14 is rejected, i.e. BIRDEM and private laboratories serve highest population.

Hypothesis (15): *Central authority makes plan in c than BIRDEM and private institutes*

Results: (described in table-7.20)

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Plan maker					
Central authority	10(100)	1(16.7)	4(100)	15.556	0.000
Departmental head	0	5(83.3)	0		

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 15 is accepted, i.e. central authority makes plan in government institutes.*

Hypothesis (16). *Interdepartmental coordination is better in BIRDEM. than government institutes and private laboratories.*

Results: (described in Table-7.21)

Variable(s)	Organization			$\chi 2$	p
	Govt. (%)	BIRDEM (%)	Private (%)		
Inter-dept. co-ordination	10(100)	3(50.0)	3(75.0)	5.938	0.051

(Analysis by Chi-square test; within parenthesis are percentages)

Inference: *Hypothesis 16 is rejected, i.e. interdepartmental coordination is poor in BIRDEM.*

Hypothesis (17). *Monthly income varies among the departments in private laboratories.*

Results: (described in Table-7.41)

Diagnostic Departments	Organization (Taka in thousands)		
	Govt. institutes	BIRDEM	Private
Department of Imaging	973±71	1160	396±78
Department of Biochemistry	347±19	2949	238±51
Department of Imm/Serology	362±31	1349	570±187
Department of Microbiology	165±45	268	131±13
Department of Pathology	112±37	893	49±17
Department of Endocrinology	147±3	250	757±624
F	62.852	-	0.962
P	0.000	-	0.468
Department X organization (F)	8.396		
P	0.094		

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)

Inference: *Hypothesis 17 is rejected. i.e. monthly income same among the departments in private laboratories.*

Summary of hypothesis testing:

No. of hypothesis	Calculated value of $\chi 2$	Tabulated value of $\chi 2$	Calculated value of p	Inference
1.	29.141	13.815	<0.001	*Null hypothesis 1 is rejected*
2.	49.663	18.467	<0.001	*Null hypothesis 2 is rejected*
	7.854	13.815	<0.001	
3.	71.908	22.457	<0.001	*Null hypothesis 3 is rejected*
4.	33.115	22.457	<0.001	*Null hypothesis 4 is rejected*
5.	11.327	11.668	>0.02	*Null hypothesis s 5 is accepted*
6.	17.448	13.815	<0.001	*Null hypothesis 6 is accepted*
7.	24.822	13.815	<0.001	*Null hypothesis s 7 is accepted*
	55.351	13.815	<0.001	
8.	29.038	22.457	<0.001	*Null hypothesis 8 is rejected*
9.	9.788	9.210	0.01	*Null hypothesis 9 is accepted*
	3.139	13.815	>0.02	
	35.126	13.815	<0.001	
	56.356	13.815	<0.001	
	42.273	13.815	<0.001	
	26.705	13.815	<0.001	
	18.348	13.815	<0.001	
10.	8.148	9.488	>0.05	*Null hypothesis 10 is rejected*
	29.038	22.457	<0.001	
11.	125.90	22.457	<0.001	*Null hypothesis 11 is accepted*
	72.898	26.125	<0.001	
12.	27.089	4.61	<0.01	*Null hypothesis 12 is accepted*
	32.492	13.815	<0.001	
	14.842	13.815	<0.001	
	3.152	3.219	>0.02	
13.	58.024	22.457	<0.001	*Null hypothesis 13 is rejected*
	46.206	22.457	<0.001	
14.	2.359	_	0.264	*Null hypothesis 14 is rejected*
15.	15.556	13.815	<0.001	*Null hypothesis 15 is accepted*
16.	5.938	5.991	>0.05	*Null hypothesis 16 is rejected*
17.	8.396	_	0.094	*Null hypothesis 17 is rejected*

In concluding the findings it is revealed that, although the patients have preference of laboratories for the test purpose, doctors mainly determine the laboratories where tests are to be done. However, they (doctors) do not know the quality of laboratories. The test price is higher in BIRDEM and private laboratories and quality of service is ensured here than that of government institutes. Proper sampling and timely reporting are satisfactory in private laboratories. However, problems regarding tests, administration etc. is not usually discussed here. Test problems are higher in government institutes, which may be due to their inadequate supervision of the internal activities and problem discussion. Quality control, and test checking are better in BIRDEM and private laboratories. Overload of works in government institutes is more. Precautionary measures against health hazards during sampling and waste disposal are not satisfactory in private labs. Total population service is more in BIRDEM; and income/revenue of departments varies widely.

9. Discussion

This study was designed to evaluate the management of diagnostic services conducted by institutional and private organizations in Dhaka City. Patients' view on service facilities and referring physicians' opinion regarding diagnostic centers were initially investigated. Then personnel practices in the diagnostic centers including sources of errors were analyzed. Objectives, planning, demand estimation, identification of barriers as well as productivity and training needs of laboratory workers were assessed from the statements of laboratory heads. Finally, longitudinal assessment of services by the laboratories to target population in light of test prices, maintenance cost and monthly income by the laboratories were also studied.

9.1. Role of doctors

In general, private practitioners are the physicians who provide resources and assistance in illness but they are not employed by the government health service. This definition makes a clear distinction between private and public physicians in realign to their employer. The private practitioners usually have a financial gain directly from the patients in contrast to the public physicians who provide health care without any direct financial benefits from the patients. However, it must be mentioned that in our country majority of the government physicians are also practicing privately after their working hours in the public hospitals. Therefore, it is only the site of practice that demarcates the private and public physicians. The service from private practitioners is expensive, so the socioeconomic status of the patient primarily determines choice of health care provider. However, the referral system also performs an important link between different health practitioners and it has been reported that private practitioners refer the patient to public physicians who can not afford the cost of

private practitioners or who cannot be treated or investigated in private clinics due to lack of facilities and expertise (Lacman and Stander, 1991). As the public physicians relation to private clinics and hospitals are mainly upon profit motive, it was logical to investigate whether the patient referral for medical investigation was also influenced by such motive and not based on the service quality of the diagnostic centers.

It was found that mainly physicians practicing at government hospitals were referring patients for diagnostic service at government institutes. On the other hand, many of the physicians from BIRDEM (42%) and public hospitals (26%) were referring patients to private diagnostic centers. The reasons for such referral to private diagnostic centers was not found to be higher test accuracy but timely report delivery (73%) and patients preference (28%). A few of the physicians also considered test quality in government laboratories to be of poor quality. However, the physicians were found well acquainted with the laboratory techniques used in the laboratories and most of the physicians reported a good clinical correlation with the test report from all type of diagnostic organizations.

9.2. Patients' response

Response to lab services by the patients can be considered as the main indicator of success of diagnostic organization management. Patients response was considered regarding various aspects of laboratory management, which includes preinvestigation systems, test price, quality of investigations, report delivery system etc.

It was found that patients' profession and monthly family income might be important determining factors for their selection of different kind of service organizations.

Majority of the patients attending the physicians in the government institutes was from under Tk.10,000/month family income group whereas, in private diagnostic centers, most of the patients had a family income over Tk10,000/month. Moreover, none of the patients in the low-income (<Tk.5000/month) group was attending the private diagnostic centers or BIRDEM. These indicate that the health care service facility in our government institutes might not be good and patients do not go there if they had the financial ability to pay for it in non-government sector. Therefore, diagnostic facilities in the public hospitals need be improved to decrease the health care cost to the poor population of the country.

It is observed that a higher number (62%) of patients attending BIRDEM physicians had a preference for BIRDEM but majority of patients visiting government physicians (58%) or private physicians (77%) had no particular preference for diagnostic centers. 29% patients from government institutes, 14% from BIRDEM and 21% from private physicians indicated a preference for private diagnostic centers but they rarely had preference for government laboratories. Lack of patients' preference for diagnostics in government institutes indicate their dissatisfaction or lack of confidence on the existing service available. More than one third (35%) of the patients in government hospitals opined diagnostic service in those institutes to be of bad quality. More than half of the patients indicated sample collection problem that included anomalies like misbehaving, irregularity, losses of time, and lack of courtesy as well as problem in report delivery. Patients indicated that problems were also prevalent to some extent in BIRDEM especially noticeable their delay in processing. Private diagnostic centers were comparatively better in that regard. On the other hand as stated by the patients,

test price was comparatively higher in private laboratories and BIRDEM than government institutes.

However, patients' preference for a specific type of diagnostic organization did not ultimately determine the center they had to attend. Although about half (53%) of the BIRDEM patients selected BIRDEM diagnostics on their own choice, the rest was determined by the respective physicians. Therefore in most instances it is the physicians who determine the diagnostic center, irrespective of patients' preference.

9.3. Personnel practices in diagnostic organizations

The control, handling and processing of pathological samples and the reporting of the investigation results are key elements for the total management of diagnostic service system. Sample collection attendants, lab attendants, and test performers were found to be the personnel in those activities.

Although the academic qualification of the sample collection attendants were similar in various organizations, and even more experienced in government institutes, it was observed that sample collection problems were more in institutes than private diagnostic centers. 60% of the collection attendants in government institutes and 39% in BIRDEM mentioned about the collection problems, which might be partially due to irregular collection practices of the staffs.

Academic qualification and job experience of the laboratory attendants were also similar to sample collection attendants. However, about one third were below SSC level in government institutes. According to laboratory attendants, sample collection errors were more related to mistakes of receipts, collection and labeling. The

laboratory attendants working in BIRDEM mentioned more about the sample collection errors. Delay in report delivery and delivery mistakes were also reported to be more by the lab attendants working in BIRDEM. Attendants from private laboratories and government institutes also indicated about the sample collection and reporting problems, however, these two were less in government institutes as indicated by the laboratory attendants. Loss of report was mentioned by most of the laboratory attendants in BIRDEM and seems to be a major drawback of the laboratory services there. Moreover, both in government institutes and in BIRDEM, test withholding was indicated as an obstacle for timely reporting the results. Although many of the laboratory attendants mentioned about the collection or delivery problems in BIDEM and the opposite in government institutes, it might be important in this regard to relate the findings from the patients' view. In fact, the extent of problems existing might be higher in government institutes and the higher response rate in case of BIRDEM attendants might represent their more accountability.

Except for 18% cases in BIRDEM, it was found that sample collection and report delivery errors could be informed to the authorities and thus the problems were frequently discussed in the organizations. However, 18% of the laboratory attendants in BIRDEM and 23% in private diagnostic centers mentioned about the lack of discussion practices in those laboratories regarding sample collection or report delivery problems whereas the problems were less frequent in private sector. These indicate that informing laboratory problems to authorities and discussion of the problems regularly is not always sufficient to solve the problems. A strict management practice in private diagnostics might be more efficient in solving sample collection and report delivery problems.

Test performers were having a varying academic qualification starting from diploma in medical technology to science postgraduation or postgraduation in respective field of medical diagnostics. In all the institutes, none were found having academic qualification at or below HSC level. Workload was more in government institutes and in private laboratories, which indicate lack of appropriate number of manpower recruitment in those laboratories. In private organization, it might be done to obtain higher productivity from minimum expenses on salary but in government sector, it might reflect the neglected diagnostic medicine in health care delivery system.

The test performers indicated different problems like sample collection errors, space and working environment problems in the laboratories; administrative problems, instrumental as well as reagent problems. The test performers in the government diagnostics compared to BIRDEM and private centers more frequently reported most of these problems.

For test result checking, head of the department was directly involved in less than one fourth cases in government institutes whereas in most cases in private laboratories. In government institutes and in BIRDEM immediate senior test performers were responsible for checking the test results. The head of the departments and postgraduates in most of private laboratories signed test reports. Moreover, frequency of checking overall test performances was found more in case of private laboratories. All these indicate a better system existing in private laboratories in regard to test performance.

9.4. Quality control of tests and methods

According to the information obtained from test performers, quality control practices during laboratory tests were more appropriate in private diagnostics and in BIRDEM. It is observed that checking of quality control through discussion, meeting etc. is more frequent in BIRDEM and private laboratories than government institutes. However, none of the diagnostic centers had any quality officer separately and test performers themselves were found responsible for maintaining their own quality control practices.

9.5. Safety measures for patients and sample collection attendants

Practices of safety measures for patients and collection attendants during sample collection was found to be the use of disposable gloves and syringes in half of the cases in all types of diagnostic organizations. However, about half of the collection attendants in all the organization had no precautionary measures for themselves and 25% also indicated about the lack of any precautionary measures for patients in the government institutes. These findings suggest that patients' safety be partially neglected in government laboratories whereas collection attendants' safety is ignored in all type of organizations in Dhaka City.

9.6. Laboratory waste disposal

Laboratory waste materials including biological wastes needs to be properly disposed. Usually autoclaving or incineration is recommended before biological waste disposal to the environment. However, in most of the diagnostic laboratories in Dhaka City, the practice was found to be different. All the laboratory attendants in BIRDEM, 39% in government institutes and 50% in private diagnostic laboratories mentioned about

laboratory waste disposal in municipal corporations' dustbin. Burning as mode of waste disposal was mentioned in government and private laboratories but the laboratory attendants in government institutes also indicated use of washing basins. Such unsafe waste disposal practices may ultimately expose the peoples to risk of more health hazards.

9.7. Activities of head of the departments and implication in laboratory services

Management is a broader function, which means not only the administrative functions but also determining how the laboratory operates (Wilcox Jr, 1978). Roles played by the laboratory head are setting the strategic, tactical as well as operational objectives for the laboratory. They are also responsible for organizing the personnel, facilities, equipment and materials into a coherent organization, ensuring coordination between various departments of the organization. Head of the department of a lab are responsible for resolving existing laboratory problems and collection of feed-back for correction of deviation when activity is completed. The laboratory head also determine the technical methods to be used, supervising day to day work, handling personnel matters, anticipating potential problems. But the primary responsibility is assuring the quality as per objectives and policies set in the diagnostic organization (Wilcox Jr, 1978).

In comparing the roles of heads of the studied organizations, it was observed that planning and long-term objectives vary among various categories of centers, which also affects ultimate goal of lab services to the population. These were attributable to schedules of respective laboratories, plan makers and their participation in planning, purpose of planning and extent of involvement of central policy makers into it.

interdepartmental coordination, supervision of lab works and standards used for laboratory activities. Overall, these were better in institutional laboratories than private ones, especially in non-government institute as revealed in BIRDEM.

The departmental head must be in a position to decide the recruitment of appropriate working personnel to execute laboratory functions and purchases in order to protect his ability to assure that laboratory personnel have the proper materials to work (Wilcox Jr, 1978). In all of these aspects, decision-making authority must lie on the heads of the respective departments. However, it was found that other than BIRDEM, neither the private nor the government organizations offer the head of the department with the decision-making authority.

Estimation of demand in institutes was mainly dependent on patients' response and cost of services in BIRDEM; but in private laboratories, it was dependent on doctors' referral only. According to the information obtained from head of the department, main service barriers in government and non-government institutes were lack of expertise and instrumental facilities whereas financial problems equally affected all types of diagnostic organizations.

9.8. Productivity of employees

The volume of workload expected must be determined for proper staffing and supply of the laboratory personnel. In this study, it was observed that in the laboratories of non-government institute BIRDEM and in private laboratories, the load of work is appropriate to greater extent than that of government institutes. Moreover, greater

problems of tests in terms of environmental, administrative, instrumental and reagent also attributed to the downward situation in government diagnostic laboratories.

9.9. Training of employees

Any process that increases the skills and abilities of the employees to perform a specific job is referred to as training, which is usually distinguished from education, and is the process of increasing one's understanding, though there are obvious overlaps between the two processes (Inhorn, 1978). In this study, it is observed that educational background of laboratory personnel widely varied from organization to organization. It also noticed that training need assessment was performed better in BIRDEM and government institutes than private diagnostic centers. The unawareness of the private laboratories about the training need for the working personnel might be due to their recruitment policy for the more experienced and skilled personnel selectively from government and non-government institutes on part-time basis.

9.10. Longitudinal assessment of service

In a broader sense, this aspect can be evaluated by observing the periodic turnover of patients served by the various organizations and their departments individually from the registration data. In an attempt to procure the amount of service providence, the approximate number of patients served yearly for retrograde ten years was analyzed in the study on the basis of information collected from the respective authorities and departmental heads. It was observed that diagnostic section of BIRDEM was serving a significantly higher number of populations, than other organizations. This may be attributable to its privilege for specified service on a large number of diabetic patients regularly and the diabetic patients from other organizations in the country are also

referred to BIRDEM for diagnostic service. Moreover, BIRDEM is extending its disciplines to multi-sectors of health problems in addition to diabetes day by day. However, it was noticed that the yearly service has not increased much over time in any of the organizational groups. About the departmental services, government institutes dominates in the service of Imaging, Microbiology, Histopathology and Endocrinology over BIRDEM. On the contrary, service of Biochemistry and Serology/Immunology dominate in BIRDEM over government institutes.

9.11. Monthly income and cost assessment in various departments

Monthly income of the laboratories is dependent on overall service, quality of tests, public response along with other factors. Also these are dependent on the total space of the organization, which determine the scope for extension of diagnostic facilities. Overall, the test prices of the private laboratories and BIRDEM were found higher than that of government institutes. Therefore, the net higher income in BIRDEM and relatively higher (when adjusted for number of tests) in private laboratories was due to higher test prices.

10. Conclusions & Recommendations

It can be concluded from the present study that practicing doctors mainly determined the laboratory where the tests done though preference of patients did not always fit with doctors' preference. Although the doctors preferred non-government or private diagnostic centers than government institutional laboratories, they were not much aware of the quality of investigations or test prices in different type of organizations. Patients preferred diagnostic service in BIRDEM or in private centers but most of the patients considered the price for diagnostic tests to be much higher.

Although, pathological sample collection attendants of institutes were found more educated and experienced than that of private laboratories, problems in sample collection and labeling errors were prevalent in those organizations. Workload on test performers was also found more in private diagnostics and government institutes. Test withholding was the major problem in diagnostic service in government laboratories, whereas in BIRDEM major drawback was long delay in pre-investigation processing and report delivery. Loss of reports was another common complains in BIRDEM diagnostic service. These problems were quite infrequent in private diagnostic centers. Laboratory safety measures during sample collection were found inadequate in private laboratories and government institutes compared to BIRDEM. Laboratory waste disposal system was also improper in all diagnostic centers.

Central authority was found responsible for mainly making long-term plans in government institutes. Problems encountered in diagnostic service in the organizations were discussed less frequently in government institutes however, barriers of various sectors equally affected all categories of organizations.

Although the number of tests performed was more in government institutes, total service to population is more in BIRDEM. Regarding income generation departments of imaging, clinical pathology/histopathology and microbiology were found important for government institutes, whereas clinical biochemistry and serology/immunology departments for BIRDEM.

Based on the present health service system and facilities existing in Bangladesh and according to our study findings regarding diagnostic service management in private and public organizations, the following model for diagnostic service may be recommended. Since diagnostic service is a prerequisite for better and accurate treatment, government should take the initiatives to disseminate the service to ensure and enhance the hospital based health care service in Bangladesh. This responsibility starts from the Ministry of Health and Family Welfare (MHFW) by extending the wings of the concerned Ministry to Diagnostic Welfare Section as a separate unit within the same ministry. MHFW may form a committee of resource personnel encompassing specialist physicians, biomedical engineers, management experts, economist, and other professionals who would take the ultimate responsibility for Implementation, Monitoring, Evaluation and Development (IMED) of this sector. The committee may also provide a specific guideline for standard laboratory practice including the methods and reagents' approval prior to use in a diagnostic laboratory. They can also conduct periodic quality assurance programs. The activities and all information should be transparent to the community. MHFW should also delegate the monitoring and implementation of diagnostic activities to the grass root level. Activity of the diagnostic sector personnel should be accountable to the committee, where the committee should remain accountable for any clarification to MHFW. However, the

freedom of doctors and patients should not be controlled. The patients should have easy access to get or collect all kinds of information (physical facilities, test price, diagnostic facilities, location, complaining authority etc) about the diagnostic services so that they can choose the best one for them.

There should be a department in each diagnostic laboratory [e.g. Medical Information System (MIS) department] that would preserve necessary information from patients for any clarification as required by the committee of MHFW or by MHFW itself externally and should be accountable to the heads of various departments of that organization.

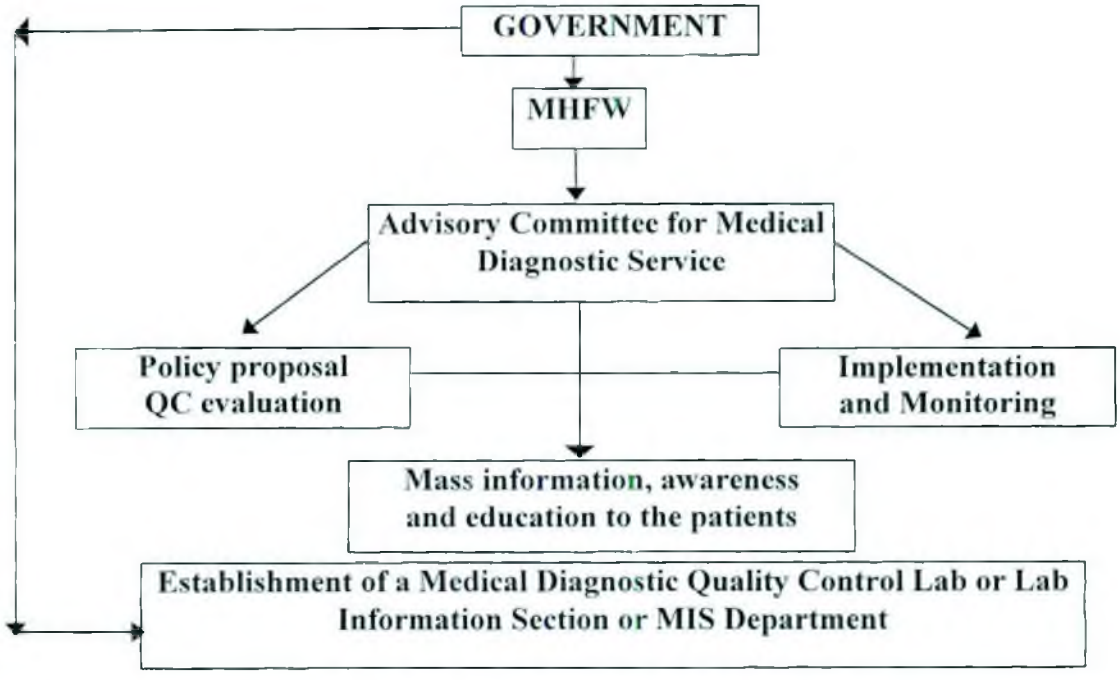
Before going to the registration-counter, the patient would show their prescription to the MIS department and tests advised by prescribing doctor would be recorded and a slip-tag may be issued to process further the requisition for paying test prices, sample collection, or preinvestigation preparation of the patients etc.

Samples may be collected only from the counter and not from the respective department for any reason. Collection attendants would collect the samples and rack it for respective department. Lab attendants would process the sample, test performers would perform the test and prepare the reports. The departmental head would take the responsibility of all kinds of discussion of problems, report checking, report signing etc. He can delegate the authority and he should have confidence about the personnel practices in his lab. Lab attendants would send signed report to the counter. If there were any incident like report lost, inaccurate report, the patients would complain to

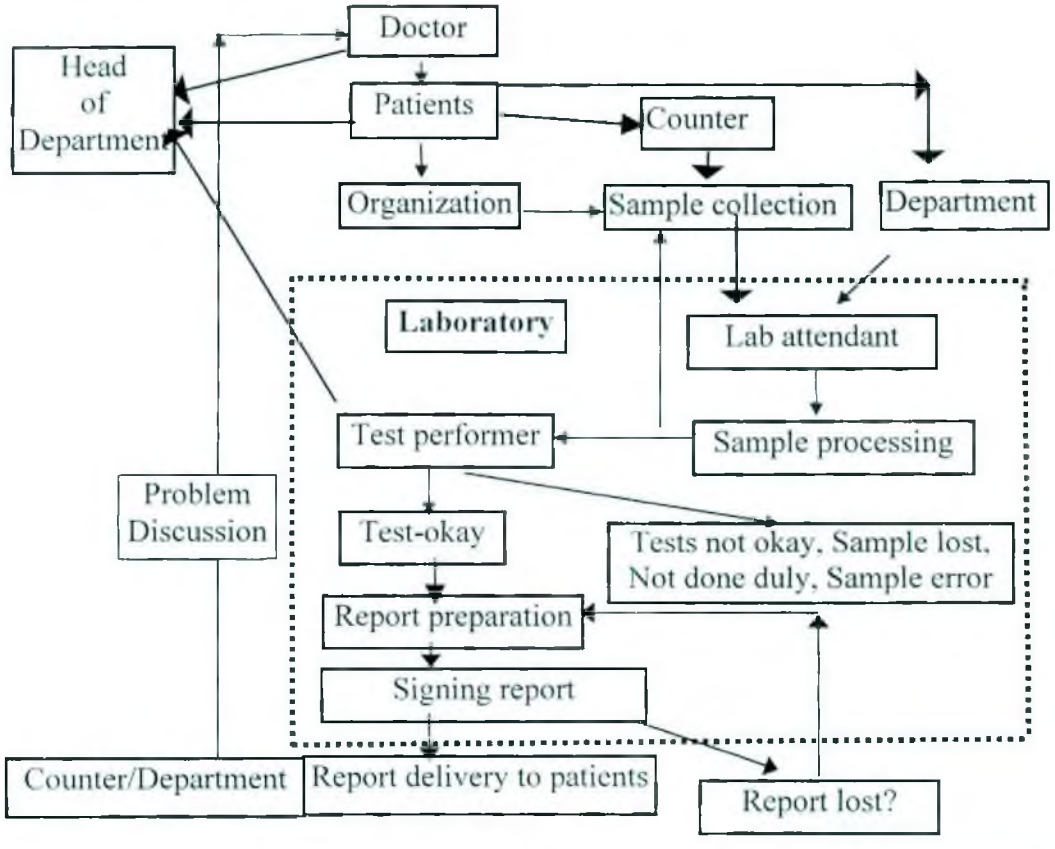
the complaining authority or departmental heads who would communicate with the MIS department, and if necessary the whole process should be repeated free of cost.

The main limitation of the proposed diagnostic service system is to motivate the practicing doctors so that they suggest the patients to choose the correct diagnostic centers. The attending physicians can inform patients about the diagnostic laboratories but doctors should not influence their choices. However, the relationships between doctors and patients also should remain beyond the control of government's policies.

Diagrammatic presentation of the Proposed Delivery System of Diagnostic Care



Proposed laboratory service system in a diagnostic center



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12. Appendices

12.1. Questionnaire for doctors

Sl No:
Name of the department:
Name of the institution:
Name:
Age
Sex:
Field of speciality:
Designation:

1. Where do you send your patients for the test?
   - Private lab ☐
   - BIRDEM/APL/ICDDRB ☐
   - Govt. lab (hospital based) ☐
2. Why?
   - Report accurate ☐
   - Earlier delivery ☐
   - Bound to send specific laboratory ☐
   - Patient's preference ☐
   - Economical ☐
3. How you justify the quality of the concern authority (investigation reports reported by your specific laboratory)?
   - Excellent ☐
   - Good ☐
   - Average ☐
   - Poor ☐
4. Do you know about the expertise lab technicians where you are sending patients for investigations?

   Yes ☐ No ☐
5. Do you very often find varying reports from different laboratories?

   Yes ☐ No ☐
6. Do you find clinical co-relation between clinical diagnosis and investigating diagnosis

   Yes ☐ No ☐

12.2. Questionnaire for the patients

SL NO:

Personal Information for the patient:

Name of the institution/ place where interview was taken:

Name of the patient:

Age:

Sex: Male/female

Occupation: a. House wife b. businessman c. student d. service e. others

Total number of family members:

The level of education: a. primary b. secondary c. graduate d. post graduate e. others

Monthly family income: a. <5,000 b. 5,001-10,000 c. 10001-15000
d. 15001-20000 e. 20001-30000 f. 30001-40000
g. 40001-50000 h. 50001+

1. Name of the test laboratory:
   - BIRDEM ☐
   - DMCH ☐
   - BSMMU ☐
   - PRIVATE LAB ☐
   - Others ☐
2. Your visit in the concern diagnostic lab/clinic/hospital was an
   a. In-patient b. Out patient
3. Do you face any problem during collection of specimen by lab attendant?
   Yes No
4. If yes what are those?
   - Misbehave ☐
   - Irregularity ☐
   - Loss of time ☐
   - Lack of courtesy ☐
   - None
5. Do you face any problem during the report delivery
   Yes No
6. Do you think the money you are paying is:
   - Very high ☐
   - Considerably high ☐
   - Appropriate ☐
7. Why you have come here for test?
   - Consultant sent ☐
   - On my own choice ☐
8. Are you happy with:
   - Behavior of lab personnel ☐
   - Timely delivery of the report ☐
   - Price that you are paid ☐
9. How did you judge the quality of the service:
   - Excellent ☐
   - Good ☐
   - Bad ☐
   - None ☐
10. Complaining authority:
    - Lab authority ☐
    - The referral doctor ☐
11. Suggestions about the service of the lab:

12.3. Questionnaire for sample collection attendants

Sl No:
Name of the department:
Name of the institution:
Name:
Age:
Sex:
Educational qualification:
Year of service:

1. What problems do you face during drawing blood samples?

2. What precautions you take before drawing the blood?
   - Disposable syringe ☐
   - Use of gloves ☐
   - None ☐
3. How do you dispose used syringe, needle, samples etc?
   - Dustbin ☐
   - Wash in basin ☐
   - Burning ☐

12.4. Questionnaire for lab attendants

Sl No:
Name of the department:
Name of the institution:
Name:
Age:
Sex: M/F
Educational qualifications:
Year of service:

1. How do you collect samples
   - On regular basis ☐
   - Occasionally ☐

2. What problem do you face during sample collections?
   - Irregularity /mistakes in receipt ☐
   - Error in collecting material ☐
   - Sample levelling problem ☐
   - None
3. Do you have any complaining authority if you face any problem in your service?
   Y ☐ N ☐
4. If yes who is he?
   - Central authority ☐
   - Immediate boss ☐
   - Departmental head ☐
   - None ☐
5. How many days per month they discuss about the problem you are facing or faced?
6. What problem do you face with report delivery?
   - Not served in due time ☐
   - Mistakes in delivery to proper patient ☐
   - Report lost ☐
   - Test not done for any reason/withheld ☐
   - None ☐

12.5. Questionnaire for test performers

Sl. No:
Name of the department:
Name of the institution:
Name:
Age:
Sex:
Educational qualifications:
Designation:

1. How many tests you perform per day?
2. The number of tests you perform per day are
   - Overload for you ☐
   - Appropriate for you ☐
   - Less than you could do ☐
3. If overloaded the chances of error is:
   - Frequent ☐
   - Occasionally ☐
   - None ☐
4. Who does check the test result?
   - Departmental head ☐
   - Immediate boss ☐
   - Colleagues ☐
5. Who does sign the test results?
   - Postgraduate ☐
   - Graduate ☐
   - Others ☐
6. What problem do you face during the test?
   - Sample error ☐
   - Lab space problem ☐
   - Lab environmental problem ☐
   - Administrative ☐
   - Instrumental problem ☐
   - Reagent problem ☐
   - None ☐
   - Others ☐
7. How frequent you check for quality control?
   - Monthly ☐
   - Fortnightly ☐
   - Weekly ☐
   - 6 monthly ☐
   - None ☐
8. How do you check quality: using standard samples?
   - In every assay batch ☐
   - For each kit ☐
   - Occasionally ☐
   - Never ☐

12.6. Questionnaire for the departmental heads

Sl. NO:
Name of the Institution:
Name of the department:
Departmental head (designation):
Name: Age: Sex:
Qualification: service year:

1. What are the objectives of this unit?
2. How frequently objectives updated?
   - Yearly ☐
   - After two years ☐
   - After five years ☐
3. What is the long term objective of the sector?
   - Formulation of policy to increase the service ☐
   - Allocation of resources for implementing policies ☐
4. Do you have any operational planning to achieve the long-term planning?
   Yes ☐ No ☐
5. If yes what are those?
   - Identification of appropriate methods of testing ☐
   - Training of the lab personnel ☐
   - Assigning activities and task to employees ☐
6. Who makes plan for the year?
   - Central authority ☐
   - Departmental head ☐
7. If central authority makes plan do you have any participation?
   Yes ☐ No ☐
8. If yes, to what extent
9. Plans being developed for
   - mid-stream corrections ☐
   - fall-back situations ☐
   - corrective actions when project gets off-track ☐
10. What are the alternative strategies analysed?
11. Are sector objectives explicit and quantified?
    Yes ☐ No ☐
12. What are the informal objectives?
13. What is the process of deciding on diagnostic objectives?
14. Do central policies exist which govern the acquisition and use of the resources needed to attain diagnostic objectives?
    Yes ☐ No ☐
    - If yes to what extent?
15. Is sector planning, objective setting and priority setting done in co-operation with and/or in taking into consideration other sectors which affects sector performance?
    Yes ☐ No ☐
16. If yes, what is the process?
17. How many times you supervise the activities of your subordinates?
    - Daily ☐
    - Weekly ☐
    - monthly ☐
18. Are you alone take the responsibility of checking the activities of subordinates?

Yes ☐ No ☐

19. If no who share your responsibility?
    - Head of other departments ☐
    - SRO ☐
    - Any other personnel ☐
20. How you allocate the task to your subordinates?
    - Back ground experience ☐
    - Time involved ☐
    - Seniority ☐
21. Do you think that feedback is necessary for checking?

Yes ☐ No ☐

22. If yes, how you collect the feedback?
    - Documents ☐
    - Discussion ☐
    - meeting ☐
23. If there is no feed back system, how do you monitor the activities?
    - No monitoring ☐
    - responsibility ☐
    - I do not know ☐

Beneficiary analysis:

24. Do sector plans identify target population groups to serve?

Yes ☐ No ☐

25. If yes, what are the target population to serve? (Demand)
26. What are the indicators do you set for demand estimation?
27. If sector single out special need of the targeted population, what are those?
28. On what basis is priority of service needs determined?
29. Will beneficiaries be asked/invited/force to participate in service delivery and/or to share in the costs of provided services?
30. Can unmet demand be estimated?

Yes ☐ No ☐

31. If yes,
32. How you estimate the unmet demand?
33. What are the major service access barriers and how can they is avoided, circumvented, eliminated?

Provision of goods and services:

34. Who is the major institutional service provider?
35. Are performance data available on service providers?
36. If yes, what are those?
37. What goods and services are provided to the community?
38. By whom and how?
39. What level of technology is available in the sector? How is it be used?
40. Can the technologies be developed within the life of project?
41. Will the proposed delivery mechanisms be capable of providing the goods and services needed to meet the projected demand?
42. Will the most cost/effective provider provide the services?
    - Least test price with accurate test result. ☐
    - Concession for those who tests more than one test ☐
    - Less waste of kits ☐

Procurement and logistics materials:

43. What are the logistics supports of this sector?
44. How does the sector procure materials and supplies?
45. What procedures are followed?
46. On what basis is the volume of needed materials and supplies forecasted?
47. How will goods and services purchased?
48. Are materials and supplies are centrally purchased, received and stored?
49. How does the organisation assure itself that it has actually received the material s and supplies being charged for, that there are no damaged materials, and that all materials reach the storage area without theft?
50. How are supplies distributed from central store to the user?
51. How is equipment identified, inspected and maintained?
52. What is the sector capacity to produce its own supplies?
53. How much is imported?
54. How effective is the distribution network?

Organizational design:

55. How does the sector relate to other sectors and external agencies?
56. Is this relationship changing?
57. If yes, in what extent?
58. What are the intra-sector and intra-institutional relationships in terms of:
    - Co-ordination of plans and policies ☐
    - Co-operation of staff and line levels
    - Sharing of services ☐
59. What is the locus of decision making?
60. How centralised is the sector in terms of :
    - Decision making ☐
    - Execution ☐
61. To what degree are programmatic activities integrated or free standing?
62. Which are the most powerful pressure groups?

Personnel:

63. What is the number and type of sectoral human resources by category of worker available and needed?
64. What are the sectors training facilities by category of worker?

65. To what extent is the sector dependent on other sectors to meet its personnel needs?
66. What is the sectors competitive position to attract and retain personnel?
67. What incentives are available? What policy options is available to change maldistribution of professional?
68. What "full time equivalent" staff members are employed in each occupational category?

Control system:

69. How do you set/check the standard of the test?
70. Quality control of manufactured supplies and drugs, of services produced and delivered

Estimation of demand for services:

YEAR	TARGETED POPULATION TO SERVED FOR THE YEAR(A)	POPULATION SERVED (B)	UNMET DEMAND(A-B)	REASONS
1989				
1990				
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998				
1999				

Capacity utilisation:

Equipment:

MACHINE	TOTAL TEST CAN BE DONE	TOTALDONE	% OF CAPACITY UTILISED	IDENTIFICATIO N OF PROBLEM

Personnel:

Positions	Qualifi-cations	Training need identification	Possible training	Task assigned /work schedule			

Infrastructural cost:

Space cost (monthly)	Electricity, water, gas bill (monthly)	Name of Instrument	Instrument cost at current market price	Cost for furniture & fixture

Operational cost:

Test name	Test done per week	Test price	Instruments /method used	No of test can be done/week	No of test done	Manpower require for the test

(Analysis by one-way ANOVA within organizations; two-way ANOVA between organizations)