



Cost Analysis of Chemical Pathological Investigations in Biochemistry (Chemical Pathology) Laboratory of De Soysa Hospital for Women (DSHW)

¹Dr.Thangarajah Gandeepan

Ministry of Health, Sri Lanka

ABSTRACT

Reliable and timely results from laboratory investigations are critical elements for decision-making in curative health care. Health services highly dependent on reliable and timely laboratory investigations which used to diagnose, treat and prevent patients from diseases. In addition, it is useful in surveillance and control of diseases such as Covid-19.

The objectives of this case study are identifying the range of chemical pathological investigations, identify the process of chemical pathology investigations, the equipment needed for investigations and the reagents needed for the chemical pathological investigations and analyses the cost and determine the strategies to minimize the cost and to recommend solutions.

Direct observation, key informant interviews and focal group discussions were used to assess the existing situation. FGD successfully carried out for chief MLT including MLTs. Key informants were Director, Deputy Director, Chief MLT and ward in-charge sister were interviewed Identified problems were prioritized based on the in-depth interview with the Deputy director of DMH.

Four major problems are identified in bio-chemistry laboratory. The main problems selected based on pareto principle “defect in sample collection procedures during pre-analytical phase”.

Isikawa diagram was used to analyze the root causes and the human resource related factor was detected to have highest underlying and root causes.

Non-availability of SOPs/non-revision of manual to guide sample collection is however a major drawback at the moment. It is recommended nurses have to be trained adequately at the inception and also on service training in performing sample collection. Delays in sample collection can be avoided by ensuring the following Well-trained staff, by good working organization and well-designed SOPs.

1. Introduction

Laboratory services is one of building blocks of health service model which is a significant part of health systems. An effective laboratory service in a hospital consists of competent organizational and management structure, efficiently managed human resources, well planned laboratory infrastructure, appropriate care and maintenance of equipment, continuous provision of laboratory supplies, a regular updated functional information management system and frequently evaluated quality assurance management system. Ministry of Health identifies health laboratory service as an essential component in the health care service. It is committed to provide a quantitative and qualitative essential laboratory support to health care providers (Ministry of Health Sri Lanka, 2006).

The future of Sri Lankan Health system mainly depends on several key factors such as increased elderly population, climate changes, lifestyle changes, new and re-emerging diseases and health financing. It's crucial to focus on improving the cost-efficiency and reliability of laboratory investigations as the above key factors has increased the demand of laboratory investigations on top of economic crisis (Bogavac-stanojevic & Jelic-ivanovic, 2017). The health awareness of people and high literacy rate increase the demand for laboratory services. Cost-effective strategies and efficient use of laboratory investigations is mandatory to address the rising demand of laboratory services during the economic crisis in Sri Lanka.

DMH is the second oldest maternity home in Asia. It delivers care for over 15,000 maternity cases each year includes, majority of them are in high-risk. In addition, it offers services in, gynecology, new born care, sub-fertility and family planning. Intensive Care Units provides notable services and useful for the mothers and for the new born babies. Laboratory system in DMH contributed immensely for carryout the services without interruption

2. Objectives

1. Identify the range of chemical pathological investigations
2. To identify the process of chemical pathology investigations, the equipment needed for investigations and the reagents needed for the chemical pathological investigations
3. To analyse the cost and determine the strategies to minimize the cost and to recommend solutions.

3. Methodology

Direct observation, key informant interviews and focal group discussions were used to assess the existing situation.

FGD successfully carried out for chief MLT including MLTs. Key informants were Director, Deputy Director, Chief MLT and ward in-charge sister were interviewed

Identified problems were prioritized based on the in-depth interview with the Deputy director of DMH.

4. Situation analysis

4.1 Human Resources

There are thirteen MLTs are present at DMH now. The medical laboratory technicians (MLT) are under the chemical pathologist and carried out all test procedures on clinical samples.

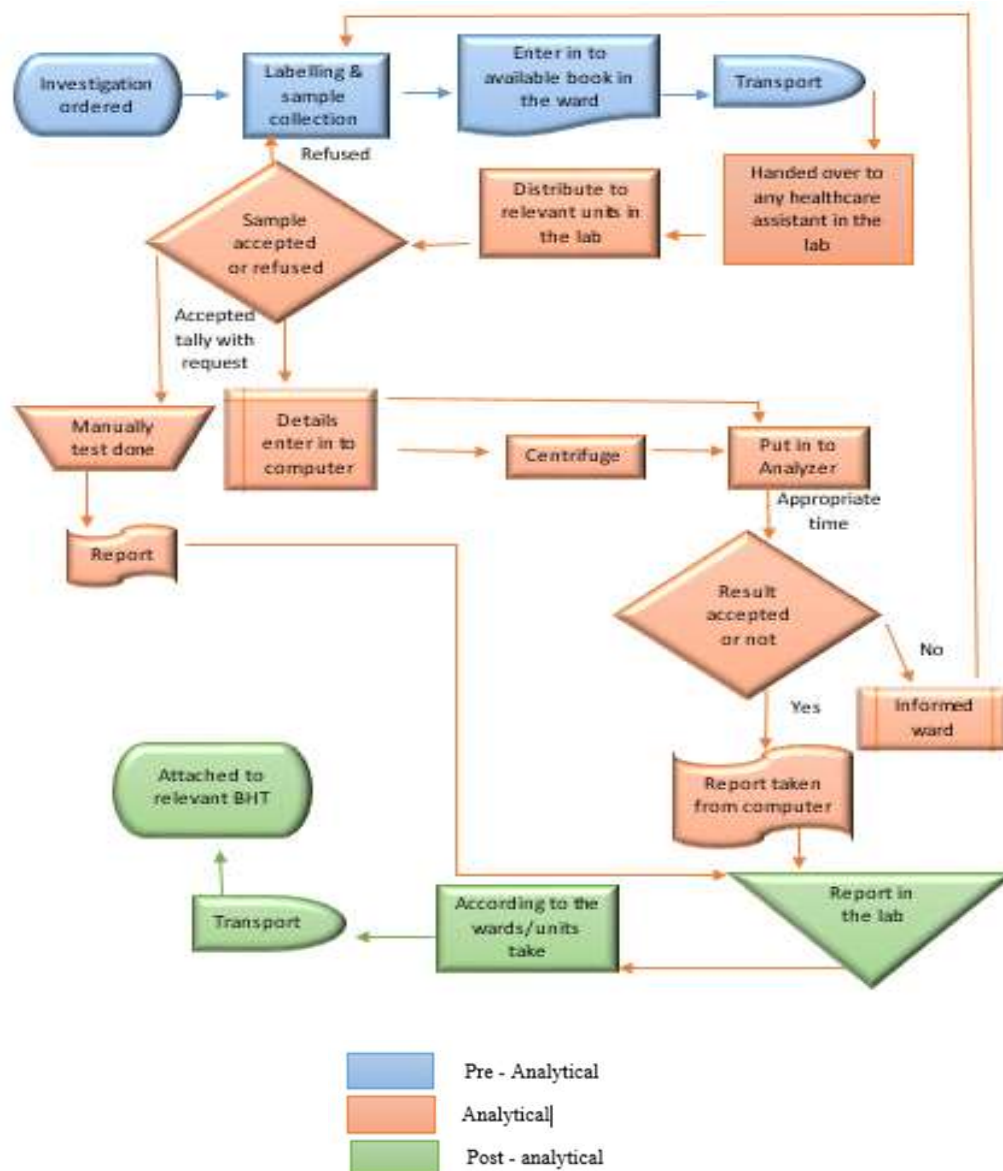
Consultant Chemical Pathologist supervises all laboratory procedures and oversee MLTs. Consultant Chemical pathologist is ensuring the quality and accuracy of chemical pathology reports by quality assurance process.

Chief MLT is under the supervision of chemical pathologist ensure overall supervision of laboratory staff including MLTs, Laboratory assistants and minor staff. Chief MLT is preparing the roster for MLTs and other staff. MLTs are carried out all test procedures on clinical samples. MLTs do internal quality control each day before starting to function bio chemistry analyzer. Regent stores maintained by Chief MLT.

4.2 Range of chemical pathological investigations

The chemical pathology department do general biochemistry tests and other special tests. They mainly do LFT, RFT, Bone profile and Sugar tests. In addition, they do tumor markers, hormones assay, bio chemical tests in urine, CSF and other body fluids, electrophoresis and other immunological tests.

Figure 2: Process of chemical pathology investigations in biochemistry laboratory.



The above process is carried out in chemical pathology department. MLTs daily do quality assurance according to check list. Records of results entered in computers with the names and other details like bed head ticket number ward number, the samples requested and results of samples.

Routine biochemistry samples accepted until 2.30 pm as a stipulated time is required for sample preparation and do test before 4.00pm. They accepted very urgent tests if it is informed to the laboratory. Results of routine biochemistry tests are delivered before 4 pm. They accepting samples for night laboratory after 3.00pm and only selected urgent tests can performed at night laboratory.

4.3 The equipment needed for investigations

Majority of bio chemical tests are performed by MLTs using two analyzers. They are Selectra Pro-XL and Beckman Coulter AU-480 machines. Selectra-XL is 5 years old analyzer and it will go into service agreement next Year and Beckman Coulter AU 480 is 10 years old which already in-service agreement. MLTs are performing routine preventive maintenance procedures for these machines. Minor repairs are done from bio medical engineering services department whenever support needed.

4.4 To identify the reagents needed for the chemical pathological investigations

Both Analyzers in DMH are wet Bio chemistry analyzers. Wet analyzers need liquid reagent and distilled water. The cost of reagents used for wet analyzers comparatively low than reagents used in dry analyzers. But Dry analyzers reports accuracy and sensitive are high and maintenance free for 5 years.

4.5 To analyses the cost and the recommendations to minimize the cost.

Table 2: Analysis of Bio- Chemistry Analyzer

Test Name	No of components/Tests	Equipment Name	Equipment/ Model	Test per hour	Maximum Tests per day
LFT	Albumin, Globulin, Alkaline po4, SGOT, SGPT	Selectra, Beckman Coulter	Pro-XL, AU 480	200/hour 480/hour	600
RFT	Urea, Serum creatinine, SE	Selectra, Beckman Coulter	Pro-XL, AU 480	200/hour 480/hour	600
Bone Profile	Ca, Albumin, Phosphate, Alkaline phosphatase	Selectra, Beckman Coulter	Pro-XL, AU 480	200/hour 480/hour	600
Sugar Set (PPBS, FBS, BSS, OGTT) CRP		Selectra, Beckman Coulter	Pro-XL, AU 480	200/hour 480/hour	600
Lipid Profile	Serum Cholesterol, LDL, VLDL, HDL, HDL/LDL ratio	Selectra, Beckman Coulter	Pro-XL, AU 480	200/hour 480/hour	600

Table 3: Cost analysis of Bio-Chemistry tests

Lab Test Name	Reagent Cost per test	Labor Cost	Overhead cost	Print Cost	Machine Maintenance cost	Cost/Test
LFT	Rs.500	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs 560.25
RFT	Rs.150	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.210.25
Bone Profile	Rs.200	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.260.25
Sugar Test						
1.FBS	Rs.20	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.80.25
2.OGTT	Rs.60	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.120.25
CRP	Rs.200	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.260.25
Lipid Profile						
Serum Cholesterol	Rs.350	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.410.25
LDH	Rs.50	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.110.25
	Rs.150	Rs.57	Rs0.50	Rs.2	Rs0.75	Rs.210.25

Note: The reagents cost calculated are approximate figure and it will fluctuate with SLR depreciation. These cost may vary depends on variety of analyzer whether it is dry or wet analyzer.

Table 4: Labour/Salary Cost includes Consultant salary, MLT salary and Health Service assistant salary

Human Resource	No of Staff	Salary	Total Salary	Total HR Salary/Month	Total Tests/Month	Salary cost/Test
Consultant	01	Rs 350 000	Rs 350 000	Rs 350 000	600X30=18000	1,025000/18000= Rs.57
Medical Officer	01	Rs 250 000	Rs 250 000	Rs 250 000		
MLT	03	Rs. 125 000	Rs.375 000	Rs.375 000		
HAS	01	Rs 50000	Rs 50000	Rs 50000		
				Rs 1 025 000		

Table 5: Other Costs details

Name	Total Cost/month	No of test/month	Cost/test
Over Head Cost (Electricity, Water, Telephone)	9000	600X30=18000	Rs 0.50
Printing test cost	36000	600X30=18000	Rs.2
Maintenance cost (Service agreement) =160000/year	160000/12	600X30=18000	Rs.075

5. Problems identified in biochemistry laboratory

Four major problems are identified in bio-chemistry laboratory

1. Defect in sample collection procedures during pre-analytic phase.
2. Problems with continuous supply of reagents due to ordering delays and non-settlement of payments
3. No backup system with the breakdown of machines and increase downtime.
4. Underutilization of available analyzers

5.1. Defect in sample collection procedures during pre-analytical phase.

Samples can be rejected when MLTs check the request form, the test tube name, and the requested tests are not matched in pre-analytical phase which help to prevent performing unnecessary tests and reduce cost. Though defect in sample collection procedures most of the time cannot be detected in pre-analytical phase and only detected after tests are performed. Though MLTs need to make sure the adequate amount of the sample received, observe if there is hemolysis or lipemic serum.

It has observed the nurses most time not read the history of food intake, alcohol, drugs, smoking, stress, sleep, and posture because these factors may influence the result. They fail to explain all instructions to the patient for the collection of the sample. In-addition new nurses sometimes collect in incorrect containers and incorrect preservatives which affect the result. Further they didn't know the procedures which affect the result such as collecting blood for Ca without tourniquet or taking from same cannula where saline is infused.

5.2. Problems with continuous supply of reagents due to ordering delays and non-settlement of payments during post covid-19 era.

Bio chemistry lab faced supply chain issues in few instances, for a number of test reagent shortages and as a result will be forced to conserve reagent resources. Unfortunately, these reagents have no alternate suppliers. DMH at present have six-month stock with the donations and buffer stock.

5.3. No backup system with the breakdown of machines and increases the downtime during post covid-19 era.

Bio chemistry laboratory faced supply chain disruptions quite a few times resulting in severe delays to lab equipment spare parts delivery since the onset of the Covid-19 pandemic. Many spare parts of laboratory equipment are custom built and standard parts are routinely kept to a minimum by manufacturers. The above-mentioned factors have manifested as **increased lead-time** or **lack of availability** and **increased cost**. Though DMH has two analyzers they able to function with on analyzer until the breakdown got repaired.

5.4. Underutilization of available analyzers.

The two analyzers at DMH functioning around the clock 365 days. The selectra bio chemistry analyzer can perform 200/hour and Beckman coulter test can perform 480/hour. The MLTs perceived though two machines working around the clock the efficiently utilized only 25 %. The MLTs happy to accept other hospitals laboratory requests or private patients can come to OPD and handover samples which can be accommodate if permission obtained.

Priority of Problem analysed

I had discussions with Director, Deputy Director and chief MLT in this regard through in depth interviews and eventually prioritized the problem. Technical feasibility, administrative feasibility, financial feasibility, practicability, impact, time consumption and acceptance were used as criteria for prioritization.

Many emphasize that the second and third problems are interconnected as due to covid-19 infections and can dealt together and expected to become continuous Supply chain process.

According too many to solve the fourth problem, the need to cater private lab investigations or outside patients is not an easy task. Many pointed out it is difficult to increase the testing, though the analyzers have the capacity of bio chemistry laboratories. The first problem "defect in sample collection procedures during pre-analytical phase" was selected since it was given priority based on the gravity of the problem. It was given since it long lasting issue and by solving this will result in producing better outcome.

6. Analysis of the problem

Isikawa/ Cause and Effect diagram is used to analyze the underlying causes (Cause and effect diagram)

Table 6 describes the causes, underlying and root causes for “defect in sample collection procedures during pre-analytical phase”

Table 6: Causes, underlying and root causes for “defect in sample collection procedures during pre-analytical phase”

Causes	Underlying causes	Root causes
1.Man/Human	1.1. Nurses are not adequately aware and experienced in performing sample collection	1.1.1. Lack of training to take samples during pre-placement and in-service training
		1.1.2. In service training is not linked with performance appraisal and promotional system
		1.1.3. Not having necessary skills developed
		1.1.4. Lack of motivation
	1.2. Inadequate coordination between nurses and laboratory staff	1.2.1. No systematic process is available to communicate in between them.
		1.2.2. Some unit nursing staff not wanted to coordinate with Laboratory
2. Material/Policy	2.1. Inadequate and inaccurate information is available on sample collection	2.1.1. The information obtained on sample collection of nurses are inadequate and inaccurate since there is no cross-checking mechanism is available
3.Method/ Procedure	4.1. No new methods or techniques updated in sample collection	Nurses face difficulty in obtaining information from the lab staff on getting updates or method or procedures.
	4.2. Inadequate time spent on trainings when do trainings	4.2.1. lack of trainers
		4.2.2. no prior planning
4. Environment	5.1. Inadequate support from the in-charge nurses to supervise	5.1.1. Not realized the importance
		5.1.2. Fear of increased work load
	5.2. Inadequate support from the trade unions to assess the KAP of sample collection to incorporate in performance appraisal.	5.2.1. Fear of exposing task performance weakness of the members thinking it may affect the career development opportunities of the members
		5.2.2. Not willing to cordially work with the administration

6.1. Selected cause for recommendation

Selected cause for recommendation is “Human resource” since it has highest number of underlying and root causes. Further if adequate periodical trainings introduced it will help to overcome the defects in sample collection.

7.Recommendations

It is recommended nurses have to be trained adequately and experienced in performing sample collection. Delays in sample collection can be avoided by ensuring the following.

1. Well-trained staff.
2. By good working organization.
3. Well-designed SOPs.
4. Thorough reading SOPs before performing.

8. Conclusion:

DMH is the center of excellence in maternity care in providing tertiary healthcare in Sri Lanka. In order to provide quality and safe laboratory services nursing staff should be adequately trained to minimize the delays in sample collection to reduce the cost.

Non-availability of SOPs/non-revision of manual to guide sample collection is however a major drawback at the moment.

Therefore, it is recommended to train nursing staff at the inception and also on service training.

9. Action Plan

- I. Preparation of Training program with administrators, managers and supervisors of the nursing officers and with MLTs involve in this process
- II. Revisit the laboratory manual or revised the SOPs on sample collection.
- III. Annex the training tools with the performance appraisal form
- IV. Based on the information gathered in from the training, CPD programs should be prioritized and trained calendar is prepared.

Reference:

Bogavac-stanojevic, N., & Jelic-ivanovic, Z. (2017). The cost-effective laboratory: Implementation of economic evaluation of laboratory testing. 36(3), 238–242. <https://doi.org/10.1515/jomb-2017-0036>

Ministry of Health SriLanka. (2006). National Health Laboratory Policy. December, 1–4.