

Evaluation on Satellite Laboratory Network (SLS) in the District of Badulla District of Sri Lanka

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Abstract: The laboratory services play a key role in all aspects of patient management. However, Laboratory services are concentrated in secondary and tertiary care hospitals. The SLS was started in 2006 to optimize laboratory services in the Badulla district by providing certain blood investigations to peripheral hospitals.

A formal evaluation of SLS had not conducted and hardly any scientific evidence on its feasibility, effectiveness. This study aimed fulfilling this requirement.

A descriptive cross-sectional study was carried to evaluate the existing SLS and to determine the factors that need to be considered for its expansion in the district.

It was found that 5 peripheral hospitals out of 63 hospitals received this service in 2006 and increased up to 12 by 2011. More than 70% of hospitals with SLS facilities viewed that having such system was important and help in avoiding unnecessary patient transfers to higher level hospitals. More than 50% of hospitals received their reports three or more days later. 9 hospitals (75%) out of 12 ceased to receive this service by October 2013. 76% of the SLS non-implemented hospitals had heard of this service and all of them requested SLS. Need for SLS was highlighted by smaller hospitals for implementation of NCD screening.

Not receiving reports on time, refusing more samples, delaying payment to minor staff, and inadequate number of minor staff were the main reasons contributed to cessation of SLS. Also, receiving laboratories pointed requesting tests that are not agreed, not receiving extra staff and extra allocation, unsatisfactory specimens and lack of guidelines problems of implementing SLS.

However, it was concluded the importance discussion with all stake holders regrading importance and issues of SLS system in Badulla.

Key words; satellite laboratory service, peripheral hospitals, SLS.

Introduction

Badulla is one of the two districts in Uva province of Sri Lanka with population of 850,000 and population density of 300.7 per km²(Ministry of Health, 2011). The health services in the district are delivered through one Provincial General Hospital, three BaseHospitals, 44 DivisionalHospitals, 15 Primary Medical Care Units and sixteen Medical Officer of Health (MOOH) areas as shown in Table 1.

Table 1: Distribution of hospitals in the district

Hospital Type	Number	Percentage (%)
Provincial General Hospital/ Base Hospitals	4	6.4
Divisional Hospitals (Type A)	2	3.2
Divisional Hospitals (Type B)	6	9.5
Divisional Hospitals (Type C)	36	57.1
Primary Medical Care Unit	15	23.8
Total	63	100.0

Source: Office of the regional Director of Health Services - Badulla

As far as the basic health indicators are concerned, the birth rate was 22.4 per 1000 midyear population in 2007 and Infant Mortality Rate was 9.9 per 1000 live births in 2003. The death rate was 5.5 per 1000 midyear population in 2007 and the Maternal Mortality Rate was 27.5 per 100,000 live births in 2002 (FHB, 2007). The first five leading causes of hospitalization were traumatic injuries, asthma and Chronic Obstructive Pulmonary Disease, viral diseases, diseases of gastro intestinal tract and diseases of genitor urinary tract while the first five

leading causes of death were Ischaemic Heart Disease, neoplasm, traumatic injuries, pulmonary heart disease and cardiovascular diseases in the district in 2007 (FHB, 2007).

The laboratory services play a key role in all aspects of patient management such as inward care, outpatient care and clinic care. They are mainly concentrated in tertiary and secondary care hospitals while only a very limited number of investigations are being carried out in divisional hospitals and primary medical care units due to limited resources in the health sector. For example, urine albumin and urine sugar tests are being performed in each level of care compared to Fasting Blood Sugar (FBS) and Full Blood Count (FBC) which are not being carried out in some Divisional Hospitals or any primary care hospital. However, acute case management as well as clinic services such as antenatal clinics and Non-Communicable Disease (NCD) clinics are being conducted routinely at primary care hospitals too. Therefore, certain investigations such as FBS, FBC, Blood Urea, Serum Creatinine (SC), Serum Electrolyte (SE) and Lipid Profile (LP) are important in patient follow up at clinics in all healthcare institutions in the country.

The satellite laboratory service was established in 2006 by the department of provincial health services guided by the director general of the health services to optimize laboratory services in the district of Badulla. The objective of this particular service was to improve patient care in the province by;

- Providing investigation facilities to peripheral hospitals in which those investigations were not possible to be carried out due to limited resources
- Reducing patient transfer from peripheral hospitals to secondary and tertiary care hospitals due to unavailability of such investigation facilities in peripheral hospitals.
- Thereby addressing the health system for accessibility and availability of slandered curative care practices at peripheral hospital. and
- Minimize the direct, indirect and out of pocket expenditure of the people in rural underprivileged community.

Only a limited number of blood investigations were offered through this special service to peripheral hospitals. A limited number of specimens from each hospital in a given region and all those collected samples were transferred to satellite laboratories by minor staff with the help of public transport services in the district. The investigations were carried out in pre-identified satellite laboratories and reports were sent back to peripheral health institutions by minor staff, by fax or by emails. It has been planned to implement this service in the district of Badulla as a pilot project and then to expand it to other parts of the province. Further, depending on the feasibility of carrying out such a service it may be implemented island-wide.

Justification for this study

Satellite laboratory service was found to be an important service to a middle-income country like Sri Lanka with limited resources in the health sector. It was started in 2006 and a formal evaluation of this satellite laboratory service had not been carried out since its commencement to date except of informal evaluations during district and provincial health reviews. Nearly six to seven years has passed by now since its beginning and therefore it is timely to look into its effectiveness in achieving programme objectives. There was hardly any scientific evidence on its feasibility, effectiveness in patient management and possibility of expanding this service to all peripheral hospitals in the district. Therefore, the present study was planned to determine its successfulness and to identify factors that may help further improve and expand it to other parts in the province as well as the country.

Objectives

General objective

To determine the effectiveness of the existing satellite laboratory network and to determine the factors that needs to be considered for its further improvement and expansion.

Specific Objectives

1. To describe the existing satellite laboratory network in relation to services provided through the network and its coverage.
2. To determine the human resource challenges and managerial constrains with regard to the satellite laboratory network.
3. To describe the factors that needs to be considered in improving and expanding the satellite laboratory network.

Literature Review

Healthcare Delivery Services

Since the inception of mankind, some sort of healthcare delivery service has existed helping man to preserve his health status. In Sri Lanka, the predominant healthcare system has been the traditional 'Ayurvedha' system which co-exists to date with other healthcare delivery systems. With the invasion of the Europeans from the sixteenth century, allopathic system was gradually established, and today it is the most popular form of healthcare delivery system in the island (Uragoda, 1977). The curative healthcare institutions, initially instituted to treat the European invaders themselves, expanded in size and numbers and started catering to the locals as well.

Laboratory services

The initial hospitals established were manned by European health staff and consisted of very basic healthcare delivery services with almost no supportive or para-medical service like

the laboratory service (Uragoda, 1977). With the advancement of science and technology, medical field too progressed and the developments which occurred globally crossed borders into the Sri Lankan medical field as well.

Laboratories were instituted in government administered hospitals in the island towards the latter half of the last century and today, a large proportion of the hospitals have some type of laboratory which provides great support in delivering healthcare services to the people of the country. Recognizing the important role played by the laboratories, the service was expanded and today the service comes directly under a Deputy Director General of Health Services for Laboratory Services.

The laboratory service comprises of many types of services, some of which are, biochemistry, histopathology and hematology. The most basic type of laboratory would have facilities to perform basic biochemical tests while the larger laboratories are able to perform all types of body fluid and tissue analysis. However, the establishment of laboratory service requires many resources including analyzers, material and trained health staff as well as financial allocation to purchase necessary reagents and other consumables which incurs considerable costs.

Worldwide, clinical laboratory services are under pressure to reduce number of tests and cut staff and supply cost due to economic constrains. It has also been highlighted the importance of imaginative strategies to look for solutions such as rationalization of existing services and cost-effective use of available limited resources (McQueen and Bailey, 1993). It has observed that prolonged laboratory turnaround time contributed to prolonged stay in emergency departments. A Satellite laboratory service established in the emergency department had reduced laboratory turnaround time significantly and patient length of stay at emergency department has also reduced as a result (Dhatt et al., 2008). The main policy document of the country; "Mahinda Chinthana; Vision for the future" states that the government aim is to build a healthier nation that contributes to its economic, social, mental and spiritual development. It further emphasize its future aim to have a patient-focused system that provides services to the client (Mahinda Chinthana, 2005). Therefore, expansion of the existing health services to the door step of clients is important in terms of achieving the above objective.

Laboratory services in the health sector in the country play a vital role in curative care services and community health services. The laboratory services in the ministry of health in its mission statement states that it expects to upgrade existing laboratory network in the country and to make available reliable results to all patients in the country (Ministry of Health, 2008). The government of Sri Lanka spends nearly 5% of its total expenditure yearly on health services out of which a significant proportion (3%) goes to laboratory services in the country (Family Health Bureau, 2007). In addition to this expenditure from the line ministry, the provincial councils also spend a significant proportion of their total expenditure on health

services. For example Provincial Specific Development Grant (PSDG) in Uva province has spent Rs. 1938 million on providing health service in 2010 and 3285 million in 2013 which is a 70% increase from 2010 to 2013 (Provincial Directorate Health Services, 2014).

Only a handful of research has been conducted and published in the country on laboratory services. Siriwardena, 2005 conducted a survey to assess utilization of laboratory investigations in patient management. And Atapattu 2010 conducted a survey to assess capital, recurrent, and unit cost of laboratory investigations of the provider as well as client side for ante natal mothers.

Yet another research was conducted by Priyantha 2011 for the study of Utilization pattern and availability of laboratory results at medical wards.

Healthcare delivery in Badulla district

Badulla is one of the 25 administrative districts of the country located in the South Eastern slopes of the island housing a population over 800,000 (Department of Census and Statistics, 2012). The principal responsibility of providing government allopathic healthcare services is vested with the Provincial Ministry of Health, Uva province. With the exception of the Provincial General Hospital Badulla all other healthcare institutions in the district are administered by the Provincial Ministry of Health. Headed by the Regional Director of Health Services, functioning under the administrative guidance of the Provincial Director of Health Services Uva province, the provincial healthcare system delivers its health services through 63 curative health care institutions and 16 Medical Officer of Health areas by 2012 (Provincial Ministry of Health, 2012).

Satellite Laboratory Service

Considering the accessibility to healthcare institutions, geographical terrain, low population density, limited resources in the health sector and the government mission of providing good quality laboratory services to the public, the provincial health department of Uva launched a special service called "Satellite Laboratory Service" in the district of Badulla as a pilot project in 2006 (Provincial Ministry of Health, 2008).

The concept of Satellite Laboratory System was initiated by the Provincial Directorate of Badulla identifying focal hospitals which could assist in carrying out biochemical and pathological tests for the smaller hospitals in the region. Provincial General Hospital, Badulla and Base Hospital, Mahiyangnanaya were identified as the focal laboratories at its initial stage (Provincial Ministry of Health, 2008). The smaller hospitals were identified as hospitals which cater to a large population but with limited laboratory capacities and geographically situated along one route of access. The first and second lines of satellite hospitals were identified along the western parts of the district. Divisional Hospitals Haldummulla, Haputale, Diyatalawa, Bandarawela, Uva Paranagama, sprinwelly, lunugala, Hopton, Passara and Welimada were expected to send 200 to 300 samples for testing

to PGH Badulla three days of the week (Provincial Ministry of Health, 2008). The third line of satellite hospitals were identified along the North Eastern parts of the district where Divisional Hospitals Kandeketiya, Rideemaliyadda, meegahakiula, Uvatissapura, Batalayaya Hebarawa and Girandurukotte, were expected to send samples to Base Hospital Mahiyanganaya (Provincial Ministry of Health, 2008).

An expert panel of administrators, clinicians and public health specialists were consulted to identify the tests under the system and ten biochemical tests were identified at the onset, which were FBS, Blood Urea, Serum Glutamic Oxaloacetic Transaminase, Serum Glutamic Pyruvic Transaminase, Standard Agglutination Test, Serum amylase, Alkaline Phosphatase, SE, LP and Serum proteins. These tests were identified as investigations which could assist much in the diagnosis and management of critical and common illnesses. It was expected that an employee of the most distant hospital would bring the samples coordinating with the other hospitals and bring samples from all the hospitals along the way to the final focal hospital.

Even though a similar type of laboratory service was not seen in other parts of the country before it was implemented in the district of Badulla, this service has now been extended to districts of Monaragala, Rathnapura, Nuwaraeliya and Ampara but expected results not being achieved. (Ministry of Health, 2012 and RDHS performance reviews).

A formal evaluation of an intervention is mandatory after a certain period of time since its commencement in order to assess the effectiveness in terms of achieving its set objectives. It has found in annual district and provincial health reviews that this special laboratory service was cost effective in providing laboratory services to peripheral hospitals in the district although those were not formal evaluations (Provincial Ministry of Health, 2012). To date there has not been any published research conducted on the satellite laboratory service in Badulla or any other district which implements this service.

Global situation on Satellite Laboratory Services

There is only a handful of literature published on satellite laboratory systems in scientific journals. Satellite laboratory service has existed in other countries like the United States of America and the United Kingdom (Johnson, 1994, Wei et al., 2010). [Johnson \(1994\)](#) reported that a satellite laboratory service as a viable solution to the problem of unavailable laboratory test results and it can effectively reduce the number of surgeries delayed and the number of patients who undergo surgery before laboratory test results were available.

Several countries in the Asia had also trialed satellite Laboratory systems and China is one country which has published literature in this field. Contrary to the findings in the West, a research conducted to evaluate satellite laboratory services in China found it was not sustainable long term. Wei et al., (2010) found in an evaluation of microscopic laboratory service in another study in China, two years after it beginning, that the service was not

effective in achieving its objectives and the service was abandoned based on the findings. Therefore, the satellite laboratory service in the district of Badulla merits a formal evaluation at present.

Research methodology

According to the objectives of the study the current study aimed at exploring the current situation, human resource challenges and managerial constraints of the satellite laboratory service, and to identify and describe factors necessary for further expansion of this service.

This was a descriptive cross-sectional study conducted in the district of Badulla. All curative health institutions in the district were considered as the study population for the present study. Health institutions with the satellite laboratory system were the inclusion criteria. Health institutions that provide only preventive care services and no curative care services was selected as the exclusion criteria. All institutions fulfilling criteria was included in the study. Pre-tested interviewer administered questionnaires with close ended and open-ended questions together with desk review guidelines were used as study instrument in this study. The content of the questionnaires was prepared in consultation with team of expert, taking objectives of the study into consideration and also reviewing relevant literature. All questions used pre-coded responses except for few questions which were open-ended. Responses to open-ended questions were coded later by the principal researcher. The questionnaires were pre-tested in a group of hospitals where a similar kind of service was going on in the district of Monaragala. The validity of the questionnaires was assessed with face validity, content validity and consensual validity by a panel of experts including the principal researcher, the supervisor, a medical administrator, a consultant community physician, a senior medical laboratory technician and a senior nurse who was directly involved in this satellite laboratory service.

There were 2 questionnaires. First questionnaire was used to collect data from hospitals where the satellite laboratory service was implemented. The second questionnaire was intended on need assessment of such system in other hospitals.

Desk review guidelines

The desk review is a method used to gather data extensively of a condition which is not well known and a selected group of persons go through what is available up to date and review the existing condition to arrive at some conclusions (UNDP, 2008). The guidelines for this review were developed by the principal researcher in consultation with the supervisor. Guidelines regarding the implementing satellite laboratory system in 2006 in Badulla district.

Data collection

Investigators themselves visited all healthcare institutions with prior arrangements. The questionnaires were administered to the medical offices that were in charge of those health institutions.

These medical officers could seek help from other staff who directly involved in satellite service whenever it was required. The medical officers who were in charge were asked to write their answers to open ended questions which were qualitative in nature at the end of the questionnaire administered to peripheral hospitals where Satellite Laboratory System was already implemented.

Data entry and analysis

The investigators themselves handled the entire data entry and statistical analysis process. All questions that were to collect quantitative data were pre-coded for convenience of data entry. A detailed data entry sheet was prepared on SPSS 17.0 software. Questionnaires were screened for completeness at the end of the day during data collection and the required data cleaning was made accordingly. Data entry was carried out simultaneously with data collection directly into the SPSS data sheet the investigators analysis was carried out to find out errors in data entry and necessary corrections were made accordingly. Statistical analysis was carried out using the software package SPSS (version 17.0).

Desk review on satellite laboratory service

A desk review was conducted among a group of people from the satellite laboratory following desk review guidelines. This group consisted of the Director of the hospital, consultant chemical pathologist, consultant microbiologist, consultant hematologist, a medical officer from the medical laboratory department, two MLTs and two minor staff personnel who were directly involved in the satellite laboratory service. The entire desk review was tape recorded with the consent of all participants and later translated carefully into a text by the principal investigator. The analysis of this text took place through the process of sequencing, capturing and coding. During this analysis similar responses were taken together and any response unique to one particular participant was taken separately. Any information that may reveal the identity of the participants was deleted or removed from the analysis.

Ethical considerations

Permission to carry out this study was obtained from the Provincial Director of Health Services and Regional Director of Health Services, Badulla. The objectives of the study were explained and confidentiality was assured to all participants of the study before the beginning of data collection. Informed written consent was obtained from all the study participants. The study participants were informed that they were not going to receive monetary allowances for their participation in the study before getting the informed consent. The electronic version of the data base was password secured and the data sheets were kept under lock and key. Ethical clearance for this study was obtained from the Ethical Review Committee of the University of Colombo.

Results

Table 2: Distribution of hospitals included in the present study by their type

Hospitals Included in the study	Number	Percentage (%)
Provincial General Hospital	1	1.8
District General Hospital	0	0
Base Hospital –Type-A	2	3.7
Base Hospital –Type-B	1	1.8
Divisional Hospital – Type-A	2	3.6
Divisional Hospital – Type-B	6	10.9
Divisional Hospital – Type-B	29	52.7
Primary Medical Care Unit	14	25.5
Total	55	100.0

The present was conducted in 55 hospitals out of 63 hospitals in the district. More than two third these hospitals was Type C Divisional Hospitals and Primary Medical Care Units (PMCU).

Table 3: Distribution hospitals in the present study by involvement in the Satellite Laboratory Service

Intervention category	Number	Percentage (%)
Satellite Laboratory	2	3.6
SLS implemented hospital	12	21.8
SLS non-implemented hospital	41	74.6
Total	55	100.0

Two hospitals functioned as satellite laboratories providing investigations facilities to peripheral hospitals at the initial stage. These two hospitals were provincial general hospital, Badulla and Base Hospital, Mahiyangnanaya. Twelve other curative care institutions (22%) out of 55 hospitals received this laboratory service at the beginning of this particular service.

Table 4: Distribution hospitals involved in the Satellite Laboratory Service by type of the hospital

SLS-implemented hospitals	Number
Base Hospital	2
Divisional Hospital - Type-A	2
Divisional Hospital - Type-B	3
Divisional Hospital - Type-C	5
Total	12

The SLS started with 5 (9%) hospitals receiving this service and two other hospitals were added to this service each year since 2006 to 2010 except in 2008. No other hospitals started to receive this service after 2011.

Table 3: Distribution of study hospitals by the implemented year of SLS

Year	Number (%) of hospitals started SLS	Cumulative number (%)
2006	5 (9.4)	9.1
2007	2 (3.8)	13.2
2009	2 (3.8)	17.0
2010	2 (3.8)	20.8
2011	1 (1.9)	22.6
SLS-Not received	43 (77.3)	100.0

The SLS started with 5 (9%) hospitals receiving this service and two other hospitals were added to this service each year since 2006 to 2010 except in 2008. No other hospitals started to receive this service after 2011.

Table 4: Distribution of study hospitals by tests received through SLS when the service was begun in each hospital respective year

Test	Received from SLS Number (%)	Not received from SLS Number (%)	Total Number (%)
FBS	7 (58.3)	5 (41.7)	12 (100)

Blood Urea	4 (33.3)	7 (66.7)	12 (100)
SE	2 (16.7)	10 (83.3)	12 (100)
LP	8 (66.7)	4 (33.3)	12 (100)
SGOT	5 (41.7)	7 (58.3)	12 (100)
SGPT	5 (41.7)	7 (58.3)	12 (100)
Other	1 (8.3)	11 (91.7)	12 (100)

Among 12 hospitals received SLS(satellite laboratory service) service 8 (67%) and 7 (58%) hospitals requested and received LP and FBS respectively while only one hospital has requested and received other tests such as SAT, Serum amylase, Serum bilirubin and Serum protein through this service.

Table 5: Distribution of methods of transporting specimens and receiving reports through Satellite Laboratory System

Method	Yes Number (%)	No Number (%)	Total Number (%)
Transporting specimens-Minor staff by bus	12 (100)	0 (0)	12 (100)
Transporting specimens by ambulance	0 (0)	12 (100)	12 (100)
Transporting specimens by other means	0 (0)	12 (100)	12 (100)
Receiving reports-Minor staff by bus*	12 (100)	0 (0)	12 (100)
Receiving reports by Ambulance	0 (0)	11 (100.0)	11 (100.0)
Receiving reports by other means	0 (0)	12 (100.0)	12 (100.0)

* Missing value = 1

All hospitals (100%) that received this service used their minor staff (100%) and public transport facility (100%) to transport specimens and to receive report of investigations through SLS.

Table 6: Distribution by the place where Satellite Laboratory System found to be most useful

Most useful place*	Number	Percentage (%)
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Inward patient management	8	72.7
Clinic patient management	3	27.3
Total	11	100.0

* Missing value = 1

Most of the hospitals (73%) found SLS useful in inward patient management.

Table 8: Distribution of study hospitals by the day of receiving reports

Day	Number	Percentage (%)
Day 1 (same day)	0	0
Day 2	5	41.7
Day3	2	16.6
> 3 days	5	41.7
Total	12	100.0

More than 50% of hospitals received their reports most of the time on third day or after three days of requesting and sending specimens to satellite laboratory.

Table 9: Distribution of study hospitals by current status of SLS

Current status	Number	Percentage (%)
Going on well compared to its beginning	2	16.7
Going on with no progress	1	8.3
Not functioning at all	9	75.0
Total	12	100.0

Nine hospitals (75%) out of 12 hospitals were no more receiving SLS at the time present study was conducted.

Table 11: Distribution of study hospitals by maintaining a register related to SLS

Characteristic	Yes	No	Total Number (%)
	Number (%)	Number (%)	
Having a	7 (58.3)	5 (41.7)	12 (100)

register at hospital			
Accurate up to date	0 (0)	12 (100.0)	12 (100)

Only 7 (58%) had a register for recording information related to SLS. However, none of those registers were complete and accurate up to date.

Table 12: Categories of opinions of Hospital staff on existing satellite

Laboratory service

'Reviewing existing service'	'Receiving minor staff claims on time' 'Having no proper method for specimen transfer' 'Reports getting through fax machine being not clear' 'Increasing number of days per week for a hospital to receive satellite laboratory service'
'Need of regular monitoring'	'Poor coordination between public transport service and health service' 'Delayed and sometimes missing reports' 'Adjusting according to situations such as screening for Non Communicable Diseases' 'Need of a having proper guidelines for specimen collection and transfer, and training minor staff on proper handling of specimen'
'Alternative methods'	'Using internet facilities for receiving reports instead of fax machine' 'Nominating Base Hospital, Diyathalawa and Base Hospital,'

Walimada as satellite laboratories’
‘Using modified vaccine carriers for specimen transfer effectively’
Using some other service such as courier service for specimen transfer if possible’

In a qualitative research, it is important to recognize and document the researcher’s pre-understanding of the phenomenon being studied [12]. It was observed during the data collection for quantitative component of the present study that the officers in charge of the health care institutions were having different opinions regarding this satellite laboratory service. Therefore, it was felt that identifying different opinions of hospital managers is important for policy makers and health managers for further improving the existing service in the district and for exploring the possibility of expanding the service to other part of the country. The entire text was carefully read several times and all possible meaning units were identified. These meaning units were then condensed into a few words to identify and analyze themes as given in the table 12.

Table 13: Distribution of SLS-non-implemented hospitals by their awareness on SLS

Characteristic	Yes Number (%)	No Number (%)	Total Number (%)
Having heard of SLS	31 (75.6)	10 (24.4)	41 (100)
Usefulness of having such a service	41 (100.0)	0 (0)	41 (100)

Most (76%) of the curative care institutions where the Satellite Laboratory System was not implemented had heard of Satellite Laboratory System that was going on in the district and all these institutions claimed that having such a service is important in patient care.

Table 14: Distribution of SLS-non-implemented hospitals by investigations being

currently done

Test	Yes Number (%)	No Number (%)	Total Number (%)
FBS	20 (48.8)	21 (51.2)	41 (100)
FBC	2 (4.9)	39 (95.1)	41 (100)
Erythrocyte Sedimentation Rate (ESR)	2 (4.9)	39 (95.1)	41 (100)
Urine Full Report (UFR)	2 (4.9)	39 (95.1)	41 (100)
Blood Urea	1 (2.4)	40 (97.6)	41 (100)
SE	1 (2.4)	40 (97.6)	41 (100)
Blood for Malaria Parasite	1 (2.4)	40 (97.6)	41 (100)
Sputum for Acid Fast Bacilli	1 (2.4)	40 (97.6)	41 (100)

Most of the SLS-non-implemented (49%) had facilities for getting FBS done within their institutions. However, they hardly had laboratory facilities for other basic investigations done within their institutions themselves.

Table 15: Distribution of SLS-non-implemented hospitals by type of investigation that is needed through such a service

Test	Yes Number (%)	No Number (%)	Total Number (%)
FBC	38 (95.0)	2 (5.0)	40 (100)
UFR	30 (75.0)	10 (25.0)	40 (100)
FBS	22 (55.0)	18 (45.0)	40 (100)
ESR	21 (52.5)	19 (47.5)	40 (100)
LP	18 (45.0)	22 (55.0)	40 (100)
SC	14 (35.0)	26 (65.0)	40 (100)
Blood Urea	13 (32.5)	27 (67.5)	40 (100)
SE	9 (22.5)	31 (77.5)	40 (100)
Serum Glutamic Oxaloacetic Transaminase	7 (17.5)	33 (82.5)	40 (100)

Serum Glutamic pyruvate Transaminase	7 (17.5)	33 (82.5)	40 (100)
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Most of the SLS-non-implemented hospitals were in the opinion that having such a satellite laboratory service would be more useful in clinic care and Out Patient Department care.

The tests that more than 50% of SLS-non-implemented hospitals expected to receive through such a satellite service were FBC, UFR, FBS

and ESR

Table 16: Distribution of SLS-non-implemented hospitals by their opinion on usefulness of SLS in patient management

Characteristic	Yes Number (%)	No Number (%)	Total Number (%)
Useful in diagnosis	39 (95.1)	2 (4.9)	41 (100)
Useful in prescribing	38 (92.7)	3 (7.3)	41 (100)
Useful in monitoring the prognosis	38 (92.7)	3 (7.3)	41 (100)
Useful in avoiding unnecessary transfer of patients	35 (85.4)	6 (14.6)	41 (100)

Almost all hospitals were in the opinion that having such a satellite laboratory service would be important in diagnosis, prescribing and monitoring of the patient's prognosis. Majority (85%) felt that it would also be important in avoiding unnecessary transfer of patients to higher level hospitals.

Table 17: Distribution of SLS-non-implemented hospitals by the place where Satellite Laboratory System found to be most useful

Characteristic*	Number	Percentage (%)
Useful in inward care	21	51.2
Useful in clinic care	29	70.7
Useful in OPD care	35	85.4

* More than one response was considered in this variable

Table 18: Categories of opinions of staff (Laboratory in Provincial General Hospital-Badulla) Regarding existing satellite laboratory service

'General'	<p>'Started in 2006'</p> <p>'Offering more tests other than those decided at the beginning for SLS'</p> <p>'SLS not going on well compared to its beginning'</p> <p>'Using minor staff and return ambulances for sending reports to peripheral hospitals'</p>
'Weaknesses and deficiencies'	<p>'Receiving requests for other tests other than those initially planned for'</p> <p>'Unsatisfactory specimens due to not having a history of the patient, not labelling, inadequate specimens, transporting with no cold box, improper collection and improper transport'</p> <p>'Not receiving extra allocations for this service from the ministry'</p> <p>'Not having adequate staff to provide this kind of satellite service'</p> <p>'Not having facilities such as internet at peripheral hospitals for sending reports'</p>
'Suggestions for future'	<p>'Developing guidelines for this particular service and adhering to them'</p> <p>'Training all the health staff on how to effectively utilize such a satellite service and on proper specimen collection, labelling, storing and sending them to satellite laboratory'</p> <p>'Strengthening laboratories in other hospitals such as BH-Mahiyangnanaya, BH - Diyathalawa as satellite laboratories to their peripheral hospitals'</p> <p>'Provide extra staff and extra allocations for reagents and other logistics'</p> <p>'Having proper and regular monitoring and</p>

evaluation mechanism for this service'
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The text of the desk review conducted among the staff of the satellite laboratory was read carefully and categorized as in table 18. 'General views', 'weaknesses and deficiencies' and 'suggestion' were the main categories identified which were interpreted and discussed under discussion chapter.

Discussion

The present study aimed at evaluating the satellite laboratory service initiated in the Badulla district in 2006. A proper evaluation had not been conducted since its commencement and therefore it was the right time for the evaluation to be conducted.

Laboratory services are an important supportive service in patient management in a hospital. The present study was conducted among 55 hospitals including all the hospitals involved in the satellite laboratory services.

Laboratory facilities at Provincial General Hospital, Badulla and Base Hospital, Mahiyangnanaya were initially planned to use as satellite laboratories in 2006. However, only laboratory facilities at Provincial General Hospital, Badulla provided this satellite facility to peripheral hospitals in the district since 2006 to date.

About 22% of peripheral hospitals (Base Hospitals – 2, Divisional Hospitals-Type-A – 2, Divisional Hospitals-Type B – 3 and Divisional Hospitals-Type C – 5) in the district received this satellite service during last seven years (Table 2). Even though this service has started with 5 peripheral hospitals receiving the satellite service only another 7 peripheral hospitals started to receive this service by 2011. Since 2011 no other peripheral hospital newly started to receive this satellite service (Table 3). Therefore, this data showed that the extension of this service has ceased since 2011.

Among 11 tests offered through Satellite Laboratory System only FBS was requested and received by more than half of the Satellite Laboratory System implemented hospitals while only very less number of peripheral hospital requested for testes such as standard Agglutination Test, Serum amylase, Serum bilirubin, Serum protein (table 4). The requirement for testing facilities vary from hospital to hospital and therefore it is important to frequently assess the requirement of peripheral hospitals for testing needs and decide on tests offered through this kind of satellite service.

It was very interesting to see that all hospitals who received the satellite laboratory facility used only their minor staff with public transport services for sending specimens and receiving reports through this laboratory service (Table 5). This is very important in terms of cost-effectiveness of such a satellite service.

More than 70% of hospitals who received satellite laboratory facilities found having such a service was important for inward patient management and every aspect of patient care such as proper diagnosis, prescribing and monitoring prognosis of the

patient's condition. They also found that this particular service was very useful in avoiding unnecessary patient transfers to higher level hospitals only because of not having such testing facilities (Table 6 and Table 7). Therefore it is important to receive reports of requested tests at least on the same day of requesting and sending specimens to satellite laboratory. However, more than 50% of hospitals who requested tests through this service received their reports after three or more days later (Table 8). Using other facilities such as internet and faxing for receiving reports will be important to reduce this delay in receiving reports. Even though the satellite laboratory used faxing for sending reports to peripheral hospitals it was not successful as the reports received through fax machine were not clear enough to read (Table 18). Therefore, strengthening the internet facilities for these health institutions may help to overcome this delay.

The Table 9 shows the current status of this satellite laboratory service in the district by 2013. Accordingly, nine hospitals (75%) out of 12 Satellite Laboratory System implemented hospitals were not receiving this service at the time present study was conducted even though almost all hospitals who received this service found that having such a satellite service was very useful in patient management, particularly for inward care within their health facilities. Not receiving reports on time and some issues related to minor staff such as delay in paying their claims and inadequate number of minor staff were the main issues for those Satellite Laboratory System implemented peripheral hospitals with regards to satellite laboratory service (Table 10). Even though 7 (58%) SLS-implemented hospitals had a register to keep records on Satellite Laboratory System. None of those registers was complete and accurate to date (Table 11). These are not going to be major issues for such a useful service as these issues can be settled easily by having a regular and proper monitoring and an evaluation mechanism for this service in the district.

The Table 12 shows the findings of analysis of opinions of SLS-implemented hospitals regarding collecting and sending specimens to satellite laboratory, receiving reports and the importance of having such a satellite service for patient care in a peripheral hospital. They collectively pointed out the importance of reviewing the service, regular monitoring the service and flexibility of the service in terms of adjusting to changing needs of the peripheral hospitals by increasing number and type of tests offered through this service and looking for alternative methods for sending specimens and receiving reports. This is very important as far as the patient management is concerned because disease pattern and therefore the testing needs of peripheral hospitals is going to vary frequently. Therefore, proper monitoring and evaluation of such a service is important after its implementation in terms of achieving the objectives of such a service.

Most (76%) of the Satellite Laboratory System -non-implemented hospitals had heard of this particular service going on in the district and all of them felt that having such a service for their health facilities too will be useful for delivering patient care within their institutions (Table13). Only very few SLS-non-

implemented hospitals have had facilities for basic tests such as FBC, and UFR other than FBS which was carried ESROUT with a glucometer (Table14). FBC, FBS, UFRESR, Blood Urea/SE, LP and SC were the tests that these SLS-non-implemented hospitals expected to receive through such a satellite service (table15). These institutions also think that having such a satellite service is going to be useful for various aspects of patient care including diagnosis, prescribing, monitoring the prognosis and avoiding patient transfers only because of not having such testing facilities (table16). These SLS-non-implemented hospitals also viewed that such a satellite laboratory service is going to be important for Out Patient Department and clinic care as well as inward patient care (Table17). This is going to be important for health managers in the district as well as policy makers and programme managers at national level in terms of exploring the possibility of expanding testing facilities through such a satellite service to clinic and Out Patient Department services as far as Non Communicable Diseases are concerned.

The Table 18 shows the categories of the opinions of the staff from the satellite laboratory. It is evident that the satellite laboratory service is not going on well from their side due to deficiencies and weaknesses as in Table 18. Requesting more tests other than those tests agreed to be provided through this service, not receiving extra staff and extra allocations for this service, receiving unsatisfactory specimens and not having proper guidelines for this service were the main issues identified by the satellite laboratory. These all are managerial issues which can be settled by health managers at Provincial Health Department and negotiating with ministry of health, Colombo. As they have suggested developing proper guidelines and adhering to them, training peripheral staff on each and every aspects of this service, providing extra staff and extra allocations required for this service and having a proper monitoring and evaluation mechanism may help to re-establish this important and useful service to the public who come to peripheral hospitals for their health needs.

Satellite laboratory service has been effectively used in health services in other countries. For example Kimball and Johnson [10] have shown in their evaluation study that satellite laboratory service could reduce unnecessary surgical delays and number of surgeries that underwent without laboratory investigations.

These data collectively showed that having a satellite laboratory service in a district like Badulla which is considered to be rural is going to be important and useful in different aspects of patient care such as inward and Out Patient Department patient management, and clinic follow up. Therefore, it is important to discuss with stake holders in the district and the ministry of health, Colombo the current issues with regard to satellite laboratory service in the district of Badulla and settle those managerial issues to make it function properly and to provide a good quality laboratory service to the public.

Limitations

1. The study was a descriptive cross sectional study that liable to some bias such as recall bias. Pre and post

study design could be a better option for this kind of scenario. However, due to non-availability of a proper information system of this service it was not possible to conduct such study design.

2. Costing of this kind of a service is essential in terms of deciding its future expansion to other hospitals and other parts of the country. However it was not possible to consider costing study within the present study due to financial and time constraints.

CHAPTER SIX

Conclusions and Recommendations

6.1 Conclusions

1. Satellite laboratory service was started with five hospitals in 2006 and 12 out of 63 curative care institutions were receiving this service by 2011. No other hospital was started to receive satellite service after 2011.
2. All hospitals who received the satellite laboratory facility used only minor staff with public transport services for sending specimens and receiving reports through this laboratory service.
3. More than 70% of hospitals who received satellite laboratory facilities were in the opinion that having such a satellite service was important for inward patient management and to avoid patient transfers to higher level hospitals only because of not having such testing facilities within their institutions.
4. More than 50% of hospitals who requested tests through this service received their reports three or more days later.
5. Nine hospitals (75%) out of 12 SLS-implemented hospitals were not receiving this service at the time present study was conducted in 2013.
6. Not receiving reports on time and some issues related to minor staff such as delay in paying their claims and inadequate number of minor staff were the main issues for those SLS-implemented peripheral hospitals in relation to satellite laboratory service.
7. The SLS-implemented hospitals collectively emphasized the importance of having such a satellite laboratory service and the need of reviewing the service with regular monitoring and evaluation of the service. They also pointed out the need for flexibility of the service in terms of adjusting to changing needs of the peripheral hospitals by increasing number and type of tests offered through this service.

8. Most (76%) of the Satellite Laboratory System -non-implemented hospitals had heard of this particular service going on in the district and all of them felt that having such a service for their health facilities too will be useful for delivering patient care within their institutions.
9. Only very few Satellite Laboratory System -non-implemented hospitals had facilities for basic tests such as FBC, Erythrocytes Sedimentation Rate and UFR other than FBS, and expecting FBC, FBS, and UFR, Erythrocytes Sedimentation Rate, Blood Urea/SE, LP and SC to be received through such a satellite service.
10. Satellite Laboratory System -non-implemented hospitals also viewed that having such a satellite laboratory service is going to be important for Out Patient Department and clinic care as far as the screening of Non Communicable Diseases in the community is concerned.
11. Requesting more tests other than those tests agreed to provide through this service, not receiving extra staff and extra allocations to continue this service, continuous receiving unsatisfactory specimens and not having proper guidelines for this service were the main issues identified by the satellite laboratory.

1.2 Recommendations

1. Both Satellite Laboratory System -implemented and Satellite Laboratory System -non-implemented hospitals raised the importance and usefulness of having such a satellite laboratory service in a rural district like Badulla. However, no hospital started to receive this service after 2011 and only 3 (25%) out 12 hospitals who were receiving the service continued to receive this service by 2013. Therefore, it is recommended to review the service and settle all those managerial issues to make it function well.
2. Both peripheral hospitals who received the service and the satellite laboratory staff pleaded for having proper guidelines and for a training of peripheral health staff on proper collection, storing and sending specimens to satellite laboratory. Therefore, it is recommended for provincial health managers to take necessary steps for development of guidelines and arranging necessary training for peripheral health staff.
3. All those who involved in this service emphasized the importance of having a proper monitoring and evaluation mechanism for this service. Therefore, it recommended to form a review committee for this service for continuous monitoring and rectify any issues whenever it comes.

4. Divisional Hospital-Sprinvaley and Divisional Hospital-Haldummulla had used a modified vaccine carrier for transporting specimens effectively from their institutions to satellite laboratory.

Therefore, it is recommended to review this method further and use this method of transporting specimens from other hospitals too.

5. It is suggested to improve other laboratories as satellite laboratory to their peripheral hospitals. As laboratories at Base Hospital-Mahiyangnanaya, Base Hospital-Diyathalawa and Base Hospital-Walimada were improved over the years it is recommended to look for the possibility of utilizing these laboratories as satellite laboratories their peripheral hospitals.
6. As provision of extra resources to satellite laboratory is important for having an uninterrupted service it is recommended to provide minimum human resources and extra allocations to satellite laboratory to continue this service.

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19. The Web site of Google search, Pub med, Medline and BMJ were used for literature reviewing

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