

**ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF MEDICAL LABORATORY SCIENCES**



ASSESSMENT OF SUPPLY CHAIN MANAGEMENT OF LABORATORY EQUIPMENT, REAGENTS, SUPPLIES AND ITS POTENTIAL IMPACTS ON THE QUALITY OF LABORATORY DIAGNOSTIC SERVICES OF PUBLIC HOSPITALS IN ADDIS ABABA, ETHIOPIA.

PRINCIPAL INVESTIGATOR: BIADGLIGN ASRAT (BSc, MSc CANDIDATE.)

ADVISORS: FATUMA HASEN (MPH, Ph.D. CANDIDATE.)

ABAY SISAY (BSc, MSc)

A RESEARCH THESIS SUBMITTED TO THE DEPARTMENT OF MEDICAL LABORATORY SCIENCES, COLLEGE OF HEALTH SCIENCE, ADDIS ABABA UNIVERSITY, IN PARTIAL FULFILLMENT OF MASTER OF SCIENCE DEGREE IN CLINICAL LABORATORY SCIENCES (LABORATORY MANAGEMENT AND QUALITY ASSURANCE SPECIALTY TRACK).

**OCTOBER 2019
ADDIS ABABA, ETHIOPIA**

ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCE, DEPARTMENT OF MEDICAL LABORATORY
SCIENCES

THIS IS TO CERTIFY THAT THE THESIS PREPARED BY **BIADGLIGN ASRAT**, ENTITLED: “**ASSESSMENT OF SUPPLY CHAIN MANAGEMENT OF LABORATORY EQUIPMENT, REAGENTS, SUPPLIES, AND ITS POTENTIAL IMPACTS ON QUALITY OF LABORATORY DIAGNOSTIC SERVICES OF PUBLIC HOSPITALS IN ADDIS ABABA, ETHIOPIA.**” SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE DEGREE IN CLINICAL LABORATORY SCIENCES (LABORATORY MANAGEMENT AND QUALITY ASSURANCE SPECIALTY TRACK) COMPLIES WITH THE REGULATIONS OF THE UNIVERSITY, AND MEETS THE ACCEPTED STANDARDS WITH RESPECT TO ORIGINALITY AND QUALITY.

SIGNED BY THE EXAMINING COMMITTEE:

<u>ANDARGACHEW GASHU</u>	-----	-----
EXTERNAL EXAMINER	SIGNATURE	DATE

<u>MELESE HAILE</u>	-----	-----
INTERNAL EXAMINER	SIGNATURE	DATE

<u>FATUMA HASEN</u>	-----	-----
ADVISOR	SIGNATURE	DATE

<u>ABAY SISAY</u>	-----	-----
ADVISOR	SIGNATURE	DATE

CHAIRMAN OF THE DEPARTMENT OF GRADUATE PROGRAM COORDINATOR

Acknowledgment

I would like to extend my appreciation to Addis Ababa University, College of Health Sciences, and Department of Medical Laboratory Sciences for giving me a chance to conduct a thesis on this topic.

I want to express my great thanks to my advisor Fatuma Hassenn (MPH, Ph.D. Cand.) and Abay Sisay (BSc, MSc) for giving valuable comments and information to the thesis writing up.

Finally, I would like to extend my great pleasure to study participants and Public Hospitals, which made this research accomplished.

Table of Contents

Acknowledgment	ii
Table of Contents	iii
List of tables	vi
List of figures	vii
Acronyms/ Abbreviation.....	viii
1 Introduction	1
1.1 Background of the study	1
1.2 Statement of the problem	3
1.3 Significance of the study.....	5
2 Literature.....	6
2.1 Overview of Laboratory Supply Chain	6
2.2 Supply Chain management practices	7
2.3 Laboratory service quality.....	8
2.4 Impact of supply chain management on Laboratory service quality	9
3 Objectives of the study.....	13
3.1 General objective.....	13
3.2 Specific Objectives.....	13
4 Hypothesis.....	13

5 Methodology	14
5.1 Study area	14
5.2 Study design and period	14
5.3 Population.....	14
5.3.1 Source population	14
5.3.2 Study population.....	15
5.4 Inclusion and exclusion criteria.....	15
5.4.1 Inclusion criteria	15
5.4.2 Exclusion criteria	15
5.5 Study variables	15
5.5.1 Dependent variables	15
5.5.2 Independent variables	15
5.6 Measurement and Data collection	15
5.6.1 Sample size calculation and sampling method	15
5.6.2 Data collection	16
5.6.3 Data collection procedure	16
5.7 Data quality assurance (Validity and Reliability of the Study).....	16
5.7.1 Validity.....	16
5.7.2. Reliability	17

5.8 Data analysis and interpretation	17
5.9 Operational definitions	18
5.10 Ethical consideration	20
6 Result	21
6.1 Response rate.....	21
6.2 Respondents Demographic Profile.....	21
6.3 Supply chain management practices	23
6.4 Provision of quality laboratory services.....	24
6.5 Observation of supply chain management practices	25
6.6 Observation of the provision of quality laboratory services	26
6.7 Impact of employee factors and Supply Chain Management Practices on laboratory service quality.....	27
7 Discussions	29
8 Limitation of the study.....	32
9 Conclusions and Recommendations	33
9.1 Conclusions	33
9.2 Recommendations	33
10. References.....	35
Annex II: Information sheet	40

List of tables

Table 1: Summary for Reliability and sampling adequacy of supply chain management practices of Public Hospitals, Addis Ababa, Ethiopia, 2019-----	17
Table 2: Demographic characteristics of respondents of Public Hospitals (n=159), Addis Ababa, 2019-----	23
Table 3: Observation of supply chain management practices of public hospitals (n=13), Addis Ababa, Ethiopia, 2019-----	26
Table 4: Observational of provision of quality laboratory services of public hospitals (n=13) Addis Ababa, Ethiopia, 2019-----	27
Table 5: Impact of employee, management factors and Supply Chain Management Practices on laboratory diagnostic service Quality of laboratory services in Public Hospitals, Addis Ababa, Ethiopia, 2019-----	28
Table 6: Proportionate sampling of respondents of Public Hospitals, Addis Ababa, Ethiopia, 2019-----	39

List of figures

Fig 1. Conceptual framework of supply chain management of laboratory equipment's, reagents and consumables and impact on quality of diagnostic services Addis Ababa, Ethiopia, 2019----	12
Fig 2: Descriptive statistics supply chain management practices of respondents (n=159) of Public hospitals, Addis Ababa, Ethiopia, 2019-----	24
Fig 3: Descriptive statistics of provision of quality laboratory services of respondents (n=159) of Public hospitals, Addis Ababa, Ethiopia, 2019-----	25

Acronyms/ Abbreviation

AHB	Addis Ababa Health Bureau
AAU	Addis Ababa University
AIDS	Acquired immune deficiency syndrome
ART	Anti-retroviral treatments
CEO	Chief Executive Officer
CD	Cluster of differentiation
CRM	Customer Relation Management
EPHI	Ethiopian public health institute
EPSA	Ethiopian Pharmaceuticals Supply Agency
FANC	Family antenatal care
FMOH	Federal Ministry of Health
HIV	Human immune deficiency viruses
IQC	Internal quality control
IOM	Institute of medicine
IRB	Institutional Review Board
IS	Information Sharing
ISO	International Organization for Standards
LM	Logistic Management
NCD	Non-communicable diseases
OF	Order Fulfilment
QA	Quality assurance
QC	Quality control
SCM	Supply Chain management
SCMP	Supply Chain Management Practices
SCMS	Supply chain management system
TB	Tuberculosis bacilli
USAID	United States Agency International Development
WHO	World Health Organization

Abstract

Background: Supply chain management process allows the right laboratory commodities in the right quantities in the right condition delivered to the right place at the right time for the right cost. Poor management of laboratory equipment, reagents and other suppliers with recurrent stock-outs of reagents, frequent equipment breakdown was a major gap in ensuring quality and uninterrupted testing leading to patient dissatisfaction, and it needs more attention to strength and improve supply chain management practices.

Objective: This study aimed to assess supply chain management of laboratory equipment, reagents, supplies and its impact on the quality of laboratory services of public hospitals in Addis Ababa, Ethiopia.

Methods: The study employed a quantitative design using a hypothesis testing approach to identify the effect of supply chain management of laboratory equipment, supplies, reagents, consumables on quality of laboratory services. 169 questioners were distributed to employees working in laboratory divided on thirteen (13) public hospitals found in Addis Ababa, from February 2019 to May 2019 using questioner and observational checklist. After data was entered to SPSS 23, frequency, percentage was computed, presented using tables and graphs, and Binary logistic regression was analyzed to see the effect of the independent variables with dependent variables by using Odds Ratio (OR) with 95% confidence interval with p-value of less than 0.05.

Result: The 61.5% (n=8/13) of public health facilities had policy criteria for selection and procurement of laboratory commodities, 51.3% (n=7/13) of the laboratory stores met the standard storage criteria's which were the good features of supply chain management practices, while in 77% (n=10/13) of public hospitals laboratory staffs had no access to training particularly related to supply chain management, during the last six months and visit time 69.2% (n=9/12) public hospitals encountered stock out reagents and controls of coagulation, hormonal, chemistry tests, 69.2% (n=9/13) encountered suppliers misbehave during procurement, 61.5% (n=8/12) public hospital laboratory had no work planned budgetary projections and in the 61.5% (n=8/12) public hospitals the laboratory professionals were not involved in the procurement process. 73.5% (n=117/159) of participants indicated that the overall extent of supply chain management of public hospital laboratories were not adequately practiced. 70.4 % (n=112/159), 73.6% (n=117/159), 69.2% (n=110/159), 74.8% (n=119/159), 79.9% (n=127/159) of participants indicated there was no adequate practice of logistics management, supplier relation management,

customer relationship management, information sharing, and order fulfillment respectively. In case of quality service provision in 84.6% (n=11/13) of public hospitals there was lack of vaccine against Hepatitis B and 84.6% (n=11/13) of public hospital laboratories did not monitor quality control for each tests on daily bases. Findings also revealed that 56% (n=89/159) of laboratory professionals indicated that their laboratory did not provide timely services as per to preset turnaround times, 57.9 % (n=92/159) of laboratory professionals indicated that their laboratory did not provide reliable services, 63.3 % (n=101/159) of laboratory professionals indicated that laboratory service provision was not as per to safety requirements. Logistic regression showed the difference in supply chain management and quality due to educational level, degree (AOR=0.25(0.07-0.84)), masters (AOR=0.19(0.04-0.86)). Practicing logistics management (AOR=3.32, 95% CI= (1.4-8.0) and order fulfillment (AOR=3.56, 95 % CI=(1.32-9.56) were found 3.32 and 3.56 times more likely to provide the quality laboratory service than those which did not practice it respectively.

Conclusion: Based on the study findings we can conclude that, the supply chain management practices and provision of quality laboratory at public hospitals needs improvement to meet the standard. Recruiting employee with higher education, practicing logistics management and order fulfillment led to success in the provision of quality laboratory services. From observation, our finding showed lack of training related to supply chain management, non-involvements of laboratory professionals in purchasing, stock out of reagents and controls, supplier's misbehaving and absence of HB vaccine were major gaps in provision of quality of laboratory services.

Keywords: Supply chain management, Laboratory, Quality, Service.

1 Introduction

1.1 Background of the study

Accurate, reliable and timely laboratory tests are required to diagnose illness, identify causative factors, monitor the effectiveness of treatment, and perform surveillance for key diseases improving patient care across the entire health care system (1). To overcome continuous changes in customer needs, providing desired quality service, improving the organization's performance adopting a supply chain management is a top strategic priority (2). Actively working for improvement to increase and generate service of higher quality ensuring patient satisfaction is features of effective supply chain management (3). Supply chain management is controlling the information, materials, services, and money promoting the quality of an organization's operations dealing with the management processes of flows of goods, information and funds among supply chain partners through personal and professional competence, ability to deal with external parties, and the development of public relations with the health sector as a whole (4).

Supply chain management involves planning, coordinating, and controlling the movement of material, finished goods from supplier to customer, through flow of material, finance, information, and decisions made at different levels throughout (5). Cooperating with the supplier improves purchasing management and supply chain performance for better control, to achieve competitive advantage through their network of suppliers examining whether the service provided will meet with customer's requirements and expectations (6). Implementation of advanced technology in supply management system helps to organize vendor, storage location, and equipment data, able to respond more rapidly and accurately to inquiries for information related to inventory, purchase order activity, and supply usage, and the system proven to be effective making significant improvements to material management system with a net savings in operating expenses (7).

In the clinical laboratory, quality is the degree to which a set of inherent characteristics fulfills requirements having the capacity, resources, skilled and experienced professionals, good relationships with customers and users. Hospital management is responsible to provide support, playing critical role to direct processes, manage human resources, individual planning, supplier

management, build supply chain linkages toward improving quality, performance, and encourage, promote supply chain quality management through collaboration, communication, integration, and having good relationships with approved suppliers to supply laboratory equipment, reagents, and supplies that that fulfils needs of customer (8).

The effects of supply chain management on laboratory service quality is making use of available resources and managing issues related to organizational aspects like demand forecasting, resource allocation, inventory management, information management, supplier and customer relationship management, building, allocating authorities and responsibilities, and organizing interface processes. Moreover, recent studies reveal that elements like the absence of strong leadership and mandating authority, as well as power and interest relationships between stakeholders severely hinders the integration and coordination of processes along the health care supply chain (9). Identifying the various dimensions of service quality and focusing on setting administrative priorities in measuring the quality of their services improves organizational functions and competitiveness (10).

Effective supply chains determine the success or failure of any public health program in the public sector, decision makers increasingly direct their attention to improving supply chains, and due to its improvements bring important, quantifiable benefits. Well managed supply chains benefit public health programs in important ways by increasing program impact, enhancing quality of care and improving cost-effectiveness and efficiency (11). Supply chain management practices therefore brings a new dimension as it brings laboratory diagnostic services under the spotlight of the public thereby forcing hospital managers and government to improve quality of services through providing adequate, appropriate supplies, increasing professional satisfaction, morale, and motivated staff are more likely to deliver a higher quality of service (12).

1.2 Statement of the problem

Customers are expecting improved access to routine health care, including care for diseases and conditions, but until recently, it has received little attention though, there is a growing demand for access to quality laboratory diagnostic services (13). The study at Laboratory of university of California San Francisco Medical Center indicated that the unpredictable patient testing workload is the primary factor affected the consumption of supplies of items, in combination with delivery delays, ordering problems with distributor, and unacceptable performance of a shipment, that affected sufficient in stock levels of all supplies not to be maintained (7).

A study done in Kenyatta National Hospital identified that low employee capacity, low technology adoption, ineffective communication, and insufficient funds were major factors affecting service quality perceptions, patient satisfaction in the public health sector (14). Low adherence to the standards and regulations governing supply chain management, delays of supplies delivery, absence of common tools for keeping track of laboratory reagents ordering and receiving, and procurement under emergency orders were factors reported that potentially affected availability and the quality laboratory diagnostic services in Tanzania (15). Up to 73% of health facilities faced a challenge of high levels of stock outs due to limited capacity of staff managing logistics and supplies at health facilities in Northern Rwanda (16), Inadequate technical and management capacity, poor communication, and weak logistics management system was cited in barriers of supply chains for health commodities in sub-Saharan countries (17).

Management of laboratory equipment, reagents and other supplies of public hospitals in Ethiopia was identified as a major gap in ensuring quality and uninterrupted laboratory testing leading to recurrent stock outs of testing reagents, frequent equipment breakdown, and customer dissatisfaction and the overall increased cost of the health (18). Lack of strong coordinating body at the Federal Ministry of Health (FMOH) level, lack of clarity of roles and responsibility between Ethiopian Pharmaceutical Supply Agency (EPSA) and public hospitals were identified major problems of the Ethiopian public health supply chain management (19). In the present competitive market, evolution and rapid changes have compelled the public hospitals to

overcome the competitors by taking more attention on systems that influence the progress of organization activities with new approaches and attitudes about supply chain management (20).

This study assesses supply chain management from perspectives of supplier relation management, customer relation management, information sharing, order fulfillment, and logistics management practices in public hospitals by evaluating their impact on the laboratory service provision. No researches conducted particularly in the area of supply chain management and laboratory service quality of public hospitals in Ethiopia. Therefore, there is a gap in knowledge and availability of data in supporting supply chain management, and its impact on the quality of laboratory diagnostic services.

Furthermore, this research has inspired by existing problems; lack of adequate knowledge/training in supply chain management, frequent stock outs of laboratory supplies, poor quality service delivery, and customer dissatisfaction.

1.3 Significance of the study

This study gives an indication on the status of supply chain management practices; the public hospitals can use the findings to form new strategies to improve the current level of supply chain management and Laboratory service provision.

This research fills a knowledge gap through evidence-based information to managers of public hospitals and other stakeholders.

This research will contribute to the availability of literature on this area, the findings can be baseline information for laboratory managers, policymakers, and system designers that can strive to improve the supply chain management and finally improving the quality of laboratory service.

2 Literature

2.1 Overview of Laboratory Supply Chain

An inadequate supply of required reagents and supplies characterized the laboratory supply chain system, which in turn affected by the lack of information on these commodities for procurement and resupply decisions. Distribution systems need systematically designing, strengthening or supporting laboratory commodities. Patients wait too long to receive results from hospitals for critical commodities (21). Equipment management, purchasing, and inventory management are a critical component of the quality management system. Efficient and cost-effective laboratory operations need proper management of the equipment and uninterrupted availability of reagents, supplies, and services to ensure accurate, reliable, and timely testing. The inability to test, even for a short time, is very disruptive to clinical care, prevention activities and public health programmer (22).

Supply chain is a system of suppliers, manufacturers, distributors, and customers where material typically flows downstream from suppliers to customers and information flow in both directions. movement of material, parts, and finished goods from supplier to customers, though the combined efforts of national governments and international aid organizations, the prevalence of quality assured laboratories in low-income countries has increased considerably in recent years. Collective effort and commitment by governments, donors, implementing partners, supply chain organizations, and health facility staff will minimize the challenges and bring the laboratory aspect of the supply chain upfront with the pharmaceuticals (23). Selection and procurement of diagnostics and laboratory technologies are often challenging given the wide choice of products and suppliers in the global market. Understanding of the needs at each level of the health system is critical and should be the first step. Clear technical specifications and good procurement practices are necessary to guide sound procurement decisions. Advanced planning in public health care provides critical information and management requires to allocate resources that will enable the organization to reach its objectives utilizing limited available resources most efficiently based on need assessment identified (24).

2.2 Supply Chain management practices

The management of equipment, reagents, and supplies in the laboratory is often a challenging task. Proper supply chain management of purchasing and inventory can produce cost savings ensuring good quality supplies and reagents are available when needed, used and stored in a manner that preserves integrity and reliability (25). Supply chain management practices involve a set of activities undertaken in an organization to promote effective management of its supply chain with short term objectives are to enhance productivity, reduce inventory and lead time while to increase market share and integration of supply chain (26). Supply chain management practices as the set of activities that organizations undertake to promote effective management of the supply chain in the form of strategic partnership between retailers and Suppliers, close partnership with suppliers, close partnership with customers, just-in-time supply, strategic planning supply chain benchmarking, few suppliers, holding safety stock and sub-contracting, e-procurement, outsourcing and many suppliers (27).

The processes of laboratory supply chain management practices, in general, included information flow, capacity and skills management, logistics management, demand management, customer relationship management, supplier relationship management, service performance, order process management, increase customer satisfaction, assurance and improve service delivery. Information management, customer relationship management, supplier relationship management were determined to have a significant, and positive direct relationship with organizational performance (28). Supplier relationship management is defined as a process where customers and suppliers maintain a long-term close relationship as partners via coordination, cooperation, commitment, information sharing, and feedback and good supply chain practices (9). Logistics management is an operational component of supply chain management, including quantification, procurement, inventory management, transportation, and data collection and reporting, focusing more on specific tasks particular related to supply chain management systems (11).

Customer relation management is maintaining long-term customer relationships by developing information continuously and understanding what customers' needs in form of the attitude of staff to the patient in the hospital through performance evaluation that includes customer

satisfaction and customer involvement in design and feedback processes (29). Information management is the coordination and integration of operational processes across hospital supply chains that provide the mechanism through which personnel collect and manage such information, which is necessary to support sound and objective decision making in managing the supply chain (14). To manage relationships and partnerships in supply chain management cooperative culture between buyers and suppliers, close internal communication, and teamwork, employee Training and empowerment programs are a necessity (4).

2.3 Laboratory service quality

People are constantly looking for quality health products and services. The existence of this desire for quality has caused health facilities throughout the world to consider it as an essential component of any service and production process (30). The definition of health care quality is that developed by the Institute of Medicine (IOM): "the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" and should be: effective; efficient; accurate; patient-centered; reliable; and timely. Access dimensions are summarized as the availability (or physical access), affordability (or financial access) and acceptability (or cultural access) of laboratory services. The availability dimension of access deals with whether the appropriate laboratory services are available in the right place and at the right time to meet the needs of the clients. Affordability concerns the 'degree of fit' between the full costs of using laboratory services and individuals' ability-to-pay in the context of the household budget and other demands on that budget. Acceptability is concerned with the fit between provider and patient attitudes towards and expectations of each other (31).

Quality clinical Laboratory is "degree of fit" or compatibility between the laboratory system on the one hand and individuals who need to use these services on the other hand (8), it can be also defined as accuracy, reliability, and timeliness of reported test results. The laboratory results must be as accurate as possible, all aspects of the laboratory operations must be reliable, and reporting must be timely to be useful in a clinical or public health setting (32). The health system, in general, is complicated, requiring effort for the promotion of administrative quality,

including the management of product, information, and financial flow from the source of supplies to the manufacture and assembly of the product right to the delivering of the final product to consumers (9). The quality of health care services from a management perspective, use available resources to provide the right service, at the right time, at a reasonable cost, dealing with the management processes of flows of goods, information, funds among supply chain partners to satisfy customer needs (4). High quality level of health services must provide efficiently to improve patient satisfaction, patient retention, loyalty, profitability, service guarantees, and growth of health institution (18).

2.4 Impact of supply chain management on Laboratory service quality

The selection and purchasing of laboratory equipment, reagents, and consumables that affect the quality of its service is based on their ability to supply services as per laboratory requirements and established criteria's, cost of the reagents/consumables or services, performance in terms of lead time, quality of goods supplied, appropriate storage facilities by the supplier's site. Access to technical personnel by the service provider and monitor the performance of suppliers to ensure that purchased products consistently meet the stated requirements (8), and the well-managed laboratory should have a good quality system that ensures the provision of accurate and reliable test results (12).

According to the research in New Zealand (NZ) public hospitals, statistical significance was obtained, $p = 0.01$ for the relationship between performance quality and order fulfilment ($p = 0.030$, classify inventories according to their importance, $p = 0.01$ for the relationship between performance quality and order fulfilment, $p = 0.000$, with hospital profitability and order fulfilment an effort to control ordering costs) (33). Similar study aimed to examine supply chain management practices that consist of strategic supplier partnership, customer relationship management, information sharing, and its relationship to competitive advantage of the firm in terms quality (responsiveness, dependability, price) among managers in Johor Bahru areas, identified that information sharing was the determinant factor of supply chain service quality ($p < 0.01$) followed by customer relationship ($p < 0.05$), and strategic supplier partnership ($p < 0.05$) respectively. The researcher found that information sharing has a strong determinant on supply

chain responsiveness than customer relationship and strategic supplier partnership. Therefore, better information sharing, the better supply chain responsiveness was. From these findings, managers were recommended to improve information sharing effectively, so that supply chain responsiveness can be increased and generate the firm performance (3).

A study done in Jordan intending to explore and measure the effect of supply chain management on the quality of health service from the perspective of procurement officers indicate that , there is medium relationship between the supply chain management dimensions (the relationship with suppliers, specifications, standards, delivery, and after-sales service) and the quality of healthcare services. The study showed a significant impact of supply chain management dimensions at 5% significant levels (the relationship with suppliers ($p=0.0$), specifications, standards ($p=0.0$), delivery ($p=0.0$), and after-sales service ($p=0.0$)) on the quality of healthcare services (in terms of responsiveness, trust and safety) (4).

According to the study sought to explore the SCM practices among public hospitals in Nairobi, the impact of these practices on quality of service in public hospitals in terms of relationship with suppliers (after procurement service, and compatibility) were implemented by a majority to a large extent while delivery was implemented in moderate extent. Regarding the relationship between supply chain management practices and service quality; compatibility ($p=0.002$), delivery ($p=0.032$), maintenance ($p=0.031$) had statistically significant relationship with service quality. The study also showed the major challenges faced by public hospitals were; uncertainty in terms of supplies, lack of proper planning, and lack of financial resources and the research established a positive correlation between service quality and supply chain management practices (9).

Another similar study on factors affecting provision of service quality in the public health sector in Kenyatta National Hospital on the total of one hundred and three respondents comprising; sixteen doctors, thirty two nurses, twenty nine clinical officers, fourteen laboratory technologists, twelve pharmacists, indicated there were a negative relationship between low employee capacity, low technology adoption, ineffective communication, insufficient fund, and provision of quality

services which were statistically significant with a p-value of 0.03, 0.04, 0.02, and 0.01 respectively, that finally affected health service quality perceptions and patient satisfaction (14). Another study on the logistics management in Brazil's large companies indicated that improving logistics efficiency, sourcing management, market mediation and customer management improved service reliability ($p=0.035$) and service responsiveness ($p=0.074$) (34).

A study done in Ethiopia, showed availability, access, and affordability of high-quality healthcare services become challenging due to frequent stock outs laboratory reagents and supplies at public health facilities (19). According to the study on the assessing the outcome of strengthening laboratory management towards accreditation (SLMTA) on laboratory quality management system in city government of Addis Ababa, Ethiopia, 105(73.4%) of the participants respond that there is not enough equipment in their laboratory, 115 (79.9%) of the lab equipment did not service according to the scheduled in the laboratory because of poor resource allocation. Based on this study, 52.4% of the participating professionals agreed that test results were reported out of turnaround time beyond the established turnaround time and the main reason was a shortage of reagents and supplies that account for 47.9% followed by equipment downtime (35).

The qualitative assessment research of the supply chain management of Nondrug Consumables at Greater Accra Regional Hospital Ridge, aimed at identifying operations of supply chain examining the effects of supply chain management operations on healthcare delivery, and how the flow of information can prevent stock out situations; it was found that operational factors of supply chain management at Ridge hospital include procurement process, requisitions of goods, and payment of suppliers. The study also revealed that factors such as shortages, non-involvement of departmental heads in the demand forecasting process, ad hoc purchases and delayed supply of goods have effects on healthcare delivery (36).

The study on factors affecting the quality of laboratory services in health facilities found in Addis Ababa, Ethiopia, revealed that provision of quality laboratory services had statistically significant association with internal quality Control (AOR=6.11, 95% CI=2.11,17.70), availing

enough equipment (AOR=7.76, 95% CI=2.55,23.66), and communicating with clients (AOR=3.24, 95% CI=1.25-8.42). The factors affecting provision of quality laboratory services were due to 41.1% high workload, 53.4% poor equipment quality, 57.4% lack of management support, 64.3% shortage of resources (18). Providing quality laboratory services cannot succeed unless the supply chain delivers a continuous supply of laboratory equipment, reagents, and supplies to its customers dealing with coordination and collaboration of staff, managers and having a good relationship with manufacturers and suppliers. From this perspective, it will be more realistic to evaluate the laboratory supply chain managements, and its impact on the quality provided public hospitals in Addis Ababa, Ethiopia.

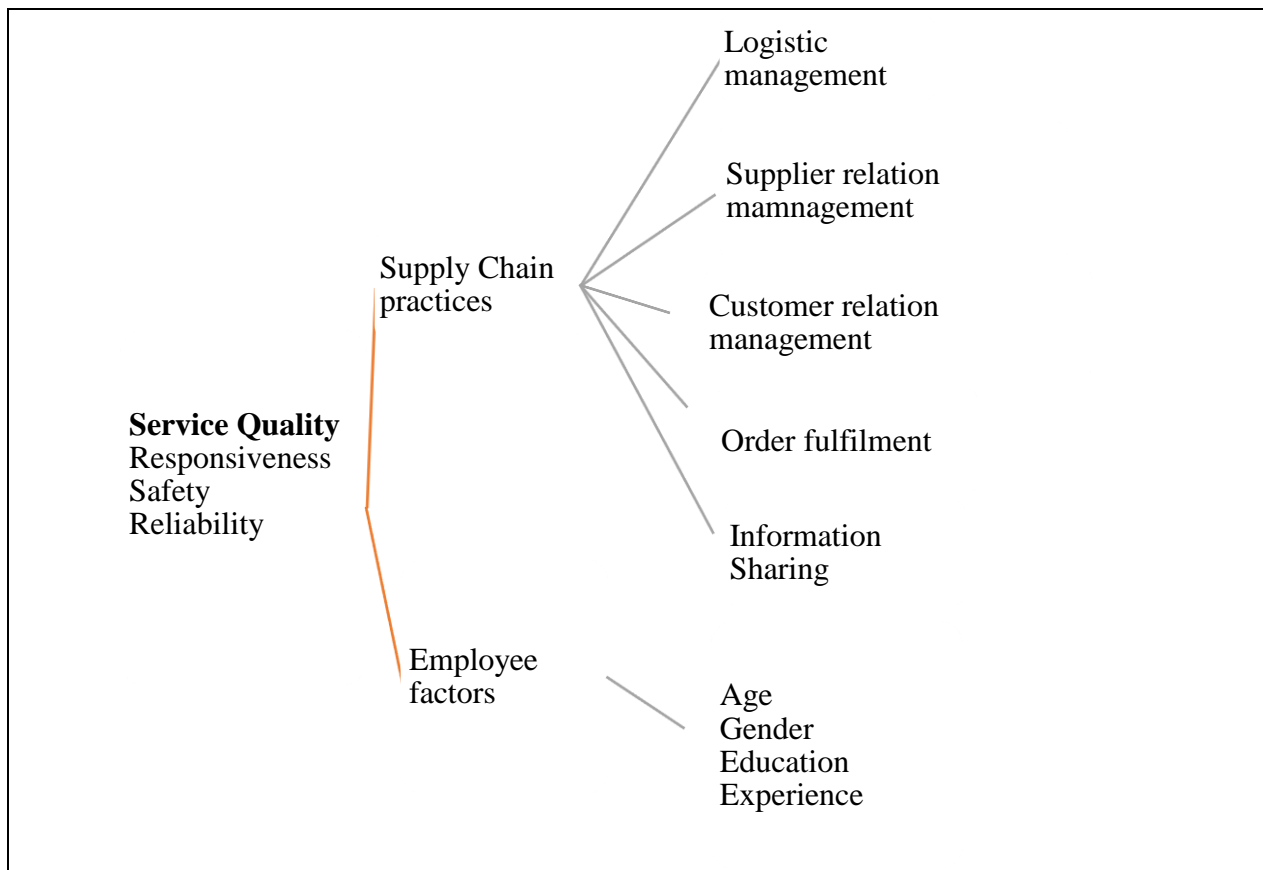


Fig 1. Conceptual framework of supply chain management of laboratory equipment's, reagents and consumables and impact on quality of diagnostic services Addis Ababa, Ethiopia, 2019

3 Objectives of the study

3.1 General objective

To assess supply chain management of laboratory equipment, supplies, reagents, consumables and its potential impact on the quality of laboratory services of public hospitals in Addis Ababa, Ethiopia, February to May 2019

3.2 Specific Objectives

- To assess the supply chain management practices of laboratory equipment's, reagents, consumables at public health facilities
- To assess the status of provision of quality laboratory services at public health facilities
- To assess the difference attributed by employee characteristics (gender, age, educational level, experience) on the management of the supply chain and quality of laboratory services
- To assess the effect of supply chain management practices on the quality of laboratory services at public health facilities

4 Hypothesis

The study includes the two main hypotheses as follow:

4.1-There is no significant statistical difference for the management of supply chain due to gender, age educational level, and experience.

4.2-There is no significant statistical effect of the supply chain management practices, logistic management, Customer Relation Management, Information Sharing and Order Fulfilment on quality of laboratory diagnostic services (Responsiveness, Reliability, and Safety of lab services)

5 Methodology

5.1 Study area

The study was conducted at public hospitals found in Addis Ababa, the capital city of Ethiopia, the seat of the African Union and Economic Commission. It is located in the geographic center of the country and covers a landmass of 540 sq. km. It is administratively subdivided into 10 sub-cities and 116 woredas as Lowest level administrative unit in the city has an estimated population of 3.6 million in the city proper and a metro population of more than 4.6 million (36). The study includes all 13(thirteen) public hospitals that the city has, six under Addis Ababa Health Bureaus, four were under FMOH, one from federal police and one from Ministry of defense, and one under Addis Ababa University providing teaching, specialized, and referral services (37). Public hospitals in Addis Ababa are Saint Paul's Hospital Millennium Medical college, Black Lion Specialized Hospital, Saint Peter TB Specialized Hospital, ALERT Hospital, Yekatit 12 Medical College, Ras Desta Memorial Hospital, Gandhi Memorial Hospital, Zewditu Hospital, Tirunesh Beijing Hospital, Minilik Hospital, Amanuel Hospital, Armed Force Hospital, Police Hospital, and they are not only limited to providing services for the people residing in the city, provides service to a significant number of populations in the surrounding areas outside the city and other regional states and peoples of other countries. As the city is the center of the country in many socio-economic aspects of peoples' life and due to the expectations, that better health services are available in the city of hospital services became overcrowded.

5.2 Study design and period

The study employed a quantitative design using a hypothesis testing approach to identify the effect of supply chain management of laboratory equipment, supplies, reagents, consumables on quality of laboratory services from February to May 2019 using questioner and observational checklist.

5.3 Population

5.3.1 Source population

Staff of public hospitals who were responsible in supply chain management activities

5.3.2 Study population

Laboratory staffs (Laboratory directors, laboratory quality managers, logistic officers, operational laboratory staffs), and pharmacy heads/Store keepers of public hospitals.

5.4 Inclusion and exclusion criteria

5.4.1 Inclusion criteria

Voluntary employees who have worked over six months in the public hospitals were included

5.4.2 Exclusion criteria

Employee who were unwilling to participate and not available during study time

5.5 Study variables

5.5.1 Dependent variables

Status of supply chain management, Provision of quality Laboratory Service (responsiveness, reliability, and safety)

5.5.2 Independent variables

Age, Sex, Educational levels, Experiences that are management and professional factors, Supply chain management practices

5.6 Measurement and Data collection

5.6.1 Sample size calculation and sampling method

The study units were an employee of public hospitals. We conducted a study on all 13 (thirteen) public hospitals found in Addis Ababa, Ethiopia. Sampling frame consists of conveniently selected target groups of middle level managers (Laboratory directors), supervisors (Laboratory quality managers, Safety officers, Logistic officers, pharmacy store/heads), and section heads as they are more familiar with supply chain management practices and provide accurate and objective information. Simple random sampling was used to select laboratory (operational) employees other than managers from study hospitals to avoid bias. The sample size of the study participants was determined by using single population proportions formulas by considering: because of the absence of the previous study taken $p=50\%$ level of significance $=0.05$ marginal of error (d) $=5\%$.

Sample size $=n$ $Z (\alpha/2) = z$ -score at 95% confidence interval $=1.96$ the formula the sample size (n) was $n = z^2 P (1-P) / d^2$ $n = 1.96^2 * 0.5 * 0.5 / 0.05^2 = 384$

Based on the profile of public hospitals the total study populations were 301 as can be seen from annex I which is less than calculated sample size and a correction factor was done based on the finite population formula (nf), therefore the sample size was

$nf = \frac{n}{1+n/N} = \frac{296}{(1+296/384)} = 168.73 \sim 169$ and as it can be seen from annex I, the sample size was allocated proportionately for 13(thirteen) public hospitals.

5.6.2 Data collection

The study used primary and secondary data collected through a structured questionnaire and observational checklist; the questionnaire included demographic profile, supply chain management practices, laboratory service quality in public hospitals found in Addis Ababa, Ethiopia.

5.6.3 Data collection procedure

The health facilities that were selected for the assessment was first located. Hospital chief executives of the facilities was approached to obtain consent for undertaking the data collection at the establishments after Hospital Ethical Review committees have evaluated it. The empirical data for the study were collected through a well-structured questionnaire and observational checklist, the respondents to this questionnaire were free to answer the questions according to their scruples without been bound to satisfy the researcher. Trained and experienced data collectors interviewed the study participants using a questionnaire for data collection. The principal investigator involved in the overall activities of data collection and assurance of confidentiality of information.

5.7 Data quality assurance (Validity and Reliability of the Study)

5.7.1 Validity

To ensure the validity of the questionnaire it was given to professionals for judgment, appropriateness and overall evaluation. The questionnaire was pre tested over 5 % of the sample size in AaBET Hospital out of the study site to ensure that it was clear for respondents. After the pre-test, some modification of the questioner was made for unclear and difficult question. These pre-test data were not included in the analysis of this study. Training was given for three laboratory technologist data collectors by the principal investigator to clarify how to collect data.

The completeness of the questionnaire rechecked at the end of the day by the principal investigator to check the completeness of information.

5.7.2. Reliability

Reliability, on the other hand, relates to the consistency of collected information. To maintain the reliability of the instrument used a pilot study carried out on a sample to employees before the collection of the data. The responses of respondents scored and the result of the reliability test carried out to show that the questionnaire used in the study regarded as sound, consistent and reliable. The reliability of the tool was determined using Cronbach’s Alpha. Alpha value over 0.70 indicates that the overall scale can be considered as reliable. Sampling adequacy measurement tests also examined by Kaiser-Meyer-Okin statistics to validate the use of factor analysis. KMO value of 0.842 indicates sampling adequacy. Cronbach's alpha among items in these study questionnaires was 0.802, which exceeded the prescribed threshold of (0.70) in comparison, and values are compatible with the reliability test of the conducted pilot study; hence, the scale is sound and reliable.

Table 1: Summary for Reliability and sampling adequacy of supply chain management practices of Public Hospitals, Addis Ababa, Ethiopia, 2019

Supply chain management practices	Value	Expected values
Overall Cranach’s alpha	0.802	> 0.70
KMO (Kaiser-Meyer-Olkin) value	0.82	>0.8

5.8 Data analysis and interpretation

In the study process, different types of raw data were collected processed, analyzed and interpreted. A descriptive study carefully designed to ensure a complete description of the situation, making sure that there is minimum bias in the collection of data and to reduce errors in interpreting the data collected from the descriptive study. Data entered and analyzed via SPSS version 23. Descriptive statistics (frequencies and percentage) computed and summary results

presented using tables and graphs and analyzed using regression analysis. Specific objectives (I) and (II) were analyzed using descriptive design to document the supply chain management practices and provision of laboratory services at the public hospitals. Binary logistic regression analysis was used for specific objective (III) and (IV) established the extent to which the independent variables, employee factors and supply chain management practices affect the laboratory service quality.

The extent of practices of supply chain management of laboratory reagents, supplies, consumables measured by using a 5-point liker scale, as the values of variables vary from 1 (very small extent practices) to 5 (a very large extent practices), the degree of compliance proper management of laboratory reagents, supplies increases. For performing cross-tab analyses and binary logistic regression analysis, it was necessary to reduce the number of categories of 5-point variables to 2-point variables.

The new categories of variables were defined as follows:

1. Adequate practices to supply chain management (a very large extent or large extent)
2. Inadequate practices to supply chain management (moderate practices, small practices or very small extent)

Laboratory service quality was measured in terms of responsiveness (timely service delivery), reliability and safety of laboratory services.

1. Provision quality Laboratory services (yes responses to the quality practices, timely service, reliability, and safety)
2. Not providing quality Laboratory services (no responses to the quality practices, timely service, reliability, and safety)

At the 5% level of significance, the strength of the association between two categorical variables is statistically significant if the P-value is smaller than 0.05. If the P-value is greater than or equal to 0.05 it is the two variables are independent of each other at the 5% level of significance.

5.9 Operational definitions

Quality in Laboratory is defined as accuracy, reliability, and timeliness of the reported test results. The laboratory results must be as accurate as possible, all aspects of the laboratory operations must be reliable, and reporting must be timely to be useful in a clinical or public

health setting, aims to confirm the requirements of the customers to meet their expectations and to satisfy them, in terms of responsiveness, reliability, and safety (8).

Responsiveness: speed in response to customers' requests having validity and reliability in measuring the quality of services in the health care sector with 80% or more of tests meet pre-established Turnaround time.

Safety: Service provided to be free from uncertainty, risk and doubt to ascertain the degree to prevent harm to workers, visitors, and the community availing safety materials like emergency shower, eyewash, spill kit, First aid kits, fire extinguisher, Personal protective equipment's, glove, mask, eye goggles, disinfectants.

Reliability: examines the ability of the laboratory to perform services with consistent availability, IQC being monitored and passed, overall improving customer satisfaction.

Supply chain management practices are the set of activities that organizations undertake to promote effective management of the supply chain (27).

Logistics Management is an operational component of supply chain management, including Quantification, procurement, inventory management, transportation, and data collection and reporting, focusing more on specific tasks within a particular supply chain management. It process of getting right laboratory commodities in the right quantities in the right condition delivered to the right place at the right time for the right cost.

Supplier relation management is a process where hospitals and suppliers maintain a long-term close relationship of the relationship by supplying products, specifications set by the hospitals as conditions for the supply in the tender, indicates to delivery dates between the supply officer at the hospital and the company that supplies medical equipment and supplies. After procurement service: follow-up maintenance service and supply parts and needs by suppliers to the hospital after the Compatibility is the appropriateness of medical equipment and supplies (5).

Customer relationship management is maintaining long-term customer relationships by developing information continuously and understanding what customers' needs in form of the attitude of staff to the patient in the hospital through performance evaluation that includes customer satisfaction and customer involvement in design and feedback processes (29).

Order fulfillment is one of supply chain activities in an organization involving classifying inventories according to their needs, capacity to respond to demand fluctuations, supplier buyer

integrated planning, forecasting, replenishment, reducing lead time, maintaining high level of emergency supplies in meeting the customer requirement service level (35).

Top-level managers-chief executive officers, medical directors, administrative directors

Middle-level managers-laboratory heads, pharmacy heads

Supervisors-quality officer, safety officer, logistics officers, pharmacy store man

Low-level managers-section heads of Microbiology, clinical chemistry, hematology e.tc

5.10 Ethical consideration

This study was approved by the “departmental research and ethical review committee” (DRERC) of the department of medical laboratory science with protocol number DRERC/406/19/MLS, and it was also approved the study and ethical committee of Addis Ababa Health Bureau before the study was commenced. A permission letter was obtained from the department of clinical laboratory science and AAHB. There was a high degree of confidentiality during data collection and no name of any health facility and participating subjects were put in the result instead the aggregate result of the facilities was used.

5.11 Result dissemination

The result of this study was submitted to the Department of Medical Laboratory Science, and will be presented. The findings will be submitted to Addis Ababa Health Bureau and presented at national and international conferences, and it will be sent to publication in peer-reviewed journals and disseminated to the concerned bodies.

6 Result

6.1 Response rate

A total of 169 questionnaires were administered out of which 159 were filled and returned, which gives a response rate of 94.08%.

6.2 Respondents Demographic Profile

In this study, a total of 159 respondents from 13(thirteen) public hospitals has participated, 56.6% (n=90/159) of them were male employees and 67.3% (n=107/159) were in the group of 26-35 years of age. 73% (n=116/159) of respondents were degree holders, 44.0% (n=70/159) respondents had 6-10 years of experience, 31.44 % (n=50/159) of respondents were supervisors (table 2).

Table 2: Demographic characteristics of respondents of Public Hospitals (n=159), Addis Ababa, 2019

Variables	Demographic Item	Frequency	Percent
Gender	Female	69	43.4
	Male	90	56.6
	Total	159	100
Age Group	18-25	11	6.9
	26-35	107	67.3
	36-45	36	22.6
	46-55	5	3.1
	Total	159	100
Educational level	College Diploma	25	15.7
	Bachelor degree	116	73.0
	Master's Degree	18	11.3
	Total	159	100
Work Experience	1-5	66	41.4
	6-10	70	44.0
	11-15	19	11.9
	>15	4	2.5
	Total	159	100
Management level	Middle level(heads)	13	8.2
	Supervisory	50	31.44
	Low level	48	30.18
	Operational	48	30.18
	Total	159	100

6.3 Supply chain management practices

73.5 % (n=117/159) of participants indicated overall supply chain management practices had not been implemented as per the requirements. 70.4% (n=112/159), 73.6 % (n=117/159), 69.2% (n=110/159), 74.8% (n=119/159), 79.9% (n=127/159) of participants indicated there was no practice of logistic management, supplier relation management, customer relation management, information sharing, and order fulfillment respectively (fig 2).

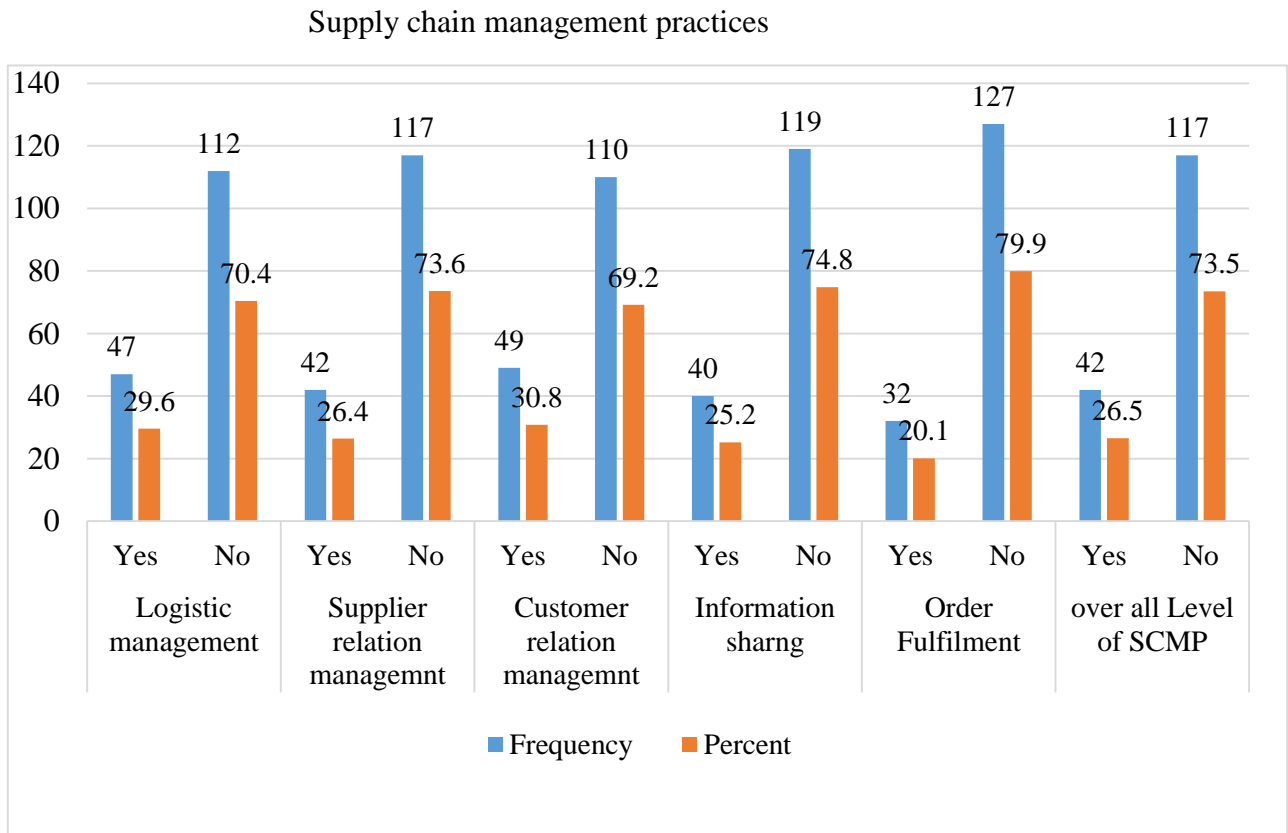


Fig 2: Descriptive statistics supply chain management practices of respondents (n=159) of Public hospitals, Addis Ababa, Ethiopia, 2019

6.4 Provision of quality laboratory services

In terms of laboratory service provision, 59.1% (n=94/159) of respondents indicated that their laboratories did not provide quality laboratory services as per standards, 56 % (n=89/159) of laboratory professionals indicated laboratory services were not provided as per to preset turnaround times, 57.9% (n=92/159) of laboratory professionals also indicated services provided were not reliable, 63.3% (n=101/159) of laboratory professionals indicated that laboratory service provision was not as per to safety requirements (fig 3).

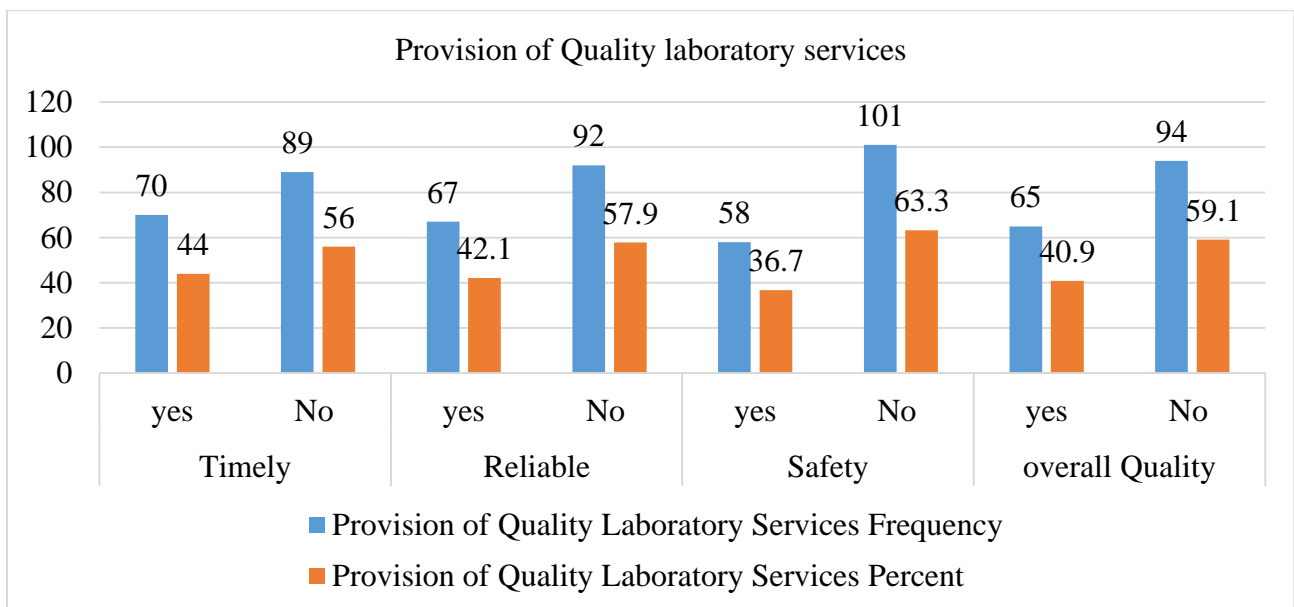


Fig 3: Descriptive statistics of provision of quality laboratory services of respondents (n=159) of Public hospitals, Addis Ababa, Ethiopia, 2019

6.5 Observation of supply chain management practices

From the observation it was found that 61.5% (n=8/13) of public hospitals had work plan and budget projection, 61.5% (n=8/13) had storage rooms with optimum temperature, moisture, space, lightening, cold chain that were according to the expectations of the standard requirements for storage, and 53.8% (n=7/13) had updated Bin cards indicating stock on hand, used, lost or adjusted, arranged in first expiry first out manner. In 77% (n=7/13) of public hospitals laboratory staffs had no access to training particularly related to supply chain management, 69.2% (n=9/12) encountered stock out of coagulation, hormonal, chemistry reagents, controls during the last six months and during visit time and in 61.5% (n=8/12) public hospitals the laboratory professionals were not involved in the procurement process (table 3).

Table 3: Observation of supply chain management practices of public hospitals (n=13), Addis Ababa, Ethiopia, 2019

Observational checklist for supply chain management practices	Response	Frequency	Percent
Involvement of laboratory professionals in the procurement	Yes	5	38.5
	No	8	61.5
Availability of training particularly related to supply chain management	Yes	3	23
	No	10	77
Presence of work plan and budget projection	Yes	5	38.5
	No	8	61.5
Presence of policy for criteria for selection and procurement	Yes	8	61.5
	No	5	38.5
Storage rooms with optimum Temperature, moisture, space, lightening, cold chain	Yes	8	61.5
	No	5	38.5
Updated Bin cards/stock cards (indicating stock on hand, used, lost or adjusted) and in FEFO	Yes	7	53.8
	No	6	46.2
Availability of funds to support laboratory services	Yes	6	46.2
	No	7	53.8
Machine failure(Hormonal, Chemistry) for last 6 months and during visit	Yes	8	61.5
	No	5	38.5
Stock out of reagents(coagulation, hormonal, Chemistry) and controls (Hematology , chemistry)	Yes	9	69.2
	No	4	38.2
Supplier misbehave	Yes	9	69.2
	No	4	30.8

6.6 Observation of the provision of quality laboratory services

From the observation it was found that 53.8% (n=7/13) of public hospitals had barcoding systems, 61.5% (n=8/13) uses vacutainer technique for phlebotomy, and 69.2% (n=9/13) had backup systems in cases of service failures. 84.6% (n=11/13) of public hospitals had no HB vaccines, 61.5% (n=8/13) had no HIV post exposure medicines, in 84.6% (n=11/13) public hospital laboratory quality control was not daily monitored for all tests and 69.2% (n=9/13) has no sufficient personal protective equipment and waste disposal materials (table 4).

Table 4: Observational of provision of quality laboratory services of public hospitals (n=13) Addis Ababa, Ethiopia, 2019

Observational checklist for Quality	Response	Frequency	Percent
Existence of barcoding system	Yes	7	53.8
	No	6	46.2
Use of vacutainer technique for phlebotomy	Yes	8	61.5
	No	5	38.5
Computer generated requisition and result reporting	Yes	4	30.8
	No	9	69.2
Use of fully automated machines with higher throughput	Yes	5	38.5
	No	8	61.5
Daily monitoring quality control for all tests	Yes	2	15.4
	No	11	84.6
Equipment calibration, maintenance, trouble shooting as per to schedules	Yes	6	46.2
	No	7	53.8
Backup systems in cases of service delivery failure	Yes	9	69.2
	No	4	30.8
Sufficient waste disposal material for infectious, non-infectious and sharps	Yes	4	30.8
	No	9	69.2
Sufficient PPE(gloves, eye goggle, facemasks, lab coats, aprons)	Yes	4	30.8
	No	9	69.2
Presence of fire safety	Yes	7	53.8
	No	6	46.2
Presence HB vaccines for all staffs	Yes	2	15.4
	No	11	84.6
Availability of HIV post exposure medicines	Yes	5	38.5
	No	8	61.5

6.7 Impact of employee factors and Supply Chain Management Practices on laboratory service quality

We carried out a binary logistic regression analysis to determine whether there is an association between laboratory service quality and employee factors. The research data indicated there was no difference in the provision of quality laboratory services due to gender, age group, and experiences. The regression analysis showed that employee holding degree and masters were statistically associated with provision of quality laboratory service than diploma holders. The null hypothesis for educational level was rejected as it had a significant statistical difference in the provision of quality laboratory services due educational level (degree=0.025, masters, P=0.031).

The regression analysis also showed that supply chain management practices of customer relationship management, supplier relationship management, and information sharing had no a significant association with laboratory service quality. Practicing logics management and order fulfillment were found 3.32 and 3.56 times more likely to provide quality of laboratory service than those not practicing. So the null hypothesis for the impact of practicing Logistics Management (p=0.008) and Order Fulfilment (p=0.012) was rejected as it had a significant effect on the provision of quality laboratory services (table 5).

Table 5: Impact of employee, management factors and Supply Chain Management Practices on laboratory diagnostic service Quality of laboratory services in Public Hospitals, Addis Ababa, Ethiopia, 2019

Independent variables		Provision of 95% COR		P.Value	95% AOR	P.Value	
		Yes	No				
Gender	Male	41	49	1.56(0.82-2.99)	0.172	1.45(0.7-2.9)	0.296
	Female	24	45	√			
Age group	18-25	1	10	0.15(0.01-2.29)	0.172	0.07(0.0-1.28)	0.072
	26-35	49	58	1.27(0.2-7.90)	0.800	0.67(0.09-5.04)	0.700
	36-45	13	23	0.85(0.125-5.7)	0.866	0.67(0.09-5.08)	0.694
	46-55	2	3	√			
Education	Masters	7	18	0.194(0.05-0.7)	0.014*	0.19(0.04-0.86)	0.031**
	Degree	46	70	0.33(0.1-0.94)	0.037*	0.25(0.07-0.84)	0.025**
	Diploma	12	6	√			
Experience	1-5	30	36	0.83(0.11-6.27)	0.86	3.0(0.25-37.5)	0.382
	6-10	27	43	0.63(0.08-4.72)	0.65	1.5(0.14-16.6)	0.739
	11-15	6	13	0.46(0.05-4.10)	0.49	0.8(0.08-9.76)	0.906
	>15	2	2	√			
LM	Yes	33	14	5.89(2.78-12.5)	0.00*	3.32(1.4-8.0)	0.008**
	No	32	80	√			
SRM	Yes	27	15	3.74(1.78-7.85)	0.000*	0.95(0.34-2.71)	0.930
	No	38	79	√			
CRM	Yes	30	19	3.38(1.67-6.78)	0.001*	1.41(0.06-3.44)	0.447
	No	35	75	√			
IS	Yes	27	13	4.43(2.06-9.52)	0.000*	2.0(0.76-5.29)	0.162
	No	38	81	√			
OF	Yes	24	8	6.23(2.60-15.2)	0.000*	3.56(1.32-9.56)	0.012**
	No	41	86	√			

Key ** Significant association at $\alpha=0.05$ √ shows reference category, LM=logistics management, SRM=supplier relationship management, CRM=customer relationship management, IS=information sharing, OF=order fulfilment

7 Discussions

Our finding indicated that majority of health facilities had policy criteria for selection of laboratory commodities, most of the laboratory stores met the standard storage criteria's which were the good features of supply chain management practices. However, in this study, the extent of implementation of supply chain management practices, 73.5% (n=117/159) of participants indicated that public hospitals had not adequately implemented supply chain management practices. 59.1% (n=65/159) of respondents indicated that their laboratories did not provide quality laboratory services as per standards which is in contrast with study in Ethiopia that 35.2% of respondents indicated quality service was not provided as per standard (18). The poor supply chain management in the public hospitals may result in prolonged stay of patients, deterioration in the medication, deaths of patients and transfer of patients to private facilities where they assume can get necessary investigations.

The study revealed that gender, age group, experiences, had no significant association with the provision of quality laboratory services which is in line with the study done in Jordan private hospitals that showed no significant difference between supply chain management, and quality of health services due to gender, age, and years of experiences; while holding masters in educational levels had significant association with provision of quality laboratory services (degree, $p=0.025$, masters, $p=0.031$) which is in contrast to Jordan study (4). This difference could be due to the fact that most hospitals participated in the study were academic, where more educated are actively involved in positions that requires knowledge to improve quality of laboratory services.

Our study identified that logistics management of public hospitals was statistically associated with laboratory service quality ($p=0.008$). It was found 3.32 times more likely to get success in providing quality laboratory service among public hospitals practicing logistics management than not practicing it, which is in line with study in England Kumerya A.S that showed logistics management improves laboratory services providing adequate, appropriate supplies, increasing professional satisfaction, and morale leading to a higher quality of service and study done at

Brazil by Marchesini MM et.al, 2016 that showed logistics management improves services reliability ($p=0.035$) and responsiveness ($p=0.074$) (11,34).

The customer relationship management practices ($p=0.447$) was not statically associated with provision of quality laboratory services. This was in contrast with study done in Kenya that showed statistical significance of effective communication with customers affected delivery of service quality to patients in public health sector affecting quality perceptions, and patient satisfaction (14). This finding was in contrast with findings of study done in Malaysia and Kuwait, that showed customer relation management improved the service quality, through efforts and strong interaction between service provider, receiver to respond for evolution, rapid changes in customer needs, giving more attention to a system that influence the progress of organization activities with new approaches, and attitudes about customer relationship management (3,20). The staffs are supposed to be trained about customer realtionship managemnt and how can successfully implemented to bring patient satisfacion to maintain long term organisational performance in terms of the quality service provision.

Public hospitals with good supplier relationship management practices had statistical significance on service quality in Nigeria; (compatibility, $p=0.002$, delivery, $p=0.032$, maintenance, $p=0.031$) and findings from study done in Jordan private hospitals ($p=0.0$) had statistically significant relationship with service quality which is in contrast to our study $p=0.930$ that was not statistically associated with laboratory service quality (4,9). Information sharing among supply chain members ($p=0.189$) were not significantly associated with service quality, which is in contrast with a study done in Malaysia, that showed information sharing was determinant factor to increase supply chain responsiveness generating organizational quality (3). This finding is also in contrast to the findings of study done in Kenya showed statistical significance of technology adoption, and effective communication channels affected delivery of service quality to patients in public health sector (14). The possible reason that supplier relation management, customer relationship management and information sharing were not associated with provision of laboratory service quality might be due to its low level of practices, due to difference in study areas that our study only included public hospitals that encounter bureaucratic issues.

Practicing order fulfillment practice ($p=0.012$) was statistically associated with provision of laboratory services. It was found 3.56 times more likely to get success in providing quality laboratory service among public hospitals practicing order fulfillment (classifying inventories according to their needs, capacity to respond to demand fluctuations, supplier buyer integrated planning, forecasting, replenishment, reducing lead time, maintaining high level of emergency supplies) than not practicing it; which is comparable with study done by Msimangira, KA, 2010, entitled with as the supplier commercial relationships, and order fulfillment in new Zealand public hospitals showed statistical significances of performance quality, and order fulfillment (classifying inventories according to their needs, responding to demand fluctuations, maintaining high level of emergency items) (33). The public hospitals tend to be responsive with respect to strategies to determine ways how to respond to the quality of laboratory services. The process that balances customers requirement in service quality, with right ordering process in place, managers can match supply with demand proactively included in plan reducing errors associated with forecasting demands.

The observational data indicated that; most of health facilities had work plan and budgetary projections, policy criteria for selection and procurement of laboratory commodities, the laboratory stores met the standard storage criteria's which were the good features of supply chain management practices. The study finding revealed that public hospitals faced with the frequent stock out of testing reagents and controls, and lack of training particularly related to supply chain management led to failure of supply chain management in the provision of quality laboratory services. These findings were similar with the findings of study done in Kenya and Addis Ababa, Ethiopia, which indicated that poor quality and frequent stock out of controls, reagents, and equipment down were the major challenges (14,18,35). The noninvolvement of laboratory in the procurement process and supplier misbehavior led to receiving most of the items not met specifications set by laboratory leading unnecessary overstock of useless items which is comparable with study done in Gahanna that indicated 90% of departmental heads were not involved in the procurement process which led to suppliers to misbehave like cheating on this process and not providing all necessary reagents, supplies, and equipment (36).

Observation data also indicated most of public hospitals used barcoding system and vacutainer techniques for phlebotomy that facilitates sample collection process in safe and timely manner. However, majority of public hospitals had no computer generated requisition and result reporting and fully automated analyzers with higher throughput that improves timely delivery of laboratory services. Majority of public hospitals did not daily monitor quality control procedures, did not perform maintenance and calibration of equipment's as per to schedules which compromised the reliability of testing, while the safety practice also remained critical as there was no sufficient personal protective equipment's, waste disposal material, vaccine for Hepatitis B, and post HIV exposure medicines that affects the safety of clients and professionals.

8 Limitation of the study

Absence of similar literatures in these areas especially in Ethiopia made difficult in the comparison of findings and this study did not address all components of supply chain management practices like outsourcing, financial management etc.

9 Conclusions and Recommendations

9.1 Conclusions

Based on the study findings we can conclude that;

Supply chain management was not adequately practiced in public hospitals. The public hospitals should strengthen supply chain management practices particularly logistics management and order fulfilment. Professionals having skills in supply chain management should be employed for good decision making to be achieved in public hospitals in terms of supply chain management practices.

Finally, also concludes that, stock outs reagents, controls, machine failure, lack of sufficient personnel protective equipment's, waste disposal materials, and lack of vaccine for hepatitis B affected the reliability, safety and led to delay in timely service delivery. The noninvolvement of laboratory professionals in procurement process, and lack of training led to purchasing of equipment, reagents, consumables, that are out of specifications encouraging supplier to misbehave, which led fail to respond to quality service demands at public hospitals found in Addis Ababa, Ethiopia.

9.2 Recommendations

Based on the study results, the following recommendations were made;

1. Since the finding indicated that supply chain management practices and provision of quality service is not as per to standards, public hospitals should improve access to quality laboratory services.
2. Since the finding indicated that equipment failure, reagent stock out were the most identified gaps, the public hospitals should give attention to strength supply chain management practices.
3. The study also indicated that lack of training particularly related to supply chain management was a major gap, it is recommended to provide seminars, short term, and long-term training, to operational staff and managers.

4. In the majority of public hospitals laboratory personnel's were not involved in the procurement process receiving most of the items that not met specifications, therefore, the federal ministry of health should revise procurement policy that denies the involvement of laboratory professionals in the purchasing process.
5. Since the present study was focused only on public hospitals, it is recommended to conduct further study.

10. References

1. Peter TF, Rotz PD, Blair DH, Khine AA, Freeman RR, Murtagh MM. Impact of Laboratory Accreditation on Patient Care and the Health System. *American Journal of Clinical Pathology*. 2010;134(4):550–555.
2. Albarune AR, Farhat N, Afzal F. Valued supply chain for integrated hospital management: A conceptual framework. *International Journal of Supply Chain Management*. 2015; 4(3):39-49.
3. Sukati I, Hamid AB, Baharun R, Tat HH, Said F. A study of supply chain management practices: An empirical investigation on consumer goods industry in Malaysia. *International Journal of Business and Social Science*. 2011; 2(17):166-76.
4. Al-Saa'da RJ, Taleb YK, Al-Abdallat ME, Al-Mahasneh RA, Nimer NA, Al-Weshah GA. Supply chain management and its effect on health care service quality: quantitative evidence from Jordanian private hospitals. *Journal of Management and Strategy*. 2013; 4(2):42.
5. Chandra C, Kachhal SK. Managing health care supply chain: trends, issues, and solutions from a logistics perspective. In *Proceedings of the sixteenth annual society of health systems management engineering forum*. 2004;1:20-21.
6. Nimanpure A, Sohan N. Measurement of Supplier Service Quality Dimensions in the Supply Chain: *International Journal of Engineering Research & Technology (IJERT)*. 2013;2(3):1-4.
7. McHugh TM. Supply-Chain-Management in the Clinical Laboratory: *Clinical Leadership & Management Review*. 2008; 20(1):1-5.
8. International Organization for Standardization. *Medical Laboratories: Requirements for Quality and Competence*. ISO 15189; 2012.
9. Odhiambo P. Supply Chain Management Practices and Service Quality among Public Hospitals in Nairobi County, Kenya. Unpublished Master's Thesis, University of Nairobi, Kenya. 2014.
10. Nakkeeran SK. Optimizing the stake holder's perspective on enhancing the service quality in health care. University Library of Munich, Germany. 2010:1.
11. Kumurya, A.S. Supply Chain Management of Health Commodities and Logistics: Fundamental Components of Booming Medical Laboratory Service: *European Journal of Logistics, Purchasing and Supply Chain Management*. 2015; 3(4):62-72.
12. USAID | DELIVER PROJECT. *Guidelines for Managing the Laboratory Supply Chain: Version 2*. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 1; (2008).

13. Abayomi A, Adesina A, Berney D, Carillo C, Angelo RD, Diomand I, et.al. African Strategies for Advancing Pathology Group Members. Quality pathology and laboratory diagnostic services are key to improving global health outcomes: Improving global health outcomes is not possible without accurate disease diagnosis. 2015; 143(3):325–328.
14. Wanjau KN, Muiruri BN, Ayodo E. Factors Affecting Provision of Service Quality in the Public Health Sector: Case of Kenyatta National Hospital, International Journal of Humanities and Social Scienc. 2012; (13):114-125.
15. Kagaruki GB, Kamugisha ML, Kilale AM, Kamugisha E, Rutta ASM, Baraka V, et al. Supply chain management of Laboratory supportive services and potential implication on the quality of HIV diagnostic services in Tanzania, Tanzania Journal of Health Research. 2018; 20(1):1-10.
16. Nditunze L, Makuza S, Amoroso CL, Odhiambo J, Ntakirutimana E, Cedro L et al. Assessment of Essential Medicines Stock-Outs at Health Centers in Burera District in Northern Rwanda: Rwanda Journal Series F: Medicine and Health Sciences. 2015; 2(1):85-88.
17. Sinishaw MA, Gebregergs GB, Shiferaw MB. Longer lead time of tuberculosis laboratory commodities in the Amhara region, Ethiopia. Asian Pacific Journal of Tropical Disease. 2016; 6(4):269-271.
18. Mesfin EA, Taye B, Belay G, Ashenafi A, Girma V. Factors Affecting Quality of Laboratory Services in Public and Private Health Facilities in Addis Ababa, Ethiopia: the EJIFCC. 2017; 28(3):205-223.
19. Tesfaye D. The study of Ethiopia public health supply chain management: before and after pharmaceuticals fund and supply agency (PFSA) (Doctoral dissertation, St. Mary's University), 2015.
20. Gilaninia S, Taleghani M, Mousavian SJ, Jalilvand S, Khanjani S, Rad MS, Shadmani E, Shiri Z, Seighalani FZ. Impact of Supply Chain Dimensions on Customer Satisfaction. Kuwait Chapter of Arabian Journal of Business and Management Review. 2012; 33(834):1-8.
21. Yao K, McKinney B, Murphy A, Rotz P, Wafula W, Sendagire H, et.al. Improving Quality Management Systems of Laboratories in Developing Countries: An Innovative Training Approach to Accelerate Laboratory Accreditation: American Journal of Clinical Pathology. 2010; 134(3): 401–409.

22. World Health Organization. Laboratory quality management system: a handbook. World Health Organization; 2011.
23. Pervez MN, Mahmud J, and Bachar SC. Supply Chain Management of Pharmaceutical Products in Hospitals: A Case Study In A Privately Owned Tertiary Level Hospital: Journal of Research in Business and Management. 2016; 4(4): 14-23.
24. WHO. Manual for procurement of diagnostics and related laboratory items and equipment. 2013. www.who.int/diagnosticslaboratoryaccess.
25. Desale A, Taye B, Belay G, Nigatu A. Assessment of laboratory logistics management information system practice for HIV/AIDS and tuberculosis laboratory commodities in selected public health facilities in Addis Ababa, Ethiopia. Pan African Medical Journal. 2013;15(46):1-8.
26. Chin TA, Abdul Hamid AB, Rasli A, Baharun R. Adoption of Supply Chain Management in SMEs. Procedia - Social and Behavioral Sciences. 2012; 65:614–619.
27. Mathur B, Gupta S, Meena ML, Dangayach GS. Healthcare supply chain management: literature review and some issues: Journal of Advances in Management Research; 2018 accessed at <https://doi.org/10.1108/JAMR-09-2017-0090>.
28. Yap LL, Tan CL. The Effect of Service Supply Chain Management Practices on the Public Healthcare Organizational Performance: International Journal of Business and Social Science. 2013; 3(16):216-224.
29. Ali Q. Service quality from customer perception: Comparative analysis between Islamic and conventional banks. Journal of Marketing and Consumer Research. 2018; 43:70-82.
30. Mosadeghrad AM. Factors Influencing Healthcare Service Quality. International journal of health policy and management. 2014; 3(2):77–89.
31. McIntyre D, Thiede M, Birch S. Access as a policy-relevant concept in low- and middle-income countries: Health Economics, Policy, and Law. 2009; 4:179-193.
32. Mosadeghrad AM. Factors Affecting Medical Service Quality. Ran J Public Health. 2014; 43(2):210-20.
33. Msimangira KA. Supply chain integration in New Zealand public hospitals: impact on supplier commercial relationships and order fulfillment (Doctoral dissertation, Auckland University of Technology). 2010.

34. Marchesini MM, Alcântara RL. Logistics activities in supply chain business process: A conceptual framework to guide their implementation. *The International Journal of Logistics Management*. 2016; 27(1):6-30.
35. Sisay A, Mindaye T, Tesfaye A, Abera E, Desale A. Assessing the outcome of Strengthening Laboratory Management Towards Accreditation (SLMTA) on laboratory quality management system in city government of Addis Ababa, Ethiopia: *The Pan African Medical Journal*. 2015; 20:314.
36. Yaba C: Assessment of Supply Chain Management in Hospitals: a case study of greater Accra regional hospital–ridge, University of Ghana <http://ugspace.ug.edu.gh>. 2014 (unpublished Paper).
37. Ethiopian population, 2018-09-24. Retrieved 2019-02-04, from <http://world population review.com/countries/Ethiopia/>. Access date; 04/02/2019:05:00pm
38. Yisma E, Dessalegn B, Astatkie A, Fesseha N. Completion of the modified World Health Organization (WHO) partograph during labour in public health institutions of Addis Ababa, Ethiopia. *Reproductive health*. 2013; 10(1):23.

11. Annexes

Annex I:

Table 6: Proportionate sampling of respondents of Public Hospitals, Addis Ababa, Ethiopia, 2019

Public Hospitals	Source Population	Lab head	Supervisors	Low level	operational	Total
SPHMMC	43	1	4	7	6	18
TASH	69	1	4	7	8	20
ALERT	28	1	4	4	6	15
SPTSH	27	1	4	5	5	15
AMSGH	14	1	4	3	3	11
Y12MC	21	1	4	4	4	13
MH	19	1	4	3	3	11
ZMH	17	1	4	4	4	13
GMH	11	1	4	2	3	10
TBGH	14	1	4	3	3	11
RDMH	14	1	4	4	3	12
AFH	12	1	4	3	2	10
PH	13	1	3	3	3	10
Total	301	13	51	52	53	169

Adapted from Addis Ababa Health Bureau and Federal Ministry of Health data base, 2019

Annex II: Information sheet

Purpose

I am conducting a research to Supply chain management of Laboratory equipment, supplies, reagents, consumables and its potential impact on quality of diagnostic services of public hospitals, Addis Ababa. Your feedback on this research is important and will help to use supply chain management as tool for improving quality of diagnostic services.

Participation: Your participation in this research is voluntary. It is your choice whether to participate or not.

Procedures: I am inviting you to take part in this research. If you accept, what is expected from you is to respond questions which may take 10 minutes about supply chain management practices of laboratory supplies, reagents and equipment's and its impact on quality of diagnostic services.

Please fill out questioners, which will be provided by data collectors or primary investigator, you may answer the questionnaire yourself, or it can be read to you and you can say aloud the answer you want me to write down. If you do not wish to answer any of the questions included in the research, you may skip them and move on to the next question. The information recorded is confidential, your name is not being included on the forms, only a number and signature will identify you, and no one else except primary investigator with access to the information will have access to your

Confidentiality: All the data obtained will be kept strictly confidential by using only code numbers, which is filled by the data collectors and investigators, and locking the data.

Right to refuse: Since participation in this study is entirely voluntarily, you can refuse or withdraw to participate in this study at any time. Your refusal will not affect your job or services given in the hospital.

Who to Contact if you have any question concerning the study you can ask with the following address

Principal investigator: Biadgign Asrat

Address: Addis Ababa University College of Health science, Department Medical Laboratory Science. Tel: 09 10 617531, Email address: bedigu988@gmail.com

Addis Ababa, Ethiopia

Annex III: Consent Form:

I have read the information above or it has been read to me. I have been given the opportunity to ask questions and my questions have been answered to my satisfaction. I voluntarily consent that I will participate in this study and I understand that I have the right to withdraw from the study at any time

Name of participant____ date____/____/____ signature____ Phone number_____

Name of data collector _____date ____/____/____ signature _____

Annex IV: Public Hospitals in Addis Ababa

- 1-St, Paul Hospital Millennium medical College
- 2-Addis Ababa Burn, Emergency and Trauma Hospital
- 3-Black Lion Comprehensive specialized Hospital
- 4-ALERT Hospital
- 5-Amanuel Mental specialized hospital
- 6-St, Peter Tb Specialized Hospital
- 7-Yekatit 12 Medical College
- 8-Menelik Hospital
- 9-Zewuditu Memorial Hospital
- 10-Ras Desta Damtew Memorial Hospital
- 11-Gahandi Memorial Hospital
- 13-Armed Force Hospital
- 14-Diffence Hospital

Annex V: Questionnaire

This study adopted logistics management part of the supply chain management from study done at Bayero University by Kumurya, A.S, from Jordanian private hospitals on the effect of supply chain dimensions on service quality in terms of strategic supplier partnership (use specifications, standards, delivery, and after-sales service), from study done Malaysia by Sukati I. et.al for Customer relation management and information sharing to assess the SCM and the potential impact on quality of service in public hospitals, specifically extending to laboratory units by adding other SCM practices. This questionnaire has been designed for the sole purpose of collecting data from Laboratory Heads, Quality Managers, Logistic Officers, Laboratory Professionals, and Pharmacy Heads/Store Keepers, on the Assessment of Supply chain management of laboratory equipment, reagents, consumables, supplies and impact on quality diagnostic services of Public Hospitals in Addis Ababa, Ethiopia. The data collected was treated with a very high degree of confidentiality and it is meant for academic purposes only.

Part A: Demographic Profile

	Variables	Response /coding
1	Department	
2	Gender (<i>Please tick where appropriate</i>)	Male ...1 Female....2
3	Age in years Year
4	Education level (<i>Please tick where appropriate</i>)	College Diploma.....1 Bachelor's Degree2 Master's Degree.....3 PhD Degree.....4
5	How many years have you been employed in public hospitals in Addis Ababa?Year
6	Please indicate the category you fall under management level	1-Middle (Lab heads) 2-Supervisor(Qo, So, Lo, Pharma store) 3- Low (section Heads) 4-Operational
7	Signature	

8	Date	
---	------	--

Part B: Supply Chain Management Practices

Please rate to what extent the following Supply Chain Management practiced in your organization. The scale below will be applicable: 1 = to a very small extent, 2 = Small extent, 3 = moderate extent, 4 = Large extent 5 = very large extent. The following are supply chain management practices

1.0	Logistics Management	1	2	3	4	5
1.1	The Selection of laboratory, equipment's, reagents, supplies and consumables is based on a plan and demand need					
1.2	Forecasting is based on the number of tests done, average monthly consumption, current stock levels, by estimating future needs , procurement in bulk on realistic estimate					
1.3	Items Stored based on special storage conditions (space, lightening, temperature) are properly inspected , arranged either based on FIFO/FEFO					
1.4	Inventory management with updated bin card/ stock card					
1.5	Periodical management review of logistics system					
2.0	Supplier Relation Management	1	2	3	4	5
2.1	The supplier relationship with the hospital Laboratory is dependable					
2.2	Compatibility (appropriateness of medical equipment and supplies to the specification agreed upon between the suppliers and the Hospital)					
2.3	Suppliers able to meet up with their delivery dates					
2.4	Suppliers are meeting with specifications set by the hospital conditions for the supply in the tender, which leads to right medical equipment and supplies acquisitions					
2.5	The hospital Laboratory enjoys follow up maintenance service with the suppliers after sale					
3.0	Customer Relation Management	1	2	3	4	5
3.1	The Laboratory frequently interact with customers to set reliability,					

	responsiveness, and other standards					
3.2	The Laboratory frequently measure and evaluate customer satisfaction					
3.3	The Laboratory frequently manages and determines future customer expectations					
3.4	The laboratory facilitate customers' ability to seek assistance					
3.5	The laboratory periodically evaluate the importance of its relationship with your customers					
4.0	Information sharing	1	2	3	4	5
4.1	The hospital and Laboratory ensure information flow among its supply chain members (frequently communicates to upper management on any issues)					
4.2	The Laboratory applies current inventory management technologies (vendor management inventory electronic data exchange)					
4.3	The hospital laboratory inform suppliers in advance of changing needs					
4.4	The suppliers keep us fully informed about issues that affect hospitals service delivery					
4.5	The suppliers share knowledge of core business processes with the hospital					
5.0	Order Fulfillment	1	2	3	4	5
5.1	The laboratory classifies inventories according to their needs					
5.2	The laboratory has capacity to respond to demand fluctuations					
5.3	There is supplier buyer integrated planning, forecasting, and replenishment					
5.4	The laboratory has reduced order fulfillment lead time					
5.5	The laboratory maintains high level of emergency supplies					

Part C: Laboratory Service Quality

Please respond to the status of quality of your laboratory service provision.

Use: 1= if your answer is yes or 2= if your answer is No

1	Provision of laboratory services	1	2
1.1	Timely services to customers(responsiveness)		
1.2	Laboratory services are reliable to customers		
1.3	Safety of laboratory services are well practiced		

Part D: Observational checklist for supply chain management and laboratory service provision

Observational checklist for Supply chain management practices			
1	Work plan and budgetary projections based on test, equipment needs, quality and assurance procedures	Yes No	
2	Policy for criteria for selection, procurement, quality checking of equipment's, reagents, consumables	Yes No	
3	Storage conditions of store rooms (temperature, space, lightening for reagents, consumables, calibrators, and controls good conditions)	Yes No	
4	Updated Bin cards/stock cards (indicating stock on hand, used, lost or adjusted) and in FEFO	Yes No	
5	Equipment condition (calibration, maintenance, cleaning, trouble shouting, service and repair according to schedules)	Yes No	
6	Involvement of laboratory professionals in procurement	Yes No	
7	Availability of training particularly related to supply chain management	Yes No	
8	Availability of finance to support services	Yes No	
9	Machine failure(Hormonal, Chemistry) for last 6 months and during visit	Yes No	
10	Stock out of reagents(coagulation, hormonal, Chemistry) and controls (Hematology , chemistry)	Yes No	
Observation check list for quality of laboratory services			
Responsiveness (TAT)			
1	Existence of Barcoding system	Yes No	
2	Use of vacationer tubes for phlebotomy	Yes No	
3	Computer generated requisition (specimen login and log out) and Result reporting	Yes No	
4	Use of fully automated machines with higher throughput	Yes No	
Reliability			

1	Quality control procedures daily monitored	Yes No	
2	Customer survey conducted every month	Yes No	
3	Monitoring service interruption (stock out, machine failures)	Yes No	
4	Backup system in case of service delivery failure	Yes No	
Safety			
1	Sufficient waste disposal materials (infectious, noninfectious, sharp)	Yes No	
2	Sufficient PPE (glove, gown, eye goggle, facemask), lab coats, aprons	Yes No	
3	Fire safety	Yes No	
4	Vaccination (HB)	Yes No	
5	Post exposure medicines	Yes No	

Declaration

I, the undersigned, declare that this MSc. thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been duly acknowledged.

MSc. candidate: Biadgign Asrat (BSc)

Signature: _____

Date of submission: _____

This thesis has been submitted with our approval as advisors.

Advisor: Fatuma Hasen (MPH, PhD. candidate.)

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.

Advisor: Abay Sisay (BSc, MSc)

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.