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Research Article

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Logistics management information system performance for laboratory commodities in public health facilities of west Shoa zone, Oromia regional state, Ethiopia: A facility-based concurrent explanatory mixed-method design.

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Abstract

Background: *A logistics management information system is a mechanism of recording and reporting that captures, analyzes, and displays logistics data. It works well if trained and skilled people record, analyze, manage, validate and use at all levels to make informed logistics decisions thus prevent shortages of commodities.*

Objective: *To assess the logistics management information system performance for laboratory commodities in the case of public health facilities of West Shoa zone, Oromia regional state, Ethiopia*

Methods: *A facility based concurrent explanatory mixed-method design was employed to assess the logistic management information system performance for laboratory commodities in public health facilities of West Shoa zone, Oromia regional state, Ethiopia from June 2021 to July 2021. Twenty health facilities were selected by using simple random sampling and purposely. Data were collected by reviewing logistic management information system tools. Data were checked for its completeness, coded, and entered into a statistical package for social sciences version 23 and analyzed using descriptive (percentage and frequency table) and inferential statistics (chi-square test). An in-depth interview was carried out to explore the challenges to logistic management information system performance and thematically analyzed.*

Results: *Logistic management information system tools availability ranges from 30-100% with utilization ranges from 15-95%. Data quality like timeliness and completeness of the reports were 80% and 75% with 80% facility reporting rate. A significant association was observed between IFRR completeness and training pattern $\chi 2$ (1, N = 109) = 4.127, P = 0.041, experience $\chi 2$ (2, N = 109) = 12.203, P = 0.002, supervision $\chi 2$ (5, N = 109) = 17.07, P = .004, and feedback $\chi 2$ (4, N = 109) = 10.037, P = 0.04. Staff turnover, workload, and inadequate manpower were major challenges identified.*

Conclusion: *The availability and utilization of logistic management information system tools need an improvement. Data quality like bin card accuracy, timeliness, and completeness still need focus. Staff turnover, lack of commitment, workload and inadequate manpower were the challenges identified.*

Keywords: Health-Facilities, Health Supply Chain, Logistics Management, Laboratory Commodities, Ethiopia.

1. Introduction

Logistics management is the process of planning, implementing, and controlling the efficient and effective flow of goods, cash, and related information from the point of origin to the point of consumption to satisfy the customer's needs and expectations. A practice of logistics management increases the demand for quality health services that cannot be provided if the required logistic data is not available [01-04].

Information is an engine that drives the logistics management cycle and it is what a manager gathers and analyses to make decisions and coordinate future actions of the logistics system [05]. Information systems are the systems and procedures that are utilized to collect, transmit and analyze data and information for decision-making and action (including record-keeping documents, data-reporting forms, and feedback reports) up and

down the supply chain, that is either paper-based or electronic systems [06].

An effective logistics management information system (LMIS) is the right combination of people, processes, and technology [07]. It works well if trained and skilled people record, analyze, manage, validate and display data and use it at all levels. This enables to make informed logistics decisions, hinder disruption of commodity supplies and identify any problems in the supply pipeline [06, 08-10]. Hence increase the responsiveness of the supply chain and fulfills customer demand for better quality health services. This is done when LMIS capture accurate routine consumption data; real-time end-to-end logistics management; demand forecasting, capacity planning, and modeling based on consumption [10, 11].

Quality laboratory services require infrastructure, adequate and well-trained laboratory personnel, and a sufficient supply of commodities. So, like any other supply chain, laboratory LMIS should record and report stock on hand, consumption data, and losses and adjustments. But its logistic system is affected by their characteristics, nature of the commodities, and their use [12-14].

LMIS should collect the three essential data needed to make logistics decisions. Stock on hand (quantities on hand in a given period), consumption data (quantities dispensed to the user), and losses and adjustments (stock for purposes other than use (expiry, damage, theft, etc.)). In the case of Ethiopia, this data is recorded and reported by using formats like bin card, internal report and requisition form (IFRRF), request and report form (RRF), and health post monthly report and request form (HPMRRF) that were designed by the integrated pharmaceuticals logistics system (IPLS) [12-15].

Such data should be reported regularly, timely, and verified for its quality. It should be validated by comparing with historical data or HMIS to ensure optimal quality. Use digital LMIS to improves data quality by reducing mathematical errors, highlighting missing information, and facilitating data capture, analysis, reporting, and feedback [07].

The generation of accurate records is necessary because most decisions regarding pharmaceuticals selection, quantification, procurement, and use depend on it. When there are poor stock records, the pharmaceuticals supply will be based on inaccurate data, which leads to stock-outs or overstock [16]. This indicates the availability of health commodities is directly associated with logistics data quality [17].

Despite the usefulness of the LMIS, it is still a challenge to sustain because of certain reasons like inadequate human resources for LMIS implementation, data analysis, validation, information sharing, and use. Poor LMIS data quality; poor reporting systems; stakeholders unable to access data [18, 19].

In contrast to the management of drugs, little attention has been given to the management of laboratory commodities. Such a lack of attention often leads to problems like poor documentation, poor planning, poor monitoring, untimely and often inaccurate data and low report submission rates. These leads to frequent stock out and expired key laboratory commodities. This leads to wastage of resources and poor client satisfaction [10, 14, 16, 18-20].

A study in Addis Ababa showed the availability of bin cards, IFRR, and RRF were reported in 92.6% of facilities. Utilization of bin cards ranged from 30-50% for hospitals and 50-80% for health centers with better utilization of bin cards at health centers for all HIV/AIDS and TB laboratory commodities. From the assessed bin card, 25% were updated and 20.8% were accurate for hospitals and HCs. IFRR and RRF were completed in only 84.6% and 92.6% of hospitals and HCs [18, 21].

The USAID technical brief 2003 shows, the percentage of LMIS forms submitted from HFs on a timely basis has increased from 62% in 1997 to 94% in 2006. Information is updated in the HFs and there is an increased use of LMIS at hospitals and health centers and district levels [22].

Another USAID report indicates that there are numerous discrepancies between users and supply mechanisms for rapid testing and laboratory consumables. Also, in hematology and biology reagents, reporting is poor, and it is important to integrate this reporting in the LMIS [23].

In Ethiopia, even though LMIS performance was evaluated, it is not adequately researched for laboratory commodities [18, 19, 21]. In addition, the magnitude of LMIS performance for laboratory commodities in West Shoa zone health facilities remain unknown. Hereafter, this study was intended to evaluate LMIS performance for the laboratory commodities and identify its bottleneck in West Shoa zone public health facilities.

Conceptual Framework

A conceptual framework is a visual or written representation that is used to show the relationship between the independent variables and dependent variables. Hence the following conceptual framework was developed after the review of various kinds of literature on LMIS performance [11, 20, 21, 23-32].

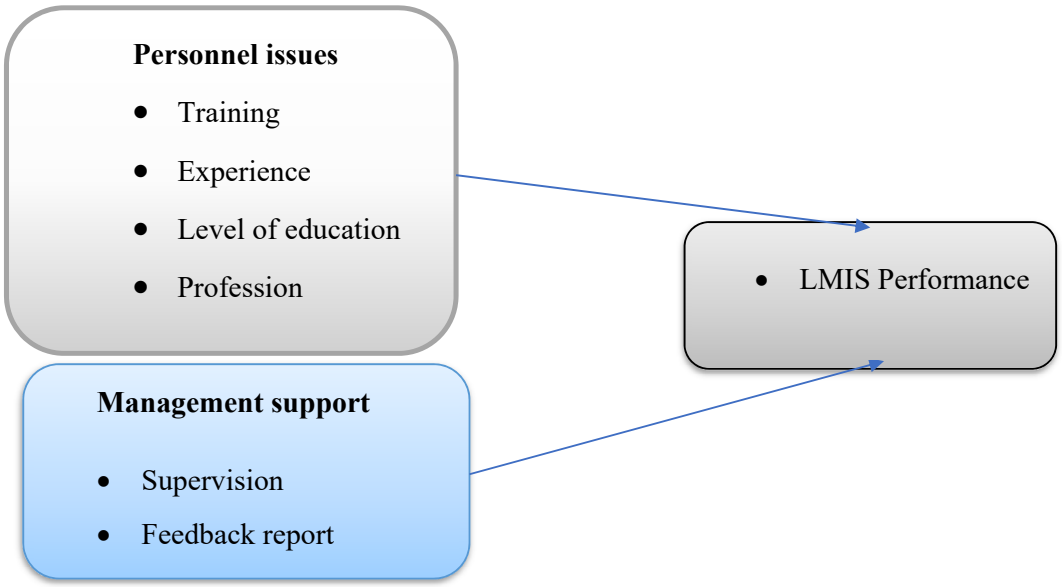

Figure 1: The conceptual framework of the study

Methods

Study Area and Period

The study was conducted in the public health facilities of the west Shoa zone, Oromia regional state, Ethiopia. Ambo town is the administrative capital of the zone and is located 114 Km to the west of Addis Ababa. The public health care service is provided by 8 hospitals, 92 health centers, and 590 health posts with 96% health post coverage and 92% primary health care coverage (24). The health facilities found in the zone were supplied by central PSA and Nekemte hub PSA. They used LMIS tools like bin card, IFRR, RRF, and Dagu software to record and report the logistics data. The facilities send RRF every two months to the Woreda health office, zone, or directly to PSA. Each SDP report to their respective medical store every two weeks for resupply. The study period was from June 2021 to July 2021.

Study Design

A facility-based concurrent explanatory mixed-method design was used. In this design, both quantitative and qualitative data are collected in the same phase, analyzed individually, and interpreted together.

Population

Source Population

All public health facilities in the zone, all health workers, all LMIS records, and reports in the public health facilities.

Study Population

RRF, IFRR, and bin cards of the laboratory commodities that were managed in the selected health facilities. Personnel working on LMIS (pharmacy head and store manager).

Inclusion and Exclusion criteria

Inclusion Criteria

All health facilities managing laboratory commodities for not less than six months were included. Laboratory commodities like chemicals and stains, clinical chemistry reagents, serology and immunoassay, miscellaneous reagents, and laboratory supplies that were taken from PPL of laboratory commodities were included. The six months RRF, IFRR were sent from the laboratory unit to the store manager, and bin cards of laboratory commodities were included.

Exclusion Criteria

Covid-19 center HFs were excluded. Health posts were also excluded because they did not manage laboratory commodities. Durables and bulk preparation laboratory commodities (for their long stays in the store), closed system reagents, and medical imaging supplies and chemicals for their limited access were excluded.

Sample size determination and sampling procedure

Sample size determination for health facility, RRF, IFRR, and bin card

The sample size for health facility

The sample size of the health facilities was determined based on the USAID delivery project logistics indicators assessment tool (LIAT). The tool recommends taking at least 15% of facilities to increase the power of generalizability (25). There were 100 public health facilities in the West Shoa zone. To increase the power of generalizability 20% of health facilities were used in this study. Accordingly, from twenty health facilities four hospitals (for their large laboratory commodity handling), and sixteen health centers using simple random sampling were selected.

The sample size for bin card

The laboratory commodities managed in health facilities were identified then commonly found items in the HF were involved in calculating bin card accuracy. Thus, a total of 194 bin cards, 60 from hospitals and 134 from health centers, were assessed for their record accuracy.

The sample size for RRF

Ethiopia uses a forced-ordering max-min inventory control system (26). In this system, health facilities were forced to send reports every two months for program health commodities. This study used six months of RRF data i.e., there were three (3) reporting periods. Therefore, 3RRF*20HF = 60RRF were assumed to be available in the past six months. But only 48 RRF were found and reviewed for its timeliness and completeness because 4HC did not utilize this RRF.

The sample size for IFRR

According to IPLS of Ethiopia, the dispensing units of the health facilities were expected to submit IFRR to their respective medical store every two weeks (26). So, in the past six months laboratory unit should be submitted a total of 240IFRR.

= 6(months)*2IFRR/month*20HF = 240IFRR.

Since this figure is large to address in the given study period it was sampled using standard sampling method, single population proportion sample size estimating formula with 95% confidence interval & 7% margin of error; assuming that 50% of the facilities were poorly utilizing IFRRs due to lack of similar study (27).

$$n = \frac{t^2 * p(1-p)}{m^2}$$

Where:

n = required sample size

t = the value of the confidence level you have chosen (at 95 percent t = 1.96)

p = estimated prevalence of the indicator

m = margin of error

Which gives **n = 196**

Since the total number of IFRR is less than 10,000 the following correction formula was used to determine sample size as follows.

$$New\ n = \frac{n}{1 + [(n-1)/N}$$

$$n = \frac{196}{1 + \frac{195}{240}}$$

$$n = 1\ 09IFRR$$

From each HFs $= \frac{109IFRR}{20\ HF}$ = 5 IFRR

Five IFRR from each HCs gives Eighty (80) IFRR and the rest 29IFRRs were from hospitals.

The sample size for the qualitative method

An in-depth interview was done to probe out the challenges of LMIS performance. Accordingly, 2 pharmacy heads and 6 store managers (3 from hospitals and 3 from health centers) were selected and interviewed.

Sampling technique

Sampling technique for health facility

The public health facilities were stratified as hospitals and HCs. There are eight (8) hospitals in this zone. One referral, two general, and five primary hospitals each found in different woreda of the zone. The referral hospital included purposively and the rest three were selected by lottery methods to increase representativeness. In the case of HCs, sixteen woreda were selected by lottery then a lottery was drawn for HC found in each woreda solely to avoid double selection of HC to increase representativeness.

Sampling technique for bin card

Lists of laboratory commodities were taken from Ethiopian pharmaceuticals procurement lists (PPL) (28). From this list, facility-managed laboratory commodities at each health facility were identified and included for performing record accuracy.

Sampling technique for RRF

All RRF in the past six months were included.

Sampling technique for IFRR

There were two reports in a month. These reports were labeled as R1 and R2 with respective months for the past six months. Then lottery was drawn to get the whole sampled IFRR from each HFs.

Sampling technique for qualitative data

Pharmacy heads and store managers were selected purposely for their high position of information on the LMIS.

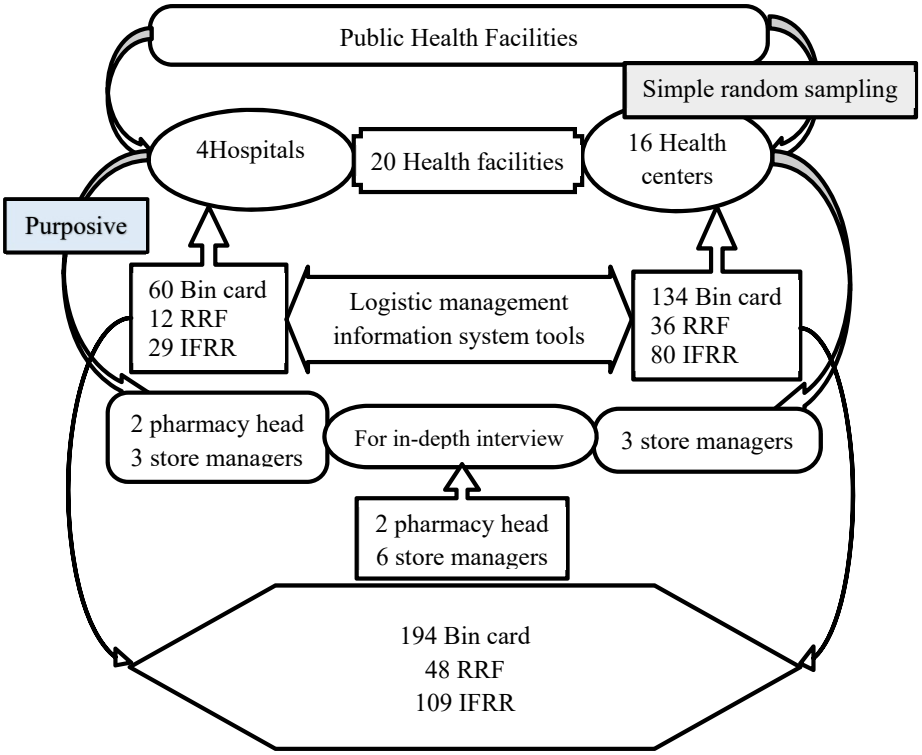

Figure 2: Sampling technique for the facility, bin card, RRF, and IFRR

Study variables

Dependent variable

- LMIS Performance
  - LMIS data quality
  - Reporting rate

Independent variables

- Staff training on LMIS
- Experience of the personnel on LMIS
- Level of education
- Supervision/support
- Feedback report
- The profession of the personnel working on LMIS

Qualitative data focusing area

- Personnel issues
- Management issues
- Facility issues
- Human resource issues

Data collection tools

Questionnaires, checklists and an interview guide were used to collect data. Questionnaires and checklists were extracted from LIAT (25) for the quantitative data. The questionnaire was used to collect health professional backgrounds. Checklists had four parts, part one: LMIS tool availability and utilization assessment tool, part two: RRF timeliness assessment tool, part three: bin card accuracy assessment tool part four: RRF and IFRR completeness assessment tool. Lastly, open-ended questions were developed for the qualitative data by the principal investigator for in-depth interviews to assess challenges of LMIS performance. Note-taking and audio records were used.

Data collection procedure

Data collectors were selected, trained on how to collect the data for not less than an hour. They collected the data by reviewing the logistics recording and reporting formats and physical verify when necessary.

Data collection procedure for bin card accuracy

The bin cards of each laboratory commodity were reviewed for their stock record count then physically crosschecked with stock on the shelves to perform bin card accuracy.

Data collection procedure for IFRR completeness

Each IFRR column was checked whether it was complete or not including mathematical error.

Data collection procedure for RRF completeness and timeliness

All RRF columns were checked whether it was complete and no mathematical error for completeness. For RRF timeliness, the remained documents from the RRF pad were reviewed whether it was sent to the woreda health office or directly to the PSA within the reporting schedule.

Data collection procedure for qualitative data

An in-depth face-to-face interview was done by the principal investigator at their office for 20-30 minutes. The principal investigator is a pharmacist with working experience of seven years. He was worked in different health facilities like referral and primary hospitals, health centers, non-government organizations (NGOs) and now he is a lecturer at Salale University. The interview was done until the point of saturation; a point at which the ideas of respondents almost became similar with the previously given or stated.

Data processing and analysis

Concurrent triangulation design of mixed-method was employed. In this mixed design, both quantitative and qualitative data were collected in the same phase of the research then analyzed

individually and interpreted together. For quantitative data, the collected data were checked for its completeness, coded, and entered into a statistical package for social sciences version 20 and analyzed using descriptive (percentage and frequency table) and inferential statistics (chi-square test). In addition, Excel spreadsheets were used for analysis. The output was summarized using tables and figures. For the qualitative data, a thematic analysis was carried out. In this analysis, the note taken was read several times to get familiarized with the data, generate initial codes, combine similar codes, review the themes and define the themes. Direct quotation and verbatim transcription were done.

Data quality assurance

Data were collected by trained data collectors. A pre-test was carried out in 10% of the sample size. Then necessary clarifications and corrections were made on vague points and other problems encountered. The trained supervisors were supervising data collectors closely. English version interview guide was converted to local language then back to English by authenticated language translator to check its consistency. For the qualitative data, credibility was checked by peer debriefing. This was done through colleagues looking at data, verifying interpretation, and offering other interpretations if the need arises. Not only this but also investigator triangulation and data triangulation i.e. different data sources were used. In addition, prolonged engagement i.e. time spent with the subject, context, and data by the investigator was used to maintain the trustworthiness of the qualitative findings.

LMIS performance indicators

Data accuracy

The percentage of the discrepancy between physical stock count and stock record count, and stock record count and logistics management information system (LMIS) report count.

1.Accuracy in keeping stock records

$$\frac{|ending\ stock\ balance - physical\ count|}{physical\ count} * 100$$

2. Facility Reporting Rates: measure the percentage of facilities that submitted reports according to reporting schedule.

$$Hospital\ or\ HC\ RRF\ reporting\ rate = \frac{Number\ of\ RRF\ submitted\ on\ time}{Total\ number\ of\ RRF\ expected} * 100$$

$$Aggregate\ facility\ reporting\ rate = \frac{number\ of\ facilities\ submitted\ report\ on\ time}{total\ facilities\ expected\ to\ submit\ their\ report} * 100$$

3. Timeliness: Percentage of facilities that submit complete LMIS reports on time

$$Hospital\ or\ HC\ RRF\ timeliness = \frac{Number\ of\ RRF\ submitted\ on\ time}{total\ number\ of\ expected\ RRF} * 100$$

$$Aggregate\ timeliness = \frac{\text{Total no. of reports submitted on time}}{\text{Total no. of reports expected}} * 100$$

4. Completeness: Percentage of LMIS record and report with complete column

$$Facility\ RRF\ completeness = \frac{Number\ of\ complete\ RRF\ submitted}{Total\ number\ of\ RRF\ expected}$$

Operational definition

• ***Accurate:*** discrepancy between stock record/bin card and physical count of the item is 0%.
• ***Near accurate:*** discrepancy between bin card and the physical count is less than 10%.
• ***Inaccurate:*** discrepancy between bin card and physical count of the item is greater than 10%
• ***Bin card:*** A stock-keeping record that keeps the information about a single lot of single laboratory commodities.
• ***Completeness:*** report or record complete if each component/ column is filled without an error.
• ***Data quality:*** the accuracy, completeness, and timeliness of data.
• ***Laboratory commodities:*** Reagents (except closed system reagents), consumables, and supplies other than durable equipment used in laboratory service.
• ***Record and report format:*** format used to record and report the three-logistics data.

Timeliness: A report sends to a higher level according to the schedule of IPLS.
• Hospitals and HCs should submit RRF to the PSA or zonal health department until the 10th day of the month following the reporting period.
• Health centers served through the Woreda health office should submit RRF to the Woreda health office until the 5th day of the month [15].

Updated bin card: updated bin card in the past 30 days

Definition of terms

• ***Accuracy:*** Similarity of quantity on stock record with the physical inventory count.

• ***Commodities:*** goods, products, and supplies that flow through a logistics system.

• ***Feedback report:*** A report that informs lower levels about their performance and provides additional information about reporting from facilities.

• ***Logistics management:*** The part of the supply chain that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption.

• ***Stock on hand:*** The quantity of usable stock in inventory at a particular point in time.

• ***Stock-keeping records:*** Records kept on products in-store.

3. Result

This chapter summarizes the quantitative and qualitative findings of LMIS performance for laboratory commodities and associated challenges in selected public health facilities of West Shoa zone, Oromia regional state, Ethiopia.

The background of personnel working on LMIS in the selected public health facilities

A total of 20 personnel with different professions, levels of education, and experience were working on LMIS at the selected public health facilities. Eighty percent (80%) of them were from HCs and they were personnel involved in managing pharmaceuticals. Most of them were pharmacy personnel in profession 19 (95%), 11 (55%) diploma holders, 12 (60%) 6-10 years working experience, and 18 (90%) trained personnel on LMIS (IPLS). (Table 1)

S/N	Respondent background		Types of Health Facilities		
			Hospital (%)	HC (%)	Total (%)
1	Sex	Male	3 (75)	12 (75)	15 (75)
		Female	1 (25)	4 (25)	5 (25)
		Total	4 (100)	16 (100)	20 (100)
2	Level of education	Diploma	0	11 (68.75)	11 (55)
		Degree	4 (100)	5 (31.25)	9 (45)
		Total	4 (100)	16 (100)	20 (100)
3	Profession	Pharmacist	4 (100)	5 (31.25)	9 (45)
		Druggist	0	10 (62.50)	10 (50)
		Nurse	0	1 (6.25)	1 (5)
		Total	4 (100)	16 (100)	20 (100)
4	Experience	1-5 Years	2 (50)	5 (31.25)	7 (35)
		6-10 Years	2 (50)	10 (62.50)	12 (60)
		>10 years	0	1 (6.25)	1 (5)
		Total	4 (100)	16 (100)	20 (100)
5	Training on IPLS/LMIS	Trained	3 (75)	15 (93.75)	18 (90)
		Not trained	1 (25)	1 (6.25)	2 (10)
		Total	4 (100)	16 (100)	20 (100)
6	Supervision	Bi-monthly	0	1 (6.25)	1 (5)
		Quarterly	1 (25)	5 (31.25)	6 (30)
		Every six months	1 (25)	4 (25)	5 (25)
		Annually	1 (25)	2 (12.50)	3 (15)
		Unexpectedly	1 (25)	2 (12.50)	3 (15)
		Never given	0	2 (12.50)	2 (10)
		Total	4 (100)	16 (100)	20 (100)
7	Feedback	Bi-monthly	0	1 (6.25)	1 (5)
		Quarterly	1 (25)	5 (31.25)	6 (30)
		Every six months	2 (50)	3 (18.75)	5 (25)
		Annually	0	3 (18.75)	3 (15)
		Never given	1 (25)	4 (25)	5 (25)
		Total	4 (100)	16 (100)	20 (100)

Table 1. The background of store managers in the selected public health facilities of West Shoa zone, June to July 2021 (Hospitals = 4, Health centers = 16)

LMIS tools availability and utilization

The availability of bin cards, IFRR, RRF, and electronic records ranges from 30-100% in public health facilities. The utilization of LMIS recording and reporting tools ranged from 15-100%. Most of the assessed public health facilities (80%) had SOP on IPLS with 100% in hospitals and 75% in health centers. (Table 2)

S/N	LMIS tools	Availability & Utilization	Types of Health Facilities		
			Hospital (%)	Health center (%)	Total (%)
1	Bin card	Available	4 (100)	16 (100)	20 (100)
		Utilized	3(95)	16 (100)	19 (95)
2	IFRR	Available	4 (100)	16 (100)	20 (100)
		Utilized	4 (100)	14 (87.50)	18 (90)
3	RRF	Available	4 (100)	15 (93.75)	19 (95)
		Utilized	3 (75)	13 (81.25)	16 (80)
4	HCMIS/Dagu software	Available	4 (100)	2 (12.50)	6 (30)
		Utilized	3 (75)	0	3 (15)
5	SOP for IPLS/LMIS	Available	4 (100)	12 (75)	16 (80)

Table 2. Availability and Utilization of LMIS reporting and recording tools in selected public health facilities in the West Shoa zone, June to July 2021.

Availability and updating practice of bin card for commonly managed laboratory commodities

Commonly managed laboratory commodities in the selected public health facilities were assessed for their bin card availability and updating practice per item per facility. Accordingly, 6% to 75% of public health facilities had bin cards for those commonly found commodities with 0 to 100% updated per item. (Table 3)

Product Lists	Bin card Availability and Update			
	Bin card Available		Update	
	Hospitals (%)	Health centers (%)	Hospitals (%)	Health centers (%)
Gentian Violet - 1% - Solution	3 (75)	7 (43.75)	1 (33.33)	2 (28.57)
Immersion Oil - Refractive Index of 1.515	3 (75)	6 (37.50)	0	2 (33.33)
Tri-sodium Citrate - 3.80% - Solution	3 (75)	7 (43.75)	1 (33.33)	0
Glucose test strip method with a machine of five packs of a test strip	3 (75)	6 (37.50)	1 (33.33)	2 (33.33)
Pregnancy Test Strip 50tests	3 (75)	9 (56.25)	3 (100)	2 (22.22)
Anti-A, Anti-B, Anti-D Monoclonal Antibody 3x10ml	3 (75)	7 (43.75)	2 (66.67)	0
Helicobacter Pylori (H. Pylori) Antigen Test Strip	3 (75)	7 (43.75)	2 (66.67)	3 (42.86)
Hepatitis HBsAg Test Cassette	3 (75)	5 (31.25)	3 (100)	0
Proteus OX-19 Antigen	3 (75)	8 (50)	1 (33.33)	1 (12.50)
Salmonella Typhi "H" + Salmonella Typhi "O" Antigen (Widal) Test, agglutination method	3 (75)	6 (37.50)	0	1 (16.67)
Applicator stick wooden 15cm long thickness 2.5mm without cotton	2 (50)	1 (6.25)	2 (100)	0
Contact activated blood lancet (automatic) 2mm	3 (75)	6 (37.50)	2 (66.67)	2 (33.33)
Capillary tube sealer of 2mm thickness 2x5mm	3 (75)	1 (6.25)	1 (33.33)	0
Cover slides rectangular size 22x22 mm thickness 0.13 mm	3 (75)	2 (12.50)	2 (66.67)	0
Micropipette tips 10-200 µl	2 (50)	1 (6.25)	0	1 (100)
Microscope slides size 27x75mm thickness 1.2mm non-frosted	2 (50)	10 (62.50)	1 (50)	0
Microscope slides size 27x75mm thickness 1.2mm frosted	3 (75)	9 (56.25)	2 (66.67)	2 (22.22)
Urine cup plastic 40ml capacity	3 (75)	3 (18.75)	1 (33.33)	1 (33.33)
Vacutainer blood collector tube with EDTA anti-coagulant purple top4ml	3 (75)	7 (43.75)	0	0

Glove disposable	3 (75)	8 (50)	3 (100)	4 (50)
Alcohol 70% solution (Ethanol)	2 (50)	8 (50)	1 (50)	1 (12.50)
Chlorhexidine Gluconate +Cetrimide 1.5%+15%w/v Solution	2 (50)	9 (56.25)	0	0

Table 3. Bin card availability and updating practice for commonly managed laboratory commodities in the selected public health facilities in West Shoa zone, June to July 2021 (Hospitals n = 4 health centers n = 16).

Bin card accuracy for commonly managed laboratory commodities

From a total, bin card reviewed 158 (81.40%) accurate, 2 (1%) near-accurate, and 34 (17.50%) in-accurate. This accuracy comprises 55 (90.16%) from hospitals and 103 (77.44%) from health centers. Accuracy ranges from 28-100% for public HFs per item. (Figure 2 and Table 4)

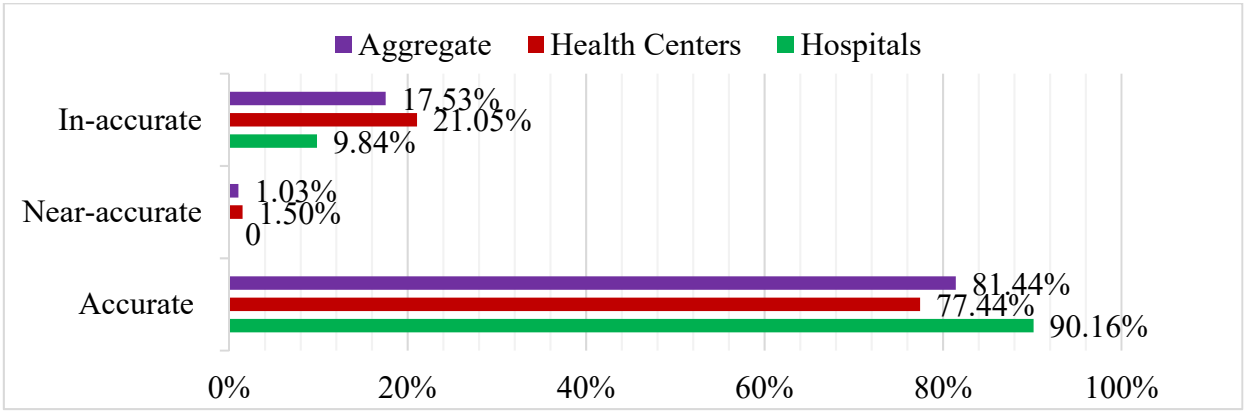

Figure 3. Bin card accuracy per health facilities in West Shoa zone June 2021 to July 2021 (Hospitals n = 60, HC n= 134).

		Bin card Accuracy				
	Hospitals			Health Centers		
Product Lists	**Accurate**	**Near accurate**	**In-accurate**	**Accurate**	**Near-accurate**	**Inaccurate**
Gentian Violet - 1% - Solution	3 (100)	0	0	6 (85.71)	0	1 (14.29)
Immersion Oil - Refractive Index of 1.515	2 (66.67)	0	1 (33.33)	4 (66.67)	0	2 (33.33)
Tri-sodium Citrate - 3.80% - Solution	3 (100)	0	0	2 (28.57)	0	5 (71.43)
Glucose test strip method with a machine of five packs of a test strip	2 (66.67)	0	1 (33.33)	5 (83.33)	0	1 (16.67)
Pregnancy Test Strip 50tests	3 (100)	0	0	7 (77.78)	1 (11.11)	1 (11.11)
Anti-A, Anti-B, Anti-D Monoclonal Antibody 3x10ml	3 (100)	0	0	6 (85.71)	0	1 (14.29)
Helicobacter Pylori (H. Pylori) Antigen Test Strip	3 (100)	0	0	7 (100)	0	0
Hepatitis HBsAg Test Cassette	3 (100)	0	0	4 (80)	0	1 (20)
Proteus OX-19 Antigen	3 (100)	0	0	5 (62.50)	1 (12.50)	2 (25)
Salmonella Typhi "H" + Salmonella Typhi "O" Antigen (Widal) Test, agglutination method	2 (66.67)	0	1 (33.33)	4 (66.67)	0	2 (33.33)
Applicator stick wooden 15cm long thickness 2.5mm without cotton	2 (100)	0	0	1 (100)	0	0
Contact activated blood lancet (automatic) 2mm	3 (100)	0	0	3 (50)	0	3 (50)
Capillary tube sealer of 2mm thickness 2x5mm	2 (66.67)	0	1 (33.33)	1 (100)	0	0
Cover slides rectangular size 22x22 mm thickness 0.13 mm	3 (100)	0	0	2 (100)	0	0
Micropipette tips 10-200 µl	2 (100)	0	0	1 (100)	0	0
Microscope slides size 27x75mm thickness 1.2mm non-frosted	1 (50)	0	1 (50)	10 (100)	0	0

Microscope slides size 27x75mm thickness 1.2mm frosted	3 (100)	0	0	8 (88.89)	0	1 (11.11)
Urine cup plastic 40ml capacity	2 (66.67)	0	1 (33.33)	3 (100)	0	0
Vacutainer blood collector tube with EDTA anti-coagulant purple top4ml	3 (100)	0	0	5 (71.43)	0	2 (28.57)
Glove disposable	3 (100)	0	0	7 (87.50)	0	1 (12.50)
Alcohol 70% solution (Ethanol)	2 (100)	0	0	6 (75)	0	2 (25)
Chlorhexidine Gluconate +Cetrimide 1.5%+15%w/v Solution	2 (100)	0	0	6 (66.67)	0	3 (33.33)

Table 4. Bin card accuracy per item in the selected public health facilities in West Shoa zone, June to July 2021 (bin card for hospitals n= 61, for health centers n = 133).

A chi-square was done to determine if any association exist between bin card data accuracy and possible contributing factors. Consequently, a significant association was observed between bin card data accuracy and type of profession χ^2 (4, N = 194) = 20.457, P = .000, training pattern χ^2 (2, N = 194) = 6.667, P = .036, feedback on report χ^2 (8, N = 194) = 16.457, P = .036, and experience χ^2 (4, N = 194) = 12.602, P = .013 (Table 5).

Variables	Bin card Accuracy		
	Pearson chi-square		
	Value	Df	Asymp. Sig. (2-sided)
Types of Profession	20.457[a]	4	.000
Training pattern	6.667[a]	2	.036
Feedback	16.457[a]	8	.036
Experience	12.602[a]	4	.013
Level of education	1.299[a]	2	.522
Supervision	15.619[a]	10	.111

Table 5: The association of bin card data accuracy and possible contributing factors in selected health facilities of West Shoa zone, Oromia regional state, Ethiopia 2021.

RRF and IFRR completeness and timeliness

From a total, RRF reviewed for their timeliness and completeness 80% were timely reported and 75% were complete. The IFRR completeness was found to be 93.69% of which 93.55% were from hospitals and 93.75% from health centers. (Figure 3)

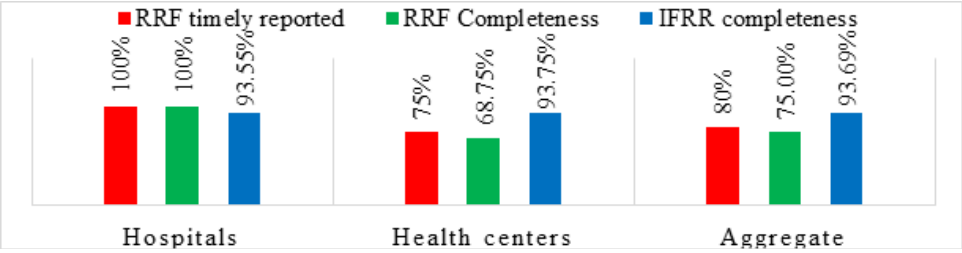

Figure 4. RRF and IFRR completeness and timeliness for selected HFs of West Shoa zone June 2021 to July 2021 (RRF n = 48, IFRR n = 109).

A chi-square test was done to determine if association exist between IFRR completeness and likely contributing factors. Consequently, a significant association was observed between IFRR completeness and training pattern χ^2 (1, N = 109) = 4.127, P = 0.041, experience χ^2 (2, N = 109) = 12.203, P = 0.002, supervision χ^2 (5, N = 109) = 17.07, P = .004, and feedback χ^2 (4, N = 109) = 10.037, P = 0.04 (Table 6).

Variables	IFRR Completeness		
	Pearson chi-square		
	Value	Df	Asymp. Sig. (2-sided)
Types of Profession	1.001[a]	2	.606
Level of education	.642[a]	1	.423
Training pattern	4.127[a]	1	.041
Experience	12.203[a]	2	.002
Supervision	17.07[a]	5	.004
Feedback	10.037[a]	4	.04

Table 6. The association of IFRR completeness and likely contributing factors in selected health facilities of West Shoa zone, Oromia regional state, Ethiopia 2021.

Facility reporting rate

The reporting rate of the health facilities was 80% with 100% from hospitals and 75% from health centers.

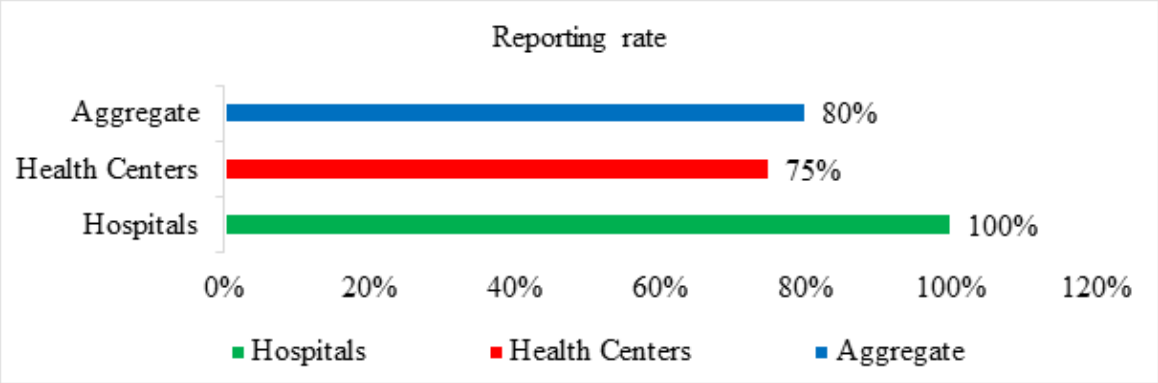

Figure 5: Reporting rate for selected HFs in West Shoa zone June 2021 to July 2021 (Hospital n = 12RRF, HC n = 36RRF).

Qualitative Finding

The qualitative findings were obtained through in-depth interviews of the pharmacy head from hospitals (2) and store managers ((6), 3 from hospitals, 3 from health centers) to explore the challenges associated with LMIS performance. The challenges identified by the respondents were thematically categorized into personnel issues, facility and management support issues, and human resources management issues.

Logistics management information system (LMIS) challenges

LMIS is very important to prevent the shortage and improve national quantification and forecast. It provides real-time data if effectively recorded and timely reported to the higher-level logistics managers.

Staff and Facility Management issues

Pharmacy personnel and facility management should believe in the importance of the LMIS in improving the availability of products. Effective LMIS reduces losses due to overstock, expiry, damage, and theft of pharmaceutical products. The respondents from various public health facilities disclose there was work load to develop and update bin cards, complete and send RRFs. There were also difficulties in recording and reporting LMIS electronically due to poor computer skills and no on-the-job training to improve their recall on how to record and report on e-LMIS.

One respondent (store manager) said that *"the staff from a different dispensing unit in addition to laboratory unit did not know their actual two weeks consumption."* Thus, the unit did not report IFRR regularly or even fail to report at all made updating practice of the bin card tiresome.

The facility manager did not even consider the pharmacy personnel as important as other staff in health care systems. One respondent (pharmacy head) said that *"the facility head and management did not even consider pharmacy personnel was important to the health facilities in delivering health care. They even want to run the pharmacist responsibility on their own (by non-pharmacy professionals) than engaging the pharmacy personnel. Not only this they even did not believe in the importance of LMIS performance and did not give any support to enhance the system."* This idea weakens pharmacy personnel's commitment to effectively performing their duty, especially the LMIS, which results in weak LMIS performance in those health facilities.

Another respondent (store manager) said that *"the facility did not have sufficient storage area and some of them were with old*

shelves that won't facilitate the stock-taking which may improve the recording and reporting system of the pharmaceuticals managed in the health facility."

Building the health workers with training, supervision, and feedback would improve the implementation of LMIS. On this contrary, one respondent (pharmacy head) said that *"there was no support or supervision regarding laboratory commodities on how to manage the product and its records and reports except for program products thus caused weak LMIS implementation in many public health facilities."*

Human resources management issues

Adequate manpower was important in processing and effectively executing LMIS. Various respondents from health facilities identified challenges related to these issues like pharmacy personnel turnover and inadequacy.

One respondent (pharmacy head) said that *"the store manager is the only trained pharmacy personnel to run electronic transactions. Now, he was transferred to the zonal health bureau that electronic recording was stopped. Not only electronic record but also another recording and reporting system like bin card update, completing IFRR and RRF were interrupted until the responsible personnel was assigned. Such interruption affects LMIS performance."*

To effectively implement the LMIS that is used in decision making to select the product and prevent an interruption of the supply of commodities hence improving commodity security there should be adequate manpower. One respondent said that *"I am the only pharmacy personnel working in this health facility that under taking manage pharmaceutical products and dispensing pharmaceuticals to another dispensing unit and the end-users that I had no time to develop, update bin card, complete IFRR and timely report RRFs to the supplier."*

Another respondent (store manager) said that *"the position for store managers in the public hospitals were two pharmacists but here I am the only one who manages the pharmaceuticals store, develop and update bin card, complete IFRR and RRF."* So, they should hire sufficient pharmacy personnel to effectively exercise the record and report of LMIS performance, and *"this was why I stopped any manual LMIS activities and only electronic record and report was done because there was no adequate pharmacy personnel and it was a time-consuming activity.*

Discussion

This chapter discusses the findings of the logistics management information system performance for laboratory commodities and its associated challenges in public health facilities. An effective logistics management information system (LMIS) supports capturing accurate consumption, loss, and adjustment and stock on hand data using various LMIS tools like bin card, RRF, IFRR, etc. to improve demand forecasting, capacity planning, and modeling (11,15).

The current study showed 95-100% availability for bin cards, IFRR and RRF whereas the utilization ranges from 80-95% for bin cards, IFRR, and RRF. This finding was better in IFRR utilization and low in RRF and bin card utilization to the study done on LMIS performances of program drugs in the East Wollega zone (29). This better utilization in the IFRR might be due to the training patterns of the staff in the current study (90%) whereas the low utilization of RRF and bin card might be due to the inadequate manpower, increased workers turnover. And lack of commitment among the existing staff in the health facilities as revealed in the qualitative finding. Such a lack of fully utilizing LMIS tools might lead to inappropriate decision-making that causes wastage of resources and client dissatisfaction in the healthcare system.

e-LMIS significantly ease the work by reducing human error and the time required for data collection, transmission, and aggregation that results in improved products available where and when needed (30). This study revealed 30% and 15% electronic records availability and utilization. This finding was lower than the study conducted in the East Gojam zone on LMIS performance of program medicines which reported 50% and 35 % availability and utilization (31). This might be due to a lack of support from facility management in timely maintenance for interrupted computers software and higher LMU as they supply software uploaded computer for HFs, this was supported by qualitative findings as the facility head (management) did not give any or timely support for pharmacy staffs.

Stock record accuracy is one of the components of data quality. Thus accurate and timely inventory data inform budgeting, procurement, inventory management, and distribution processes (32). The current study revealed 81.44% of bin cards were accurate, 1.03% were near-accurate, and 17.53% were inaccurate. This finding was found better when compared with the study conducted in East Gojam Zone, East Wollega Zone, and SNNPRS of Ethiopia which reported 63.8%, 79.1%, and 77% (29,31,33). This better performance could be due to the training patterns of the current study than the three studies as training, supportive supervision, and mentorship of staff helped the successful implementation of LMIS (10).

The stock record accuracy needs great attention when the discrepancies were more than 10% to improve data quality (34). In the case of the present study, the in-accuracy of record showed was better than the study conducted on anti-tuberculosis commodities management performance in Dire Dawa city administration, Ethiopia which reported 22.8% in-accuracy (19). This improvement might be due to the improved training pattern of the store managers on record keeping and supervision from the next higher level LMU. Such in-accuracy might lead to information distortion that affects all logistics activities in the pharmaceuticals supply chain system.

Combinations of technology improvement along with capacity building activities, and data quality assessment and feedback system were found useful in improving data quality (35). Automated, accurate, timeliness, and real-time inventory data strengthen resupply, distribution planning capacity, product

quantification, budgeting, and forecasting efforts (32). The current study revealed the timeliness and completeness of the reports were 80% and 75%. This finding was lower when compared to a study conducted in the East Gojam zone (reported 92.7% timeline and 89% complete), East Wollega zone (reported 97.8% complete), and Jimma zone (reported 76% complete), Ethiopia (29,31,36). This lower performance might be due to the lower commitment of the next higher logistic management unit in providing frequent feedback on the report. This was supported by the qualitative finding; there was no frequent feedback regarding how to records and reports. In addition, workload and inadequate manpower were another reason for the discrepancy. Such incompleteness and lack of timeliness may cause poor quantification and forecast that leads to supply interruption, wastages of resources, and stock out of commodities.

The current study showed 93.69% IFRR completeness. This finding was better when compared with the study conducted in Addis Ababa on the assessment of IPLS for the management of HIV/AIDS and tuberculosis laboratory diagnostic commodities which reported 87.5% (18). The discrepancy might be due to the improved availability and utilization of the IFRR with the built capacity of the staff with supervision and training in the current study.

The present study revealed an 80% facility reporting rate. This finding was lower than the study conducted in Kano state, Nigeria (84%) and East Wollega zone, Ethiopia (97%) (29,37). This difference might be due to improved utilization of report and requisition forms in the health facilities of the former study and the product type under investigations which was program drugs in the previous study.

Strength and Limitation of the study

The study used a valid data collection tool extracted from LIAT. As a limitation, this study did not address the transfer accuracy (RRF accuracy) which was one of the stock record accuracies. This is due to the lack of credible data in some public health facilities. In addition, there was a limitation of similar studies with similar scope for comparison purposes both in & outside the country.

Conclusion

From the finding of this study, we concluded that logistic management information systems (LMIS) tools availability and utilization still need concerns from the stakeholders. Data quality like accuracy, completeness, and timeliness needs great emphasis from all responsible bodies. Lastly, the study identified certain challenges to LMIS performance like staff turnover, staff inadequacy, lack of support from facility management, and lack of on-the-job training that weakens LMIS performance. Therefore all stakeholders like regional health bureau, PSA and health facility management should cooperate to improve LMIS performance thus improve product availability and increase customer satisfaction in laboratory service of healthcare.

Acronyms

HC, Health center; HF, Health facility; IFRR, Internal Facility Report and Request; LMIS, Logistics Management Information System; RRF, Report and Request Format; SCM, Supply Chain Management; HMIS: Health Management Information System; PSA: Pharmaceutical Supply Agency; SDP: Service Delivery Point.

Ethical consideration

Ethical clearance was obtained from the Ethical Review Board of Jimma University, faculty of health science with Ref. No. of IHRD/144/21 on May 11, 2021. The letter was submitted to the West Shoa zone health bureau to get permission. A letter was written from the West Shoa zone health bureau to the health facilities and obtained informed consent from the responsible bodies of the facilities preceding the data collection. During the study, professional and other social ethics were maintained. The name of the health facilities was coded and personnel involved in the study was not stated on the data collection tools thus confidentiality of the information will be assured.

Consent for publication

“Not applicable”

Competing Interest

The authors declare that they have no competing interests.

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