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ORIGINAL RESEARCH

Logistics Management Information System (LMIS) for Health Commodities at Public Health Facilities in Amhara National Regional State of Ethiopia: A Data Quality Evaluation Survey

Zelalem Tilahun Mekonen[1], Denny J Cho[2], Teferi Gedif Fenta[1]

[1]Department of Pharmaceutics and Social Pharmacy, Addis Ababa University, Addis Ababa, Ethiopia; [2]Logistics Department, Kyrgyz State Technical University, Bishkek, Kyrgyzstan

Correspondence: Zelalem Tilahun Mekonen, Email zelalem.tilahun@aau.edu.et

Introduction: Access to essential medicines is limited in developing countries mainly due to inefficiencies in health supply chain management, such as the absence of standard monitoring frameworks and poorly designed Logistics Management Information Systems (LMIS). Health supply chain managers need accurate and timely data for decision-making. However, routine health information systems suffer from poor data quality, reliance on paper-based reports, insufficient logistic formats, inadequate infrastructure, and limited human resources.

Objective: This study evaluates the data quality of LMIS for health commodities in public health facilities in the Amhara National Regional State of Ethiopia.

Methods: The study was conducted in Ethiopia's Amhara National Regional State. The study employed an institution-based concurrent mixed-methods design. Data collection involved 102 facilities selected through multi-stage stratified random sampling, adhering to sampling criteria set by USAID's Logistics Indicators Assessment Tool (LIAT). Data abstraction checklists were used to collect data.

Results: Of the seven tracer medicines selected to evaluate data quality, there was substantial variability in inventory accuracy rates. Inventory discrepancies were significant, highlighting potential issues with manual and digital record-keeping systems, with overall mean physical and electronic inventory accuracy rates of 74.7% and 70.6%, respectively. Additionally, the Report and Requisition Form (RRF) showed trends of timely submission, with the overall mean percentage completeness for the seven tracer medicines at 90.2%. However, the data quality experienced fluctuations, with the overall average percentage of legality (authorization of LMIS reports) and the accuracy of the RRF at 77.2% and 76%, respectively.

Conclusion and Recommendation: The evaluation of data quality revealed significant discrepancies in physical and electronic records, with notable fluctuations in completeness, legality, legibility, and accuracy within the health LMIS. To rectify these issues, robust data quality verification processes, clear guidelines, targeted interventions, strengthened monitoring systems, regular audits, and comprehensive training for health supply chain staff are needed.

Keywords: LMIS, data quality, RRF, evaluation, performance, health facilities

Introduction

Access to essential medicines in developing countries is a dire global health crisis, with preventable diseases causing death and disability due to a lack of affordable treatments.[1–3] Structural and health system deficiencies, along with economic barriers, leave one-third of the global population and half of Sub-Saharan Africa without consistent access to lifesaving medicines.[1,4–6]

Robust supply chains for medicines, vaccines, and other health products are crucial for sustaining public health.[7,8] Inefficiencies in health supply chain management, including the absence of standard monitoring frameworks and poorly designed LMIS, impede the progress of health services.[9–12]

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Health supply chain managers rely on precise, timely data for strategic and operational decisions, and information distortions can severely disrupt supply chain efficiency.[13–15] Effective management of drug selection, forecasting, procurement, inventory, distribution, rational drug use, and reverse logistics centers on real-time logistics data.[9,11,16]

A well-designed LMIS that captures and reports routine data is vital for accurate forecasting, financial planning, procurement, and distribution of health commodities. Implementing integrated pharmaceutical logistic systems (IPLS) has enhanced supply chain efficiency in many developing countries, including Ethiopia.[12,17,18] Ethiopia's Health Sector Transformation Planning II (HSTP-II) agenda also emphasized improving data quality in accuracy, completeness, and timeliness.[19]

Despite the progress, routine health information systems in the health sector still need better data quality. Major challenges include reliance on paper-based reports, insufficient logistic formats, inadequate infrastructure, limited human resources, and weak inter-sectoral collaboration.[18,20] A study conducted in the public health facilities of the Harari Region revealed that only 51.35% of health facilities achieved good overall data quality for the health management information system (HMIS). This assessment was based on three quality dimensions, which required accuracy to be ≥80%, completeness to be ≥85%, and timeliness to be ≥85%. Consequently, the results fell significantly below the national target of 80%.[21] Digital LMIS in public health facilities and Ethiopian Pharmaceutical Supply Service (EPSS) hubs face issues related to poor internet connectivity, skill gaps, and poor data quality.[9,18,22–24] A study in Addis Ababa also showed 66.61% data quality, with only 39.17% utilization of regular reports for the digital LMIS in health facilities.[25]

This study evaluates LMIS data quality in public health facilities in the Amhara Region of Ethiopia, focusing on inventory accuracy and Report and Requisition Form (RRF) reports, including timeliness, completeness, legality, legibility, and accuracy.

Methods

Study Area

The research was conducted in the Amhara National Regional State of Ethiopia, the country's second most populous region. This area is administratively divided into 13 Zones and three city administrations. Health supplies for public health facilities in the region are distributed from four hubs operated by the EPSS. The area was selected for this study because it is one of the regions that has implemented new pharmacy service and supply chain initiatives, including clinical pharmacy services, auditable pharmaceutical transactions, and the Integrated Pharmaceutical Logistics System (IPLS), which are relatively at a mature phase for evaluation compared to other areas.[11]

Study Design

The study employed an institution-based concurrent explanatory mixed-methods design, combining quantitative and qualitative approaches to gather data. This research is part of a larger project assessing the performance of the health commodities Logistics Management Information System (LMIS), in which the findings presented here are predominantly drawn from quantitative data analysis.

Source and Study Population

The study encompassed all public health facilities in the Amhara Region. Specifically, the study population consisted of randomly selected public health facilities within the region.

Sampling Procedure

Health centers and hospitals in all administrative zones, except those with security challenges, were considered for sampling. Six zones and two city administrations were grouped into three clusters based on EPSS hub locations. Ultimately, the study included four zones and two city administrations. The public health facilities

were stratified based on Zones and the level of the facility (Referral Hospital, General Hospital, Primary Hospital, Health Center). Since distance from the center is a key factor for supply chain management performance, distance from the EPSS hub, the Zonal Town, and the Woreda Town were also used for the stratification. Following USAID's Logistics Indicators Assessment Tool (LIAT), a 15% sample of facilities was selected; facilities were chosen using a multi-stage stratified random sampling method proportional to their size. Finally, a total of 102 health facilities were surveyed for the study.

Inclusion and Exclusion Criteria

Inclusion Criteria

- All Zonal Administrations.
- All public health facilities which have been operational for more than one year.

Exclusion Criteria

- Health facilities which were damaged in conflict-affected areas or had security issues during the study.
- Health Posts.

Data Collection Process

The data abstraction checklists were adapted from the Logistics Indicator Assessment Tool (LIAT), Logistics System Assessment Tool (LSAT), and the Ministry of Health's supply chain monitoring and evaluation tools.[26–28]

Data Quality Assurance

Ten experts validated the data collection tools, and data collectors underwent a two-day training session. The tools were pre-tested, and adjustments were made as needed.

Operational Definitions

Health Commodities Logistics Management Information System

It is a system designed to manage and oversee the flow of information along with the flow of health commodities across the healthcare system.

Data Quality

It is an assessment of LMIS data's fitness to serve its purpose in terms of health supply chain data completeness, timeliness, legality, legibility, and accuracy.

Data Analysis and Interpretation

The data underwent a thorough review for completeness and internal consistency before being entered into Epi Info Version 7 for initial processing. Afterward, the data were exported to SPSS Version 23.0 for comprehensive management and analysis.

Results

The study surveyed 102 public health facilities, with 58.8% located in rural areas. The majority were health centers (84.3%), followed by primary hospitals (9.8%), referral hospitals (3.9%), and general hospitals (2%). The evaluation focused on seven tracer medicines to assess the data quality of the LMIS in these facilities, explicitly targeting inventory and reporting. These medicines were selected from the basic health program categories, such as family planning, maternal and child health, malaria, tuberculosis, Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS), and infectious diseases.

Inventory Accuracy Rate

Inventory accuracy was assessed in 88 health facilities utilizing bin cards. Accordingly, variability in bin card updates among these tracer medicines is substantial, ranging from 39.8% for Oxytocin Injection to 68.2% for RHZE/RH. This

Table 1 Tracer Medicines Inventory Accuracy Rate at Public Health Facilities in Amhara Region, March 2022

SN	List of Tracer Drugs (N=88)	Updated Bin card? (%)	Physical Inventory Discrepancy (%)	Electronic Inventory Discrepancy (%)
1	Medroxyprogesterone Injection	54.5	3.0±12.6 [0, 75]	6.7±25.8 [0, 100]
2	Oxytocin injection	39.8	26.3±98.9 [0, 575]	35.6±54.8 [0, 150]
3	Amoxicillin 250 mg dispersible tab	65.9	14.9±35[0, 140]	14.1±29.4 [0, 100]
4	ORS±Zinc sulphate*	50.0	10.7±28.5 [0, 120]	19.1±39.9 [0, 100]
5	RHZE/RH**	68.2	8±28.8 [0, 200]	55.6±145.7 [0, 566.7]
6	TDF/3TC/DTG (of 90)***	45.5	6.2±13.9 [0, 58.9]	64±15.4 [0, 367]
7	Artemether+Lumefantrine tab (6x4)	52.3	6.8±21.2 [0, 100]	57.2±128.5 [0, 471.4]

Notes: *Oral Rehydration Solution; **Rifampicin, Isoniazid, Pyrazinamide, Ethambutol/Rifampicin, Isoniazid; ***Tenofovir disoproxil fumarate/Lamivudine/Dolutegravir.

variability underscores inconsistencies in inventory record update frequencies, potentially impacting inventory accuracy and supply chain management. Oxytocin Injection notably exhibited high physical inventory discrepancies (26.3% ± 98.9), whereas medicines like TDF/3TC/DTG and Artemether + Lumefantrine tablet showed lower discrepancies, suggesting more effective inventory control. Electronic inventory discrepancies also varied widely. Tracer medicines, including RHZE/RH, TDF/3TC/DTG, and Artemether+Lumefantrine tablet, displayed exceptionally high electronic discrepancies. This indicates potential issues with the accuracy of manual and digital record-keeping systems in healthcare facilities. The overall mean physical inventory accuracy for tracer medicines was 74.7%, with a standard deviation 30.4 (0, 100). The mean electronic inventory accuracy was 70.6%, with a standard deviation of 31.9 (0, 100) (Table 1).

Timeliness of RRF Reporting Rate

Out of the 102 health facilities, 100 use the RRF for bi-monthly reporting of consumption and resupply requests to EPSS and the Woreda Health Office (WoHO). For these 100 facilities, six RRF reports submitted prior to this study were reviewed, resulting in a total of 600 reports. Among the reports reviewed, the reporting date was indicated in 82% of the RRFs for the most recent reporting period [Report Period 6] and in 94% for the second most recent period [Report Period 2].

Across these six reports, the proportion of health facilities submitting their RRF report within the first five days after the reporting period ranged from 67% in the fifth reporting period to 79% in the second. This trend of timely submissions within the first five days persists consistently across all reporting periods.

Additionally, the percentage of health facilities that submitted their RRF report until the 10th day after the reporting period ranged from 7% to 16% in the fourth and last reporting periods, respectively. Few health facilities submitted their RRF after the 10th day, which exceeds the recommended timeframe outlined in the IPLS for hospitals and health centers. The percentage of facilities that did not submit the RRF report during the reporting period ranged from 6% in the second reporting period to 18% in the sixth reporting period (Figure 1).

Completeness of RRF Reporting

The completeness of RRF data components is critical for suppliers when making resupply decisions. The analysis of RRF reports consistently showed more than 90% completeness for the six tracer medicines. However, the completeness of the RRF for the Antiretroviral (ART) medicine TDF/3TC/DTG was steadily less than 70%, with an average percentage completeness of 65.7%. The overall mean percentage completeness of RRF for the seven tracer medicines was 90.2% (Table 2).

Legality of RRF

The legality of the RRF report was evaluated using five data components. The data shows a general trend of increasing percentages across all metrics as the reporting periods advance. The highest frequency for the legality data component "who prepared the report" was seen in 97% in the second Reporting Period while the lowest was

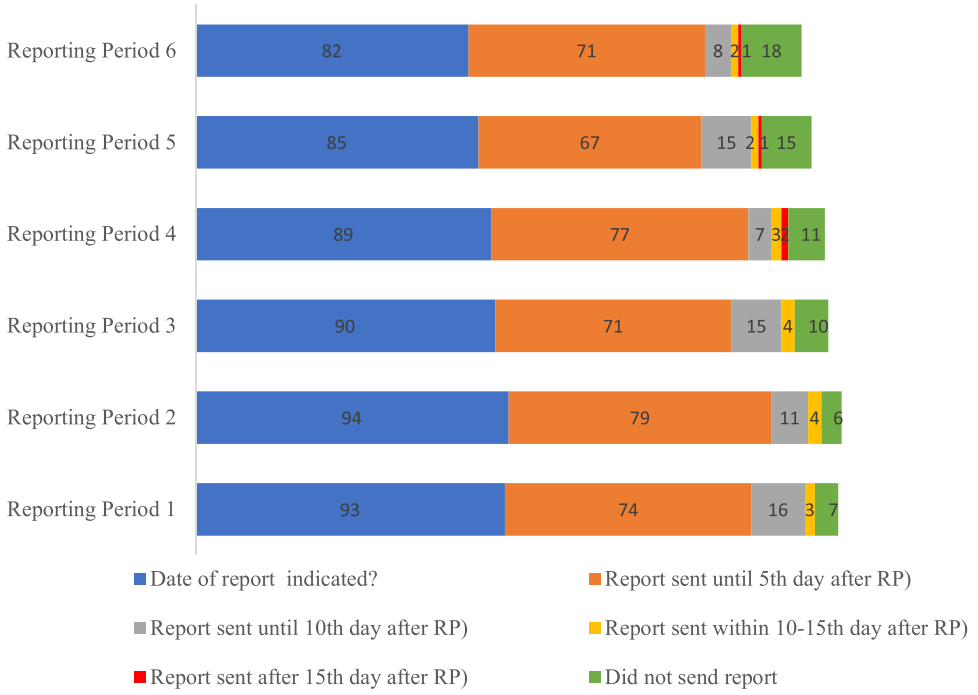

Figure 1 Timeliness of Report and Requisition Form (RRF) report at public health facilities in Amhara Region, March 2022.

in the sixth Reporting Period (81%). The legality data component "who approved report" ranged from 83% in the second Reporting Period to 74% in the sixth Reporting Period. Verification rates showed the most significant decline, from 66% in the second Reporting Period to 53% in the sixth Reporting Period. The presence of an official stamp and a cover letter followed similar trends, with the highest rates in the second and first Reporting Periods, respectively, and the lowest in the sixth Reporting Period. The overall average percentage legality of RRF was found to be 77.2% (Table 3).

Legibility of RRF

There were illegible items in the RRFs across all the reporting periods. Of the total 100 health facilities using RRFs, the percentage of health facilities with legible RRF ranges from 29% to 31% in the 2nd reporting period and the 6th reporting period, respectively. The average percentage of illegible items per the illegible RRF report ranged from 2.8% in the fifth Reporting Period to 6.4% in the first Reporting Period. The data highlights fluctuations in the quality of the RRFs, indicating periods with better and worse legibility (Table 4).

Pharmaceutical SCM M&E Reporting

Of the 102 health facilities studied, 45 were using the pharmaceutical monitoring and evaluation quarterly reporting system. The evaluation of the four reports from the year before the study showed a decline in the timely submission of reports over the four reporting periods. The highest percentage of on-time reports was in the first Reporting Period (53.3%), while the lowest was in the third Reporting Period (15.6%) (Figure 2).

Accuracy of RRF

The accuracy of the RRF report was evaluated using eight data components critical for resupply decisions. For the seven tracer medicines used to assess RRF accuracy, the highest average percentage accuracy was obtained for Amoxicillin 250 mg dispersible tablets, with a frequency of 81.1%, while the lowest was for Oxytocin injection, with a frequency of 68.5%. Among the eight data components, the highest score was for "Verified

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Table 2 Completeness of Report and Requisition Form (RRF) Report at Public Health Facilities in Amhara Region, March 2022

SN	List of tracer medicines [N=100]	"Beginning Balance"	"Quantity Received"	"Ending Balance"	"Calculated Consumption"	"Maximum Quantity"	"Quantity to Reach Max"	"Average Percentage Completeness"
1	Medroxyprogesterone Injection	95	95	95	95	94	95	94.8
2	Oxytocin injection	95	94	95	95	94	94	94.5
3	Amoxicillin 250 mg tab	96	96	97	97	96	96	96.3
4	ORS± Zinc sulphate*	90	90	90	91	91	91	90.5
5	RHZE/RH**	94	94	94	95	95	95	94.5
6	TDF/3TC/DTG (of 90)***	66	65	65	64	67	67	65.7
7	Artemether+Lumefantrine tab	95	95	94	96	95	95	95
Average Percentage Completeness		90.1	89.9	90	90.4	90.3	90.4	90.2

Notes: *Oral Rehydration Solution; **Rifampicin, Isoniazid, Pyrazinamide, Ethambutol/Rifampicin, Isoniazid; ***Tenofovir disoproxil fumarate/Lamivudine/Dolutegravir.

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Table 3 Legality of Report and Requisition Form (RRF) Reporting at Public Health Facilities in Amhara Region, March 2022

SN	Reporting Period [N=100]	No of Reports Which Indicated Who Prepared It	No of Reports Which Indicated Who Approved it	No of Reports Which Indicated Who Verified It	No of Reports with Official Stamp	No of Reports with Cover Letter	Average Percentage Legality
1	1st Report Period	92	79	63	84	79	79.4
2	2nd Report Period	97	83	66	87	81	82.8
3	3rd Report Period	92	79	62	82	78	78.6
4	4th Report Period	91	80	60	82	78	78.2
5	5th Report Period	86	75	59	79	72	74.2
6	6th Report Period	81	74	53	75	67	70
Average % Legality		89.8	78.3	60.5	81.5	75.8	77.2

Table 4 Legibility of Report and Requisition Form (RRF) Reporting at Public Health Facilities in Amhara Region, March 2022

SN	Reporting Period [N=100]	Percentage of Health Facilities with Legible RRF?	Average Percentage of Illegible Items
1	1st Report Period	80	6.4 [1, 47.3]
2	2nd Report Period	81	4.9 [1, 15]
3	3rd Report Period	75	3.5 [0.8, 15.5]
4	4th Report Period	76	4.7 [0.8, 15.8]
5	5th Report Period	74	2.8 [0.8, 18.2]
6	6th Report Period	69	3.8 [0.8, 46.9]

calculated consumption indicated on RRF", with a frequency of 88.9%, and the lowest was for "Ending balance of RRF vs Ending balance of bin card", with a frequency of 46.4%. The overall average percentage accuracy for RRF was 76% (Table 5).

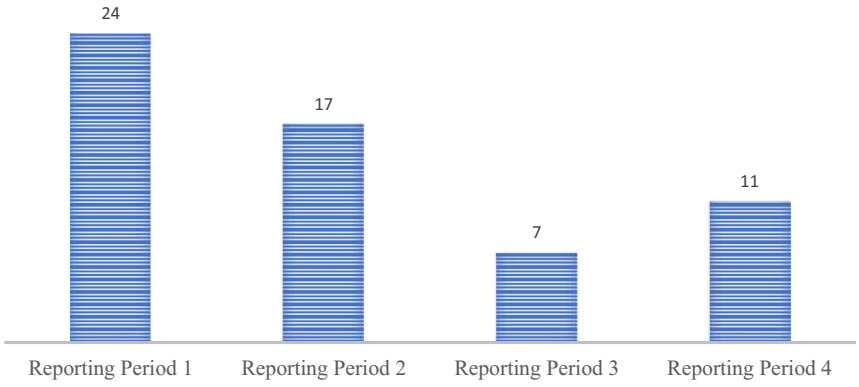

Figure 2 Pharmaceutical Supply Chain Management Monitoring and Evaluation quarterly reporting at public health facilities in Amhara Region, March 2022.

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Table 5 Accuracy of Report and Requisition Form (RRF) Report at Public Health Facilities in Amhara Region, March 2022

SN	List of Tracer Medicines	Verified Calculated Consumption Indicated on RRF	Verified Maximum Stock Quantity Indicated on RRF	Verified Quantity Needed to Reach Max on RRF	Valid Beginning Balance of this RP of RRF vs Ending Balance of Previous RRF Report	Valid Quantity Received of RRF vs Quantity Received of STV/Model 19	Ending Balance of RRF vs Ending Balance of Bin Card	Loss/ Adjustment of RRF vs Bin Card	DOS of RRF vs DOS of Bin Card	Average Percentage Accuracy
1	Medroxyprogesterone injection	89.6	85.3	83.2	77.9	87.4	47.4	78.3	69.9	77.4
2	Oxytocin injection	86.3	83.0	77.7	73.7	78.7	35.8	56.6	56.0	68.5
3	Amoxicillin 250 mg dispersible tab	91.8	87.5	81.3	78.1	85.4	56.3	70.9	97.6	81.1
4	ORS± Zinc sulphate*	89.0	85.7	84.6	75.6	88.9	40	66.7	64.1	74.3
5	RHZE/RH**	89.5	84.2	83.9	76.6	89.4	48.9	76.2	75.3	78.0
6	TDF/3TC/DTG***	84.4	83.6	85.1	78.8	87.7	55.4	76.6	75.4	78.4
7	Arthmeter + Lumfanthrine tab	91.7	86.3	85.3	73.7	84.2	41.3	67.9	66.7	74.6
Average Percentage Accuracy		88.9	85.1	83	76.3	86	46.4	70.5	72.1	76

Notes: *Oral Rehydration Solution; **Rifampicin, Isoniazid, Pyrazinamide, Ethambutol/Rifampicin, Isoniazid; ***Tenofovir disoproxil fumarate/Lamivudine/Dolutegravir.

Discussion

Data quality evaluation within healthcare facilities' LMIS revealed substantial issues in inventory recording, critically impacting the supply chain's efficiency.[29] Timely and accurate data management is essential for generating quality information for decision-making.[15,30] This study indicated consistent inventory discrepancies among tracer medicines, particularly Oxytocin Injection, which showed the highest physical inventory discrepancies (26.3% ± 98.9), indicating severe challenges in maintaining accurate physical counts. This discrepancy will result in an unprecedented stockout, which will ultimately impact the health outcomes for mothers and new-born children, as this medicine is essential for inducing labor during delivery. The overall mean physical and electronic inventory accuracy were 74.7% and 70.6%, respectively, suggesting moderate reliability in stock management. The electronic inventory accuracy is lower than the physical inventory accuracy, which may be due to less frequent updates of the digital system after the manual recordings. Electronic discrepancies underscore potential issues with data integrity and system synchronization, necessitating consistent updates across all health commodities. This is likely a result of challenges related to workload, workforce shortages, and skill gaps in managing the digital system. The inventory accuracy in this study is comparable to the study report of 77% in the Southern Nations, Nationalities, and Peoples' Region (SNNPR),[31] lower than the report of 87% by[24] in South West Ethiopia and the report of 90.6% in Addis Ababa,[32] and surpasses the report of 52.45% in West Wollega.[33] This may be due to the lack of regular updates to the bin card, resulting from workload, workforce shortages, competency gaps, and the challenges of manual LMIS, which is tedious for frequent updating.[18,33] Addressing these discrepancies requires implementing improved inventory management practices, robust inventory control systems, and comprehensive staff training to ensure adherence to inventory protocols. These enhancements will ultimately boost supply chain efficiency, reduce wastage, and ensure adequate drug availability, thereby increasing access to essential medicines and improving health outcomes for patients.

The IPLS mandates hospitals and health centers to submit the RRF report within ten days after the reporting period. Analysis of six reports from the previous year showed variability in timely submissions, with non-submission rates ranging from 6% to 18%. The findings on timely RRF reporting performance are consistent with those from the Bahirdar EPSS branch study (75.6%)[34] and are higher compared to the studies conducted in SNNPR (56.7%), Gambela (64%), and West Wollega (62.9%).[31,33,35] However, the non-submission rates during each period were comparable to those in other studies. Delays and non-submissions can significantly impact the supplier's supply planning system and the availability of medicines. This can result in stockouts, where essential medicines are unavailable when needed, or overstock situations, which can lead to wasted resources and expired products. Ultimately, these disruptions can compromise patient care by limiting access to essential medicines, leading to potential health risks and poorer health outcomes.

The completeness of RRF data components is crucial for informed resupply decisions. Analysis of the reviewed RRF reports revealed over 90% completeness for six tracer medicines, whereas the ART medicine TDF/3TC/DTG consistently demonstrated lower completeness at 65.7%. This significant discrepancy in ART medicines may be attributed to the fact that this program is well-established, leading to less attention and follow-up for this donor-based program medicines. The overall mean completeness for the seven tracer medicines was 90.2%, indicating high completeness with notable exceptions for ART medicines. This finding is lower than the 97.8% completeness reported in East Wollega[36] but higher than the completeness rates reported in West Wollega (62.9%),[33] Gambella (71%),[35] and the EPSS Bahir Dar branch (68.5%).[34]

Legal approval of RRF is critical due to concurrent financial transactions within the reporting system. Verification rates significantly declined, from 66% in the 2nd Reporting Period to 53% in the 6th Reporting Period. The overall mean legality of RRF, evaluated across five data components, was 77.2%, indicating a need for improvement. The legibility of RRF reports is problematic, potentially affecting resupply decisions. The average percentage of illegible items per the illegible RRF varied from 2.8% to 6.4%, highlighting fluctuations in report quality. Digitization of the LMIS and the RRF reporting system is essential to address these issues.

Despite initiating a quarterly monitoring and evaluation system for pharmaceutical supply chain management, adherence to utilization and timely report submission still need to be revised. Out of 102 health facilities, only 45

utilized the quarterly reporting system. An analysis of four reports prior to this revealed a decline in timely submissions, with the highest on-time reporting rate of 53.3% in the nearest 1st report period and the lowest at 15.6% in the 3rd report period. This low performance in the monitoring and evaluation report may be attributed to the recent initiation of the framework within the healthcare system, as there may not yet be full implementation across all health facilities. Hence, these findings underscore the critical need for enhanced adherence to reporting timelines to ensure the effectiveness of the monitoring system.

The accuracy of RRF reports, evaluated using eight critical data components, is paramount for adequate report verification and informed resupply decisions. The analysis revealed that Amoxicillin 250 mg dispersible tablets had the highest accuracy at 81.1%, whereas Oxytocin Injection had the lowest at 68.5%. The overall average accuracy for the RRF was 76%, indicating a substantial need for improvement in data accuracy. This study's findings are higher compared to those reported in West Oromia (37.1%),[37] Gambella (49%),[35] North West Ethiopia (59.48%),[33] and East Wollega (64.6%).[36] However, the accuracy is lower than the 84.6% reported in South West Ethiopia.[38] This low accuracy rate can be improved by digitizing the LMIS system, replacing manual calculations with automated digital processes, increasing the supply chain workforce, enhancing capacity-building training, and providing adequate supportive supervision. These discrepancies in accuracy affect informed resupply decisions, which in turn impact facility stock levels, leading to either stockouts or overstock situations. This issue compromises patient care by limiting access to essential medicines.

Conclusion and Recommendation

Data quality evaluation within healthcare facilities' Logistics Management Information Systems showed significant variability in inventory accuracy rates. Severe discrepancies in both physical and electronic inventories highlight critical flaws in manual and digital record-keeping systems. Although the RRF report showed a trend of timely submissions, there were substantial inconsistencies in data completeness, legality, and legibility. The overall mean completeness, legality, and accuracy of the RRF were 90.2%, 77.2%, and 76%, respectively.

To address these issues, it is essential to strengthen the report verification system, improve record-keeping practices, and ensure timely submissions to enhance decision-making and the resupply of medicines. Digitalization of the inventory recording and reporting system may reduce workload, improve data quality, and enhance LMIS performance. Additionally, targeted interventions should focus on improving inventory accuracy for items with high discrepancies. Furthermore, strengthening monitoring systems through regular audits and feedback, along with comprehensive training for health supply chain staff, will continuously improve data quality in both manual and digital systems.

Institutional Review Board Statement

This study was approved by the Ethical Review Committee of the School of Pharmacy (Protocol No: ERB/SOP/399/14/2022) and the Institutional Review Board of College of Health Sciences, Addis Ababa University (Protocol number: 007/22/SoP).

Informed Consent Statement

Informed consent was obtained from all participants and institutions involved in the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; participated in drafting, revising, or critically

reviewing the article; gave final approval of the version to be published; agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

All authors declared that there are no competing interests.

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