

Assessment of immunization data management practices, facilitators, and barriers to immunization data quality in the health facilities of Tach Gayint district, Northwest Ethiopia

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Abstract

Introduction: Although data quality mainly depends upon the proper management of its primary sources, limited studies examined immunization data management practice in Ethiopia.

Aim: To explore data management practices, facilitators, and barriers to immunization data quality among front-line immunization experts in the Tach Gayint district of Northwest Ethiopia.

Methods: A mixed method study design was applied using document review and key-informant interviews. Quantitative data was collected through document review from 18 health facilities and 26 key-informant interviews, were conducted on experts of immunization for qualitative data. A STATA version 14.1 was used for quantitative data analysis. Qualitative data was transcribed verbatim and translated back into English. Data was coded, reduced, and searched for salient patterns. Thematic analysis was done using open-code version 4.02.

Results: The Health Management Information System data recording tools were often lacking. The significant number (83.3%) of health facilities practiced immunization information display, while dissemination at the local level was low. The key informants mentioned that they were responsible for conducting regular Performance Monitoring Team (PMT) and Lots Quality Assurance Sampling (LQAS) as facilitators. Furthermore, a shortage of recording tools, limited supportive supervision, vertical reporting, impracticality of Lots of Quality Assurance Sampling (LQAS) at the health posts, poor implementation of Community Health Information System (CHIS), and mass vaccination were barriers identified to immunization data quality.

Conclusion: We found that majority of health workers use locally developed tools instead of using the standard data recording and reporting tools. Regular Performance Monitoring Team meetings and Lots Quality Assurance Sampling assessment were found to be facilitators. Furthermore, limited supportive supervision, vertical reporting and poor implementation of Community Health Information System were barriers. Therefore, strengthening the use of standard recording and reporting tools, conducting regular supportive supervision, and implementing routine vaccination services are recommended to improve the data management practice. [*Ethiop. J. Health Dev.* 2021; 35(SI-3):28-38]

Key words: Immunization, Data management practice, Data quality, Information use

Introduction

The Expanded Program on Immunization (EPI) has been implemented in Ethiopia since 1980 to prevent vaccine-preventable morbidity among the population of children (1). Currently, there are twelve antigens in the routine immunization program of the country, with the progressive introduction of new and underused vaccines (2). Most of the immunization services are provided mainly at the health post levels by community health service providers called the Health Extension Workers (HEWs); which are also provided at health centers and hospital levels. Despite the increasing uptake of these new and underused vaccines, current studies indicated the overall full immunization coverage is still low in Ethiopia (3).

Maintaining the quality of immunization information has been recognized amongst the approaches proven for EPI implementation success. High-quality data is required for evidence-based decision-making at all

levels of the public health system (4). This can support health workers to solve local problems, such as to routinely compare their progress against a target, to track missing children, and to identify the key areas of service improvement (5). It is also important for managers and programme implementers to support policy development and appropriate resource allocation (5, 6).

Ethiopia has been using information generated by the Health Management and Information System (HMIS) to track health service outcomes including immunization (7). The HMIS, designed and implemented in 2008, was primarily aimed at producing quality health information that supports evidence-based decision-making for quality-of-care improvement, in order to ultimately achieve desired health service outcomes (8). Additionally, at the level of health posts, the Federal Ministry of Health (FMOH) designed the Community Health Information System

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(CHIS). The CHIS is a part of HMIS and is implemented at the community level to meet the information needs of the HEWs, and to generate quality data for routine monitoring of services they provide at the community level (9).

Regarding immunization data recording instruments, there is a distinct standardized set of forms developed according to the types of health facilities. The recording instruments were developed based on the level and capacity of the health institutions and the scope of their health services delivery (10). Due to the family-centered health service approach at the health posts, a comprehensive data recording tool called family folder was designed to record health services that HEWs provide (11). The family folder is a pouch issued to every household with a unique household number. It serves as a file to store CHIS cards issued for each family or household. One of these cards is the Integrated Maternal and Child Care Card that has an infant immunization data recording section. At the health centers and at the hospital level, there is a standardized immunization register for health workers to capture immunization information. In addition to recording instruments, tally sheets and reporting formats are developed for each level, including health posts to simplify data compilation and reporting.

Regarding barriers and facilitators to immunization data quality; several researchers identified and reported different technical, behavioral, and organizational factors that affect the quality of immunization data. According to these studies, the shortage of trained human resources, limited knowledge and skills in data quality assessment, shortage of HMIS formats, unavailability of HMIS guidelines, poor supportive supervision, and interrupted regular feedback were the main factors affecting the level of data quality of HMIS (12-15).

In their systematic review study, Harrison K, et al, reported the availability and sustainability of standardized tools in health information systems as one of the pillars of maintaining immunization data quality (16). Lack of data quality assurance guidelines is another prominent barrier reported by literature that has hindered the quality of HMIS data, including immunization (17). A study by Wagenaar BH, et al, in Mozambique found that interrupted supportive supervision to health facilities and inconsistent feedback were key factors in both maintaining HMIS data quality and using data for decision-making (18). A study from Ghana, which assessed the quality of immunization Program information, also noted the need for regular monitoring of health facilities for immunization data quality (19).

Research on the quality of HMIS data in Ethiopia have also reported the presence of regular supportive supervision and feedback for health facilities as crucial in data quality maintenance (12, 15). A study in Western Amhara, Ethiopia found that workload was one of the factors determining the quality and use of HMIS routine data among health facilities (13). In addition to assessing the determinants of data quality,

several studies have examined the level of immunization data quality in Ethiopia, and the more recent studies indicated that the level of data quality is still low (20, 21).

However, regarding immunization data quality, most of the previous research mainly reported data quality level by verifying secondary data sources (reports) against primary data sources (medical records such as registers) and did not explore the practice of data management among health workers dealing with primary data sources. Some studies indicated the quality of information mainly depends upon the proper management of primary data sources (16). Supporting data recording and reporting procedures by technologies such as using electronic medical records (EMR) have been found to improve the quality of information (22-24). In developing countries, however, research indicated that, health workers are largely applying paper-based data management at the level of health institutions (25, 26). These researchers reported problems with manual data recording and reporting mechanisms such as illegibility of handwriting and inaccuracy of data. Despite showing the limitation of paper-based data recording, these studies did not do an in dept analysis of the barriers and enablers to paper-based (manual) data management. The situation in Ethiopia is not different and to our knowledge, no study examined immunization data management practices among health workers in Ethiopia. Therefore, this study was conducted to assess different aspects of immunization data management practices, and explore facilitators, and barriers to immunization data quality among health workers dealing with primary sources of immunization data in Tach Gayint district of Amhara Regional State, Ethiopia, 2020.

Methodology

Study design

A facility-based cross-sectional study was carried out by using a mixed methods approach (quantitative and qualitative) in the Tach Gayint district in June 2020. Tach Gayint is one of the districts of Amhara Regional State, located in South Gondar zone, Northwest Ethiopia. This district is 766km far from the capital city Addis Ababa and 200 km far from Bahirdar, the capital city of Amhara Regional state (27).

Study population, sample size and sampling procedures

The sample size for quantitative data was determined based on the Ethiopian FMOH recommended sample size for routine data quality assessment protocol (28). At the district level, to assess the data quality status of health facilities, the guideline recommends the inclusion of all health centers in the district. Therefore, all six health centers in the Tach Gayint district were enrolled using the census. We selected two health posts from each health center using simple random sampling (lottery method), which made a total sample of 18 health facilities. Moreover, considering the information saturation, 26 Key Informants were recruited for the qualitative part. District office head, health center heads, Immunization focal-personnel,

Health Information Technicians (HIT), and Health Extension Workers (HEWs) were identified as the study population for the qualitative study. Thus, the study recruited one HEW per health post, one EPI focal person per health center, one HIT per health center, and one health centers heads per Health center who were dealing with immunization data purposively using a maximum variation sampling technique.

Data Collection Tools and Procedures

The research team has developed checklists to obtain quantitative data and the interview guidelines for the qualitative part by reviewing available literature in Health Information Systems (HIS) (5, 28-30). The checklist used was in English, and the interview guidelines were in Amharic. Both tools were piloted in Bahir Dar zuria district before the commencement of data collection. (Supplementary_1 Supplementary_2 and Supplementary_3). Training was given to data collectors and supervisors for two days. Issues of data quality such as missing values and legibility of handwriting were checked daily by supervisors while data collectors were in the field. Furthermore, feedback was provided to data collectors to maintain the quality of the data collection process. Both quantitative and qualitative data were collected for 10 days from June 1 to 9, 2020.

Document review was conducted by 4 trained data collectors. To assess the existing immunization data management systems at selected health facilities, various documents used by health professionals to record, compile, report and use immunization data such as immunization register, tally sheets, reporting formats, displayed graphs/charts, and documented feedbacks were reviewed. The availability and functionalities of data quality assurance techniques such as the Performance Monitoring Team (PMT) and Lot Quality Assurance System (LQAS) were also assessed by reviewing documents such as the LQAS accuracy sheet, PMT minute book (data quality logbook), and the data quality protocols/guidelines.

The KIIs were conducted by two researchers from the University of Gondar and Amhara Regional Health Bureau. Both members of the study team had a master's degree in public health. Amhara Health Bureau's member is the office's immunization service coordinator, and a member of the University of Gondar is a Health Information System professional. Audio data was collected using a tape recorder. Field notes were also taken simultaneously during data collection. In general, the KII was conducted to identify whether the immunization data is managed as per the HMIS data recording and reporting procedure (10); and to explore the lived experience of the study participants regarding data management tools they that were using, as well as how and when they record, report and use immunization data.

Study Variables

The outcome variable for this study was the immunization data management practice. The research team looked for the activities carried out for data recording, storing, organizing, and the reporting of the

data generated at the health facilities. Furthermore, data quality assurance techniques, the use of data for decisions, PMT establishment, supportive supervision, and data sharing practices were researched.

Data Analysis

A concurrent quantitative-qualitative analysis approach was applied. Data obtained from the document review was analyzed using STATA version 14.1. Data was cleaned, and variables were generated, coded, and categorized. Frequency and percentage were calculated and presented using a table. Audio from the KII data was transcribed in the Amharic language verbatim and then translated back into English. The translated data was transported to Open-code version 4.02 software in a plain text form for further analysis. Contextual data was coded, reduced for salient patterns. Thematic analysis was applied to identify patterns and meaning in the data.

Results

The findings of this study are divided into two main themes: Existing immunization data management systems; and data management practices, barriers, and facilitators to quality of immunization data. With existing immunization data management systems, findings from document reviews such as recording tool availability; information use practice, PMT functionality, supportive supervision from higher levels, and CHIS implementation status are presented. In the second main theme of our report, findings from the KII about immunization data management practices include immunization data recording, Data Quality Assurance; and reporting and information use; as well as facilitators and barriers of immunization data quality are reported.

Characteristics of the health facilities and study participants

Eighteen health facilities were selected for this study. Six of them were health centers and 12 were health posts. All of them were government health facilities. Out of 6 health centers, only 2 (33.33%) and all (12) health posts were providing immunization services. Qualitative data was obtained from 26 health workers. Six of them were health center heads, 4 HIT personnel, six EPI focal personnel, 9 HEWs, and one district health office department head. (Supplementary_4).

Existing immunization data management systems

Through document review, we found that among 14 health facilities providing immunization services, the standardized immunization register was available in 8 (57.4%) health facilities. Seven (50%) health facilities were using the standardized tally sheets, and children immunization cards were available only in 4 (28.6%) health facilities. Except for 2 health facilities, all the other health facilities did not have data quality guidelines. Fifteen (83.33%) health facilities displayed immunization information using display mechanisms such as graphs and charts. Eleven months before the study period, other than regular reporting, only 7 (38.9%) health facilities disseminated immunization information for local administration and community, while 8 (44.4%) never disseminated information. A

Performance Monitoring Team was available in 13 (72.2%) health facilities. However, only 4 (22.22%) were reviewed immunization data as per expected PMT review in the last three months before this study period. Less than half (44.4%) of the health facilities conducted the Lot Quality Assurance System (LQAS). Eleven months before this study, 9 (50%) of the health

facilities never received supportive supervision from the higher authorities (either from a district or zonal health office department) on immunization data quality and only 1 (5.5%) health center received written feedback more than five times on immunization data quality. Only 5 (41.7%) health posts were implementing the CHIS. (Table 1)

Table 1: Existing immunization data management practices among health facilities of Tach Gayint district, Northwest Ethiopia, 2020

| Variables | Health center(n=6) | Health post (n=12) | Total (number, %) |
|--|--------------------|--------------------|-------------------|
| Recording tool availability(n=14) | | | |
| Immunization registration book | 2 | 6 | 8(57.14) |
| Tally sheet | 2 | 5 | 7(50.00) |
| Immunization Card | 2 | 2 | 4(28.57) |
| Data quality guideline(n=18) | 1 | 1 | 2(11.11) |
| Information use practice (=18) | | | |
| Data visual display practice | 5 | 10 | 15(83.33) |
| Information dissemination for local community | | | |
| No | 5 | 3 | 8(44.44) |
| Less than five | 1 | 2 | 3(16.67) |
| Greater than five | 0 | 7 | 7(38.89) |
| PMT functionality (n=18) | | | |
| PMT Available | 6 | 7 | 13 (72.22) |
| PMT reviewed immunization data within the last 3 months | | | |
| No | 2 | 9 | 11(61.11) |
| 1times | 2 | 1 | 3(16.67) |
| 3times | 3 | 1 | 4(22.22) |
| Identified and prioritized gaps | 2 | 0 | 2(11.11) |
| Conducted LQAS | 4 | 4 | 8(44.44) |
| Supportive supervision with written feedback (n=18) | | | |
| No | 2 | 7 | 9(50) |
| 1 to five times | 3 | 5 | 8(44.44) |
| Greater than five | 1 | 0 | 1(5.55) |
| Health posts implementing CHIS(n=12) | - | 5 | 5(41.67) |

Data management practices, barriers, and enablers to quality immunization data

From the qualitative data, this study explored different aspects of immunization data management at the health centers and health post levels. The findings are divided into two main themes, immunization data management practices and facilitators and barriers to immunization data quality. These main themes were again divided into subthemes. Immunization data management practice is presented by three sub-themes comprising of: recording tools and practice, Data Quality Assurance Technique, and reporting and information use practice. The functionality of the PMT and conducting LQAS were the main facilitators identified for the improvement of immunization data quality. Limited supportive supervision from the higher level on immunization data quality, unavailability of data quality assurance guidelines, the impracticality of LQAS at the health post level, shortage of data recording tools, mass vaccination and vertical reporting were the main barriers identified for the poor levels of immunization data quality.

Immunization data management practices

Recording tools and practice

Recording tools

Respondents highlighted that health workers used two types of immunization data recording tools. Firstly, there were health facilities that used a standardized data recording tool, that has been developed nationally, and was being implemented (the HMIS formats). Secondly, there were recording tools that health workers designed by themselves locally and used for immunization data recording.

Among the study participants, we asked about the type of immunization recording tool, few claimed to use the standardized HMIS recording formats.

'Regarding our vaccination services and its information management, we have a registration book and a tally sheet.... I will record and make a tally and provide the immunization information we provide to children to her'-HIT Personnel' – EPI focal person

The study participants reported that there was a shortage of standardized immunization data recording tools. According to these study participants, instead of standardized HMIS data recording tools, health workers used locally designed tools for immunization data recording at the health post levels. From qualitative data it was also noticed that the supply of

immunization registers and tally sheets was interrupted in many health facilities.

For example, when we asked 20 years old, female, HIT personnel; about the type of source document HEWs used to capture immunization information at the health post level, she replied.

'They (HEWs) have a registration book..., but there is often shortage. Some are preparing by the ruler; some have a registration book.'

Recording practice

In the same way with recording tools, the KII study participants reported two types of immunization data recording practices. There were health workers who record data adhering to the national HMIS data recording procedures and there were also health workers who recorded in their own way.

Respondents highlighted that as many health centers did not provide immunization services, vaccination was mostly provided by HEWs at the health post level. It was provided at different vaccination outreach sites and HEWs called it 'Ketena'. Vaccinations were scheduled once a month for each outreach site and all eligible children were vaccinated together as scheduled. Hence, data were recorded at the time of arrival of these children, monthly, and on a regular basis at these outreach sites. The HEWs took their records to these outreach sites and recorded accordingly.

'We have four outreach sites where we provided vaccination, I mean including the health post.... Mothers come to these vaccination sites. We have a card (Immunization card) Based on our register, we know which type of immunizations the baby needs, such as whether it is Pentavalent-1 or Pentavalent-2.... we make like that (we record based on the register) Mothers know about baby immunization appointments as we work at each immunization station. For example, we are providing vaccination on this immunization site on the 12th day of the month. They (Mothers) know that they will come on time...' – HEW

Respondents also mentioned that some HEWs had a different mechanism of data recording. They register all pregnant mothers in their kebele early in pregnancy and record newborns just as they get born. They had a special register to record these. And, when it is time for the children to be vaccinated (on the 45th day), they went to each 'gote' (subunits of the kebele) and record as soon as children have been vaccinated. Immunization data were not timely recorded in some health posts. In the case of a child not having their information recorded at the time of immunization provision, there was also a practice of making mothers record the information at home. Also, there was a situation of recording data while HEWs provided a home-to-home services; or when the children are vaccinated at the next appointment.

'For example, if the mother forgot the baby's immunization card at home and we did not record the data at the time we provided

vaccination; we will record it whenever we meet the mother.... As we know for sure that the baby is vaccinated; we can record at the next appointment. And, if the mother can read and write, we made her (mother) to record at home or we tell her (mother) to bring the immunization card and we record by ourselves.' – HEW

Moreover, the KII study participants from one of the health posts mentioned that their health post provided immunization services but did not record data or a compiled a report. At this health post, the HEWs did not provide immunization services at their health post; instead, they were providing vaccination going to the health center twice a month. They did not have immunization recording tools at the health post. It was mentioned that the service was provided at the health post; however, the data were recorded at the health center.

'We do not give vaccines here (at the health post) We do not record the data; they [Health centers' staffs] are the ones who have made registers and tally sheets, record data, and compile a report. But we are the ones who give the vaccine.' – HEW

Data Quality Assurance Techniques

Respondents highlighted that few health centers were using the LQAS to assess immunization data quality. Differently, there were health workers who understood ordinary data quality measures and the immunization data quality assessment.

Some health centers had a PMT committee established according to the national membership standard (i.e. led by head of the institution, HMIS in charge and all representatives of the case teams). The PMT committee reviewed the quality of the immunization information every month along with all reportable data elements at the health facility. The report was sent to the next level after a thorough review and assurance of quality. The data quality was measured by comparing different types of data sources such as a register, tally sheet, and the report. Besides, the PMT committee members were also there to see the quality of the information on the health posts.

'We have PMT that evaluates data quality and performance of the health center using key indicators. Hence, the PMT evaluated the report submitted from HPs to the HC. After I have received positive responses from the PMT on the quality of data, I entered the HPs data to the district health information system (DHIS2) to submit to the district office.... The PMT members presented at the health post level to check and verify the reported data were available in the ground. They tried to check whether HEWs collected the data from the source document i.e. family folder or tally sheet found in the health post.' – HIT personnel

According to many study participants, it was recognized that there was a belief among health

workers that immunization data quality was measured by looking for children who dropped out of vaccination services. For example, when we asked about the reason for the health centers good quality of the immunization data, a 23-year-old, male midwife, replied.

'It is in good condition. When I recorded and made a tally, I can find defaulter children. I can say my quality of immunization data is at a good level when I can identify children who have been dropped out of the immunization service and made get them back in service.' – EPI focal person

At the health post level, many HEWs viewed the quality of immunization data in terms of their immunization services coverage; and measured the level of their data quality by comparing their achievement with the plan. For instance, a 38-year-old, HEW, told us her health posts' data quality status and how she measured it, she said.

'It's (Immunization data quality) not good at our health post. Because...When we look at the percentage of our performance, it is far from what we have planned. Our plan is ambitious (yetelele new), and our performance is too small.... This was because the children of other catchment are included in our plan; that is the reason that has brought down our performance. But we evaluated the quality of our information as it was in good. Because we knew that we provided a vaccine for all eligible children in our kebele.'

Reporting and information use practices

Reporting practices: The KII study participants mentioned that a regular report from the health posts was directly delivered at Health Information Technology (HIT) Units/personnel at the health center. Health centers aggregated all reports from health posts under its catchment with the health centers' and reported hard copy and soft copy versions separately to the district health office via District Health Information Systems (DHIS₂). All health facilities have standardized reporting formats to compile reports from the registration book.

'We have reporting formats. We have monthly and quarterly report formats. Before the reporting period, we send it to all HEWs by their health posts. Then, they (HEWs) fill it out and send it to us. And we aggregate it up and send it to the district via DHIS₂ by both hard and soft copy.' – Head of the health center

Information use practices

According to the KII study participants, immunization data was mainly used for the identification of immunization dropout rates. Some others used immunization data for comparing achievement with a plan. Some said immunization information was essential for providing feedback on the area of service needs improvement.

'For example, there may be children who have stopped getting vaccinated. So, the health

center regularly reviewed the report to identify children who have dropped out. It (immunization information) helps us to improve dropout out and to compensate for our backlog.' – EPI focal

Moreover, it was mentioned that health professionals at both health center and health post level can also use immunization information to improve their service delivery gaps by comparing their performances with the plan. Also, all health facilities were using the monitoring chart to compare their plans and performance.

Facilitators and barriers of immunization data quality

Facilitators: The functionality of the PMT and LQAS were the main facilitators mentioned by most of the respondents for the improvement of immunization data quality.

There were health centers that have been established by the PMT committee as per national criteria. Thus, the PMT comprised of a variety of members from the different departments who did the regular review of the immunizations reported from all health posts to health centers monthly. They have been measuring the level of data quality using LQAS.

According to many study participants, doing the LQAS was one of the reasons for the improvement of immunization data quality.

'In the health center, we have established PMT. It comprised of case team leaders, HIT, and facility head. We have not faced inconsistency of data between register, tally sheet, and report so far. Hence, we considered that the level of our EPI data quality was good.' – Head of the health center

At the health post level, one of the HEWs, when she told us the advantage of using LQAS, stated.

'Regarding its (the LQAS) benefits, it has a lot of benefits. Although we do apply it occasionally, it tells us where we are wrong. I mean, it can show us if there is service that we have provided but remained not unrecorded.'

Barriers

Lack of guidelines, the impracticality of LQAS at the health post level, shortage of data recording tools, mass vaccination, vertical reporting, poor implementation of CHS, and limited supportive supervision from the higher level on immunization data quality were the main barriers identified for the poor level of immunization data quality.

Lack of guidelines

Some of the study participants mentioned that the poor quality of immunization data was related to the lack of guidelines.

As stated by one of the research participants;

Till today we have not drafted documents showing the strategies for data quality

assurance to improve the current level of data quality. For the past six months, I delegated as EPI focal person. However, I have no clear understanding of the EPI monitoring checklist as well as a guideline.... Besides, I could not find supporting documents and files which indicate the previous experiences in the facility- EPI focal person

The impracticality of LQAS at the health post level

At the health post level, incompatibility with implementing LQAS was a barrier to the quality of immunization data highlighted by few respondents.

'When implementing LQAS, we need to include data elements that we report and not report. It (the LQAS) requires us to include health services that we do not provide here. Then there will be zero on the registration book, tally sheet, and report. It makes no sense.' – HEW

Shortage of data recording tools

Many of the study participants were sharing their experiences, that the lack of data recording tools was the main reason for the poor quality of immunization data. A HEW; stated her experience with how the lack of recording tools affected the quality of immunization data in her health post as follows.

We need supply (recording tools). The tally sheet is important. We need both register and tally sheet to conduct data quality assurance.... right now, we do not have a registration book. We are using our own made registration book. This is a traditional data recording practice. Necessary recording tools must be availed by the district health office.

Mass Vaccinations

We recognized that mass vaccinations were another barrier to the quality of immunization information. Many health extension workers have stated that it was difficult for them to record immunizations due to the workload, as vaccinations were not provided daily, rather vaccines were given only on certain days of the month by collecting eligible children for vaccination.

On our side, the gap is caused by the workload. For example, now on Mary's day (bekedem bemariam let), there were so many children; I may not have been given them (for mothers) immunization cards; It could happen like that. – HEW

Vertical reporting

Simultaneous dual report preparation was another barrier identified with regards to the quality of immunization information. At both the health center and health post level, health workers were preparing two reports at the same time, one to send via DHIS2 and another for the program.

Poor level of CHIS Implementation

According to some HEWs, at the health post level, the poor level of CHIS implementation was another barrier related to poor immunization data quality. Some HEWS stated that they were implementing CHIS and

that its formats were convenient to use which had helped them for proper immunization data management.

'Last year, there was a tally sheet (CHIS tally sheet) that allowed me to make a tally using the household number. That one (CHIS tally sheet) was suitable for me and I had enough space to make a tally. You can't locate the household number on that (a current tally sheet). You can't make a tally of ten children using that (a current tally sheet) tally sheet. But the former one (CHIS tally sheet) was suitable and using it (CHIS tally sheet) you can make a tally of up to 20 children.' –HEW

Discussion

Overall, to improve immunization data quality, it is imperative to ensure that the information is collected and stored appropriately at the source (4). This study assessed immunization data management practices among frontline health workers at health posts and health center levels. By reviewing relevant documents in immunization data management and using Key-Informant Interviews, immunization data management practices and main facilitators and barriers to immunization data quality were explored.

Nearly, half of the health facilities did not have all types of standardized immunization data recording tools. Findings from document review of this study indicated 43% of health facilities did not have a standardized immunization registration book, and 50% of health facilities did not use the standardized tally sheets. A study conducted in the Tigray region of Ethiopia reported a comparable finding with the current study – found 50% of DPT/pentavalent-3 source document availability among health facilities (31). Also, from the qualitative findings of this study, it was found that instead of using HMIS tools, health workers were using locally designed data recording tools in many health facilities. This refutes the intention of recording and reporting procedure guidelines designed by FMOH to be used by health workers at all levels of the health system (10). Maintaining standardized recording tools is a fundamental way to proper management of immunization data at the health facilities, by maintaining its quality, and enhancing evidence-based decision making at all levels of the health system. On the contrary, the lack of standardized data tools is one of the major technical constraints to data quality reported by some of the previous studies in the field of HMIS (16). If these basic tools are not availed in a consistent manner for health facilities that primarily produce routine immunization data, it could halt efforts in the immunization program to reduce infant morbidity and mortality, as evidenced by many studies (4-6).

Less than half of health facilities were conducting the LQAS and only 22% of health facilities were conducting the expected immunization data quality review in the last three months before this study period. The reason for not routinely conducting LQAS might be related to the knowledge and skills gap among health workers (13). Research in South Africa,

conducted on factors affecting the quality of routinely collected data, reported 64% of poor data quality checking skills among health workers (14).

Quantitatively, this study found that data quality assessment guidelines were only available in 11% of health facilities. Likewise, from the qualitative part of this study, some participants have associated the low quality of immunization data with a lack of guidelines. Furthermore, we recognized that the way in which health personnel understand data quality, how to measure and the means of data quality assessment, was not consistent with the national health data quality assessment standard (28). At the health post level, many HEWs reported, that the level of their immunization data quality was measured by their achievement of immunization services coverage.

The availability of data quality assessment guidelines might help health professionals to have a common understanding of the data quality assurance techniques and would have supported them to conduct data quality assessments as per the required standard. There is research evidence that reported a lack of guidelines as one of the barriers to routine data quality. For instance, in their qualitative study on assessment of barriers and solutions of reporting data quality, Callahan T, et al, has documented that the study participants in their study mentioned the lack of guidelines and resources for conducting the DQA as barriers affecting the quality of information (17).

This study confirms this finding, in that it reports that there was limited supportive supervision from the higher levels for health facilities on immunization data quality. More than half of health facilities have never received supportive supervision accompanied by written feedback from the higher level (either from a district or zonal health office). A limited amount of health facilities (5%) received written feedback more than five times. This might be amongst the main challenges to maintaining immunization data quality. There are several research publications, that have cited adequate supervision and feedback from senior levels as a major strategy to maintaining the data quality. To mention literature from Ethiopia, studies conducted in Jimma and East Wollega zones, have reported the presence of regular feedback as one of the factors associated with quality of HMIS data (12, 15). Supportive supervision accompanied with feedback is also a proven strategy by interventional studies, especially in low-and-middle-income countries. For instance, in Mozambique, a study by Bradley H Wagenaar, et al; reported maintenance of supportive supervision and feedback from regulatory bodies, as one of the key factors in maintaining both the quality of the HMIS data and using data for decision making (18).

In this study, the impracticality of using the LQAS was amongst the barriers identified to immunization data quality at the health posts level. Some HEWs who participated in Key Informant Interviews of our study, reported that they were expected to use the LQAS to perform data quality assessment, similarly, as the

health workers did at the health center level. According to these HEWs, the difficulty is related to the LQAS design as it did not consider the scope of health posts' health services delivery. Previous studies reported that failure to use simplified data quality assurance techniques was one of the main obstacles to immunization data quality and emphasized the need to design and use easy-to-use techniques (16, 32). Furthermore, according to our understanding, poor immunization data quality at the health post level might be related to poor implementation of the CHIS, which can simplify the HEWs' data quality assessment activities if it would have been successfully implemented (11). A quantitative result of this study also indicated only 42% of health posts were implementing the CHIS.

The workload was another prominent barrier identified for the quality of immunization information in the current study. This idea has echoed by HEWs who are usually providing immunization services at the health post levels. The workload on HEWs might have influenced the existing approach HEWs were using to provide vaccinations. Based on the qualitative data obtained in this study, the HEWs practice of vaccination is limited to a few days of the month, rather than on a daily basis, this would make it difficult for them to record the quality immunization data alongside providing vaccines for children who attend on the days of the vaccination appointment. A study conducted in western Amhara, reported workload amongst personnel level, as a determinant of routine health information utilization (13).

Another barrier identified to immunization data quality by the current study was the presence of vertical reporting. Although the current Ethiopian HMIS is implementing DHIS-2 to enhance the report of all HMIS reportable indicators in a single line, our qualitative data revealed the existence of some health facilities that report immunization data for the immunization program, in addition to the DHIS-2 regular report. The preparation of a report for two parties would result in an increase in the work burden among HEWs which could in turn negatively affect the quality of immunization information. Research suggests that data collection for vertical programs can over-burden health workers with multiple responsibilities which in turn lead health workers to spend most of their time on non-essential data-related activities, thus ultimately impacting the quality of information (33).

Regarding information use, most health facilities (83.33%) utilized immunization information to track their progress against a target by displaying immunization indicators using display mechanisms such as a monitoring chart. However, beyond using the information within the health facilities, only 44% of health facilities were prepared and reported immunization reports for the local community. The qualitative finding of this study also indicated that immunization information utilization was restricted within the health facilities. None of the Key Informant interviewees mentioned the dissemination of

immunization information to the local community. By principle, governmental institutions, as well as donors in strengthening HMIS encourages health facilities to report their performances, at least once a year for local communities considering them as one of the target audiences (9, 30). Considering the intentions of these guidelines, among health facilities in our study, there was a significant gap in the practice of transferring information through disseminating immunization data for local communities.

This study invited different health workers who are currently engaging in immunization programs and explored their data management practices such as recording, reporting, and the use of immunization data. Furthermore, the literature search of the authors in this study, revealed that this was the first study in Ethiopia that explored these different aspects of immunization data management practices among front-line health staff. Furthermore, this study serves as implementation research, which was conducted to inform policymakers, managers, and stakeholders working to improve the immunization data quality and the barriers and facilitators to the immunization data among health facilities at the lowest level of the health system. Any stakeholders who want to improve the immunization data quality can use the findings of this study to develop a variety of strategies. However, due to the nature of this research, as it was implementation research, the study site was limited to a single district which was intentionally proposed by the implementers (Amhara Regional Health Bureau). Therefore, it should be noted that the findings of this study may not represent contexts outside the scope of the study.

Conclusion

This study revealed immunization data management practices among frontline health workers dealing with primary sources of immunization data at the health posts and health center levels. The required HMIS data recording tools which enable efficient collection of immunization data were often lacking. There were findings of different recording practices; where some of the health workers used standard tools and many were locally developed. Most health facilities practiced displaying immunization information through information use, while dissemination at the local levels is still very low. Tracing immunization defaulters, coverage via plan analysis, providing performance feedback and displaying monitoring charts were common immunization use practices. The practice of data quality audit initiatives like availability and functionality of PMT and LQAS at health facility level were facilitators that make a difference in EPI data quality, though efforts need to be made to improve the functionality of PMT and LQAS as per the standard. Shortage of data recording tools, unavailability of HMIS guidelines, limited supportive supervision from the higher level, vertical reporting, impracticality of LQAS at the health post level, poor implementation of CHIS, and mass vaccination were barriers identified to immunization data quality. Therefore, interventions must address these barriers that affect the proper collection and management of immunization data at the point where they are first collected. The findings of this

study are crucial for policymakers and service providers to ensure the availability and utilization of standard recording tools at the source level. Notably, availing data standard HMIS tools, ensuring data quality assurance guidelines, adopting friendly data audit techniques at the health post level, and avoiding vertical reporting are basic immunization data quality improvisations.

Declaration

Ethical approval

The ethical clearance was obtained from the Institutional Ethical Review Board of the University of Gondar. Approval was also obtained from appropriate health authorities while collecting relevant documents for document review. Informed consent was obtained before collecting data after explaining the objectives of the study, confidentiality, and its possible benefits to the study participants.

Availability of data and materials

Data will be available upon reasonable request from the corresponding author.

Competing interests

Authors declared no competing interests

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current Journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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References

1. Federal Ministry of Health. Ethiopia National Expanded Programme On Immunization:Comprehensive Multi-Year Plan 2016 - 2020 Addis Ababa 2015.
2. World Health Organization. Vaccine-preventable diseases: monitoring system. 2020 global summary;Ethiopia: WHO; 2020 [updated 15-July-2020 cited 2020 30/9/2020]. Available from: https://apps.who.int/immunization_monitoring/globalsummary/countries?countrycriteria%5Bcountry%5D%5B%5D=ETH.

3. Tamirat KS, Sisay MM. Full immunization coverage and its associated factors among children aged 12–23 months in Ethiopia: further analysis from the 2016 Ethiopia demographic and health survey. *BMC Public Health*. 2019;19(1):1019.
4. Bloland P, MacNeil A. Defining & assessing the quality, usability, and utilization of immunization data. *BMC Public Health*. 2019;19(1):380.
5. USAID, Evaluation M. Guidelines for data management standards in routine health information systems. 2015.
6. Health Metrics Network. Framework and standards for country health information systems. 2nd ed ed. Geneva: World Health Organization; 2012.
7. Federal Ministry of Health Ethiopia. Health Management Information System (HMIS) /Monitoring and Evaluation (M&E). 2008.
8. Ethiopian Federal Ministry of Health. Information Revolution Roadmap. 2016.
9. Federal Democratic Republic Of Ethiopia. Community Health Information System Data Recording and Reporting: User's Manual. 2011.
10. Federal Democratic Republic Of Ethiopia, MOH. Ethiopia Health Management Information System: Data Recording And Reporting Procedures. 2018.
11. FMOH). Agrarian Community Health Information System Implementation Manual: Revised For Second Generation Health Extension Program. Addis Ababa, Ethiopia; 2019.
12. Agago T, Sisay S, Samuel S. Implementation Level of Health Management Information System Program in Governmental Hospitals of Ethiopia. *International Journal of Intelligent Information Systems*. 2019;8:52-7.
13. Asemahagn MA. Determinants of routine health information utilization at primary healthcare facilities in Western Amhara, Ethiopia. *Cogent Medicine*. 2017;4(1):1387971.
14. Nicol E, Bradshaw D, Phillips T, Dudley L, editors. Human factors affecting the quality of routinely collected data in South Africa. *Medinfo*; 2013.
15. Kebede M, Adeba E, Chego M. Evaluation of quality and use of health management information system in primary health care units of east Wollega zone, Oromia regional state, Ethiopia. *BMC Medical Informatics and Decision Making*. 2020;20(1):107.
16. Harrison K, Rahimi N, Carolina Danovaro-Holliday M. Factors limiting data quality in the expanded programme on immunization in low and middle-income countries: A scoping review. *Vaccine*. 2020;38(30):4652-63.
17. Callahan T, Barnard J, Helmkamp L, Maertens J, Kahn M. Reporting Data Quality Assessment Results: Identifying Individual and Organizational Barriers and Solutions. *EGEMS (Washington, DC)*. 2017;5(1):16.
18. Wagenaar BH, Gimbel S, Hoek R, Pfeiffer J, Michel C, Manuel JL, et al. Effects of a health information system data quality intervention on concordance in Mozambique: time-series analyses from 2009–2012. 2015;13(1):1-5.
19. Adamki M, Asamoah D, Riverson KJJHMI. Assessment of data quality on expanded Programme on immunization in Ghana: the case of new Juaben municipality. 2015;6(196):2.
20. Ethiopian Public Health Institute. Health Data Quality Review: System Assessment and Data Verification for Selected Indicators. 2018.
21. Teklegiorgis K, Tadesse K, Mirutse G, Terefe W. Level of data quality from Health Management Information Systems in a resources limited setting and its associated factors, eastern Ethiopia. 2016. 2016;18(1).
22. Sood S, Nwabueze S, Mbarika V, Prakash N, Chatterjee S, Ray P, et al. Electronic Medical Records: A Review Comparing the Challenges in Developed and Developing Countries 2008. 248- p.
23. Goldstein BA, Navar AM, Pencina MJ, Ioannidis JP. Opportunities and challenges in developing risk prediction models with electronic health records data: a systematic review. *Journal of the American Medical Informatics Association : JAMIA*. 2017;24(1):198-208.
24. Silvestre E. How Electronic Health Records Strengthen the Health Systems of Low- and MiddleIncome Countries: Learning from Eswatini and Mexico. Chapel Hill, NC: MEASURE Evaluation, University of North Carolina. 2018.
25. Kalogriopoulos NA, Baran J, Nimunkar AJ, Webster JG. Electronic medical record systems for developing countries: review. *Conference proceedings : Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE Engineering in Medicine and Biology Society Annual Conference*. 2009;2009:1730-3.
26. Msiska K, Kumitawa A, Kumwenda B. Factors affecting the utilisation of electronic medical records system in Malawian central hospitals. *Malawi Medical Journal*. 2017;29:247-53.
27. Aynalem Adugna. Amhara Demography and Health 2018 [cited 2020 30/7/2020]. Available from: <http://www.ethiodemographyandhealth.org/Amhara.html>.
28. FMOH Plan Policy Monitoring and Evaluation Directorate. Health Dta Quality; Training Manual Addis Ababa 2018 [cited 2021 7/20/2021]. Available from: [https://search.yahoo.com/search?fr=mcafee&type=E210US91213G0&p=FMOH+Plan+Policy+Monitoring+and+Evaluation+Directorate.+Health+Dta+Quality%3B+Training+Manual.+2018.#:~:text=Health%20Data%20Quality%](https://search.yahoo.com/search?fr=mcafee&type=E210US91213G0&p=FMOH+Plan+Policy+Monitoring+and+Evaluation+Directorate.+Health+Dta+Quality%3B+Training+Manual.+2018.#:~:text=Health%20Data%20Quality%20)

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- 20Training%20Module%20Participant%20Manual.
29. Aqil A, Lippeveld T, Hozumi D. PRISM framework: a paradigm shift for designing, strengthening and evaluating routine health information systems. *Health policy and planning*. 2009;24(3):217-28.
 30. MEASURE Evaluation. Performance of Routine Information System Management (PRISM) 2019.
 31. Gebreslassie AA, Below MT, Ashebir MM, Gezae KE, Chekole MK. TE. Enhancing health facility-based data quality and use for decision making at primary health care units to improve health service delivery of maternal newborn child and adolescent health. *Arch Community Med Public Health*. 2020;6(1):031-5.
 32. Kumar M, Gotz D, Nutley T, Smith JB. Research gaps in routine health information system design barriers to data quality and use in low- and middle-income countries: A literature review. *The International journal of health planning and management*. 2018;33(1):e1-e9.
 33. Scobie HM, Edelstein M, Nicol E, Morice A, Rahimi N, MacDonald NE, et al. Improving the quality and use of immunization and surveillance data: Summary report of the Working Group of the Strategic Advisory Group of Experts on Immunization. *Vaccine*. 2020.