Enhancing Health Workers' Knowledge and Skills in Ethiopia through Tailored Health Information System Interventions

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Abstract

Background: The health information system (HIS) is fundamental for planning, monitoring, and evaluating healthcare services, and managing healthcare resources. Technical, behavioral, and organizational factors are key determinants of routine information processes and performance. Unlike previous assessments that focused mainly on the availability of health workers, this study aimed to assess the competence level of existing health workforce from the perspective of performing key routine health information tasks at point of care. It estimates the changes in knowledge and skill level of the health workforce in health facilities in Ethiopia after HIS focused interventions.

Method: A pre-post interventional study design was employed. For the baseline survey (in 2018), 99 service providers, HIS focal, and facility managers from 48 health facilities were selected in 19 HIS program implemented districts. At end-line survey (in 2022), 120 service providers, HIS focal, and facility managers from 42 randomly selected health facilities in HIS program implemented districts were included. In both surveys, self-administered questionnaire was used to collect the data. Health workers' knowledge and competence levels in performing Routine Health Information System (RHIS) tasks including data quality checking, problem solving, data visualization, data interpretation, and data use skills were assessed and trend analysis was conducted using chi-square tests changes in health professional's knowledge and competence levels over the five years period.

Results: The findings of this study showed that the capacity building interventions done by the Data Use Partnership (DUP) and the Capacity Building and Mentorship Program (CBMP) improved health professional's knowledge and competence in performing HIS tasks, as well as their problem solving and data use skills. For instance, the intervention improved health workers' knowledge of data quality verification by 37%, data visualization and interpretation skills by 29% and 20%, problem solving and data use by 24% and 28%, respectively. The intervention also increased the health workers' practice of identifying performance gaps, conducting root cause analysis, and developing action plan by 16%, 14%, and 26% respectively.

Conclusion and recommendation: Thus, supportive supervisions, mentorship and onsite coaching is crucial for improving the data quality, fostering an organizational culture of information use, and to make evidence based decisions. It is recommended to integrate various insertions such as behavioral change, technological support and capacity buildings. [*Ethiop. J. Health Dev.* 2024; 38(SI-2)]

Key words: health information system (HIS), health workers, knowledge, skill, behavioral factors

Introduction

The health information system (HIS) is fundamental for planning, monitoring, and evaluating healthcare services, and managing healthcare resources (1). The proper utilization of health information is crucial for making operational, tactical, and strategic decisions. The World Health Organization (WHO) has identified significant issues with health information, including fragmentation and duplication, which lead to insufficient use of existing information and evidence (2). Healthcare workers play a vital role in collecting, analyzing and visualizing health service data, and using it for the clinical management of patients, disease monitoring, facility management, and monitoring service performance evaluation (3). However, health system managers in developing countries often overlook the main purpose of the HIS is only to provide data for tracking the performance of programs and the overall health system (4).

Most HIS studies have focused on the technical and organizational aspects of the system, with little consideration for the human aspect of HIS. Even studies that have examined the health workforce aspect of HIS have mainly focused on the availability of human resources, while ignoring the competency and motivation of the workforce (3,5). For instance, a study conducted in Tanzania indicated that a lack of training on the HMISled to confusion about who was supposed to use the information collected, and almost 45% of study participant did not use the collected data for planning, budgeting, and evaluating service provision (1). Moreover, a study conducted in South Africa showed that human factors, including numerical skills, data quality checking skills, and motivation, affect the quality of routinely collected health data (3). Studies also showed that training, supervision, and competence in RHIS task are positively associated with RHIS implementation (6).

Despite the low investment in training for health workers in low-and middle income countries, (7) Ethiopia has made various efforts to address challenges in HIS performance. The Ethiopian Ministry of Health (MoH) has recognized digital transformation and governance as a central pillar of its Health Sector Transformation Plan II (HSTP II). The aim is to harness the vast benefits and positive impact of the HIS (8, 9). Moreover, MoH developed the information revolution (IR) agenda (10). However, empirical evidence on health workers knowledge and skill regarding health data for planning and decision making is limited.

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The DUP collaborated with CBMP universities and MoH implemented a coherent data quality assurance approach through data quality validation meetings, data quality assessments, onsite supportive supervision, need-based training, and mentoring on routine health data management. These efforts aim to improve the analysis and use of data for decision-making. This study assesses changes health workers' knowledge and skills through tailored HIS intervention in Ethiopia.

Methods

Study design and setting

A pre-post interventional study design was conducted among service providers, HIS focal persons, and facility managers at health centers and hospitals at two time points the base-line data was collected from November -December 2018, and the end-line was conducted from April to May 2022. The DUP collaborated with six universities and Regional Health Bureaus (RHBs) provided the intervention services in eleven districts found in all the regions. The partnerships were as follows: Addis Ababa University with Addis Ababa City Administration; Haromaya University with the Somali and Harari regions and Dire Dawa city administration; Hawasa University with Sidama and the Southern Nations, Nationalities and Peoples' (SNNP) region; Jimma University with the Oromia and Gambela regions; Mekele University with the Tigray and Afar regions; and the University of Gondar with the Amhara and Benishangul-Gumuz regions.

Participants

The source population of this study included all department heads or case managers, health facility heads, HIS focal and professionals responsible for health institution that was expected to use routine health data.

Eligibility criteria

A minimum of two study participants from each selected health facilities were included. Participants included the head or deputy of the facility, the health information technician or HIS focal person and MCH service provider who have program supervision or unit lead roles. However, health professionals and managers with less than six months of work experience were excluded from the study, as newly hired health professionals may not have had the opportunity for training and may not be familiar with the health information system.

Intervention description

In Ethiopia, there are ongoing efforts to improve the availability, quality and use of health information at all levels of the health system. Making better use of health data, validation processes, visualization and analysis will improve utilization of health information (8,9). The DUP promotes HIS improvements through capacity building, developing standards, systems, and tools, fostering a culture of information use, digitization, knowledge sharing and technical assistance. It supports the government to strengthen capacity, improving data quality and establishing information systems to generate and use more reliable and timely health data (11).

The goal of CBMP was also to strengthen the national HIS through proper data documentation, information use, and digitization. The intervention had two components: tailored training focused on Health Management Information System (HMIS), (Community Health Information system (CHIS), health statistics, data analysis and use, monitoring and evaluations problem identification and root cause analysis and action plan development and onsite mentorship which targeted service delivery unit heads, case-team leaders, department heads, and district office managers (6). The mentee team is composed of University academics, trained monitoring and evaluation officers at RHBs, and members from the DUP. This tailored intervention is expected to improve health workers' HIS performance and capacity in the intervention districts.

The DUP, along with CBMP universities, selected sites as incubation and testing sites for HIS interventions, intending to disseminate their learning to other districts and health facilities across the regions. Those selected sites obtained additional supports to develop and implement site-specific HIS strengthening plans. They underwent need-based and tailored trainings coupled with more frequent and structured mentorship visits (i.e. every two months) and on-site need-based trainings that focused on improving health workers HIS knowledge, capacity, and competency. Interventions were adapted to the site-specific context based on continuous monitoring through needs assessments and feedback from quarterly supportive supervision visits, and the involvement of university students and selected mentors from each district health office to follow and support health facilities within their catchment area.

Sampling procedure and sample size

The sample size was designed to generate nationally representative data from 19 selected health facilities, which were designated by RHBs as demonstration and learning districts and were supported by DUP and CBMP universities. The selection of intervention sites was determined based on the facilities, performance level where RHBs considered them as "better performed in service provision" as a key criterion for being as demonstration sites. The sampled facilities were randomly selected to conduct all components included in the Performance of Routine Information System Management (PRISM) tool, with the organizational and behavioral assessment tool (OBAT) being one of them (12). Health workers were purposely selected from these health facilities to ensure representation across all categories engaged in major HIS tasks. For the baseline survey (in 2018), 99 service providers, HIS focal, and facility managers of 48 health facilities were selected from 19 districts where the HIS program was implemented. At end line survey (in 2022), as the number of eligible participants in each facility increased the sample size became 120 service providers, HIS focal, and facility managers of 42 randomly selected health facilities of program implementation districts.

Outcome variable

The dependent variable of this study was HIS competence, Knowledge, and practice. The PRISM framework was used to collect the necessary data, Utilizing the diagnostic tool and behavioral aspect of the OBAT the PRISM measures health professional's behavioral factor on HIS performance in four dimensions: (1) perceived capabilities, (2) actual capabilities, (3) knowledge and (4) motivation level to perform key HIS tasks. This study has assessed health professional's knowledge and actual level of competence to perform key HIS tasks. Most of the variables are composite indices of more than two question items; therefore, they have been converted into percentile scores for easier interpretation and comparison, following the PRISM assessment and analysis guidelines.

Operational Definition

Knowledge towards the rationale for HIS data

We used the OBAT (13) to assess health professionals' knowledge by evaluating their level of understanding of why (1) disease, (2) service, (3) age and gender disaggregated, (4) client's residence and (5) population data are routinely collected, as well as how they can use these data at community and health facility level.

Competence on HIS

Health professionals' task competency and problem-solving skills were assessed through responses to problem sets provided in a written test. We measured their ability to (1) calculate indicators based on the data, (2) plot or visualize data in graph/chart form, (3) interpret and understand meaning of the data, (4) identify and solve problems, and (5) use information for decision-making.

Data collection tool and quality control

Pencil and paper based Self-administered questionnaires written in English were used to collect the necessary data. A four day, data collection training, was provided for 54 data collectors and 18 supervisors. As part of the training, pre-testing of the data collection tool was conducted at Dagmawi Minilik Hospital and Janmeda Health Center, which were not included in our study. All technical issues faced during pretesting were discussed and addressed.

Data processing and analysis

Responses in the questionnaire were scored by senior HIS expert and transferred to Excel. Then, Data were cleaned and analyzed using Stata version 14.0 software, and results were presented as descriptive statistics and trend analysis.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board of the Ethiopian Public Health Association. Support letters from the MoH, regional health bureaus, and district health offices were secured. A written informed consent form explaining the purpose and benefits of the study, participants' right to withdraw at any point of the data collection process, confidentiality, and other related issues was provided to study participants and who agreed to participate in the study. Furthermore, since the data collection was conducted during COVID 19, all required preventive measures, including masks, hand sanitizers and appropriate advice, were provided for data collectors and supervisors to prevent the participants and themselves from infection.

Results

Background characteristics

A total of 48 and 42 health facilities were included in the first and second cohort studies, respectively. In the first cohort (2018) 99 study participants were included, and while in the second cohort (2022), the number of eligible health workers increased to 120. In both cohorts the majority of respondents ware males (71% and 66%) and have higher educational attainment (100% and 84%). In the first and second cohorts, approximately 35% and 33% of the respondents were facility managers, 25% and 32% were HMIS focal persons and 38% and 30% were service providers with supervision role. In both cohorts, most (70% and 71%) of the study participants had received HMIS trainings including CHIS, data analysis and usage, within one year prior to the study years, and had 8.5 and had an average work experience of 8.2 years respectively (**Table 1**).

Table 1: **Socio-demographic characteristics of the participants in the study of changes in health workers' knowledge and skill through tailored HIS intervention in Ethiopia, 2022**

Variables	Category	2018		2022	
		Frequency	Percentage	Frequency	Percentage
Sex	Male	70	71	79	66
	Female	29	29	40	33
Position	Facility in-charge or deputy	35	35	39	33
	M&E unit lead or HIT	25	25	38	32
	Service provider	38	38	36	30
	Others	1	1	2	2
	Not identified	0	0	5	4
Level of education	Primary	0	0	0	0
	Secondary/High school	0	0	8	7
	Higher education (diploma, bachelor's degree and masters' degree)	99	100	101	84
	Missing	0	0	11	9
Work experience	Mean	8.5		8.2	
Received HMIS training		69	70	85	71
Health statistics		6	9	8	9
HMIS/CHIS		53	77	69	79
Data analysis and use		8	12	38	45
General M&E		5	7	15	18
ICT		0	0	4	6

Seventy-one percent of the staff currently working on recording, reporting and data analysis (i.e., heads/deputies, HMIS/M&E focal and program case team leads) have received training on HIS (e.g., HMIS, CHIS, data analysis and use, general M&E, etc.) topics in the year prior to the assessment. As described in Table 1, most the respondents received training on HMIS and CHIS, which is expected given the 2role out of the revised HMIS in 2017.

Behavioral Factors

Overall, health professional's knowledge, competence in performing HIS tasks, and problem solving and data use skills have showed significant improvement with $P<0.05$ between the two cohorts. Similarly, the HIS processes, problem solving and data use practices were higher in 2022 than the 2018 findings. The healthcare professionals also scored higher in demonstrating their of the rationale knowledge for HIS and the methods for conducting data quality verifications in the 2022 (second cohort) survey. Additionally, the average score of data visualization and interpretation skills were increased by 29% and 20%, respectively. Encouraging improvement was also observed in health professionals' ability to use data for identifying and solving problems and for decision-making. On the other hand, healthcare professionals' competency in calculating indicators showed no significant change between the 2018 and 2022 survey findings (**Table 2**).

Table 2: **HIS knowledge and competencies of healthcare professionals in the study of changes in health workers' knowledge and skill through tailored HIS intervention in Ethiopia, 2022.**

Indicators	2018	2022	OR	Chi	P-value
Knowledge of the rationale for RHIS data	50%	96%	24	53.4	0.01
Knowledge of data quality checking methods	26%	63%	4.84	27.57	0.01
Competence level in calculating indicators	33%	38%	1.24	0.54	0.46
Competence level in data visualization	25%	54%	3.52	17.5	0.01
Competence level in interpreting data	27%	47%	2.39	8.53	0.01
Competence level in problem solving	14%	38%	3.76	14.89	0.01
Competence level in the use of information	14%	42%	4.44	19.34	0.01

Practice of HIS tasks

The improved level of knowledge and skills correspond with significant improvements in HIS processes, problem solving and data use practices in the health facilities. The actual practices of healthcare providers in identifying performance related problems, root cause analysis and developing action plans for identified gaps increased significantly (from 76% to 92% and 61% to 87%) between the two surveys. In our second survey (2022), more health facilities also utilized data for decision making compared to the 2018 survey findings. Moreover, the intervention improved the utilization of routine data for performance review and evidence based decision makings. Both the availability of data quality control mechanisms and use of routine data for RHIS quality improvement improved considerably

after the intervention in 2022. The culture of data quality control and use of routine data for quality improvement also significantly increased. A substantial number of healthcare providers prepared and utilized various data visualizations that showcase the performance of their facilities (**Table 3**).

Table 3: **Routine data use practice of health facilities in the study of changes in health workers' knowledge and skill through tailored HIS intervention in Ethiopia, 2022**

Indicators	2018	2022	OR	Chi	P-value
HFs that identified performance related problems	76%	92%	3.63	10.38	0.01
HFs that conducted root cause analysis	71%	85%	2.31	5.03	0.02
HFs that developed action plan for improving facilities performance	61%	87%	4.27	18.64	0.01
Use of routine data for performance review and evidence based decision making (max 6)	58%	82%	3.29	12.91	0.01
Health facilities that prepare data visuals (average data visualization score)	71%	95%	7.76	21.35	0.01
Use of routine data for RHIS quality improvement (max 5)	53%	80%	3.54	15.41	0.01
Average score of data quality control (max 6)	74%	94%	5.5	13.5	0.01

Our study showed that the intervention improves the health workers' knowledge and competency, as well as the organizational culture of evidence based decision making practices (fig. 1).

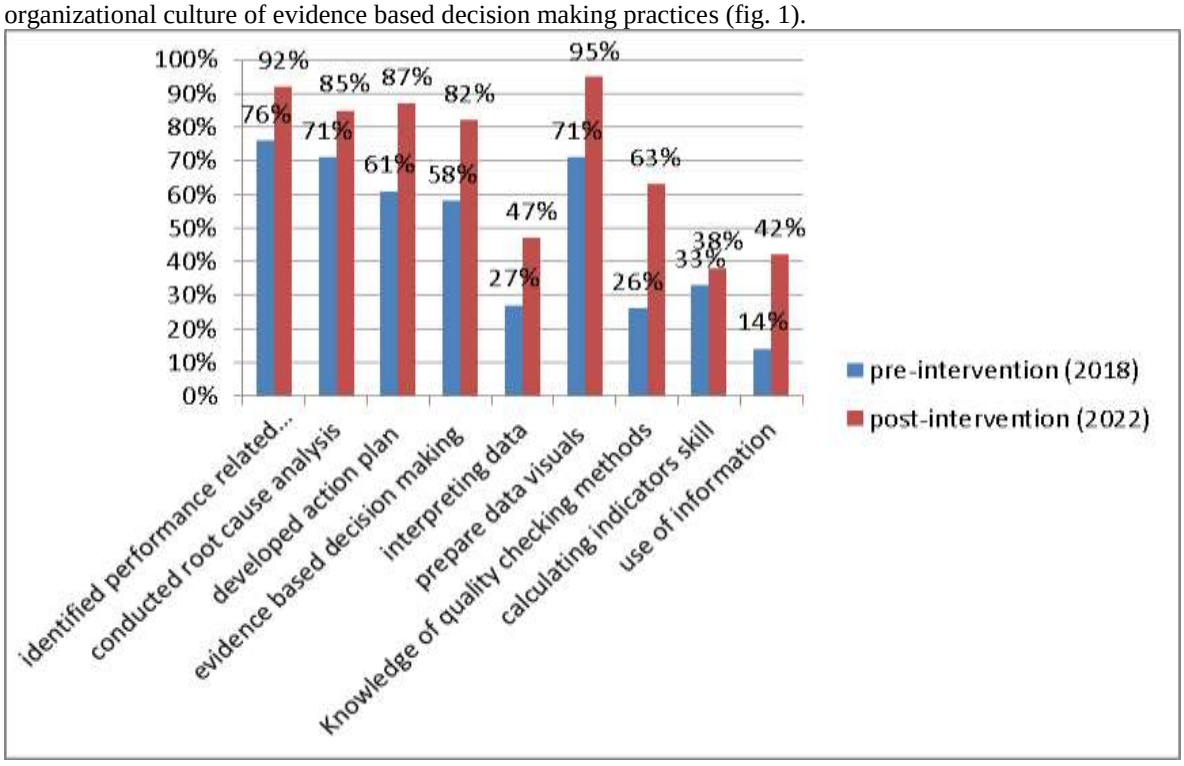

Fig. 1: **comparison of health workers' knowledge, skill and practice of HIS before and after tailored Health Information System intervention in Ethiopia, 2024.**

Discussion

Our study showed that health professional's knowledge, competence to perform HIS tasks; problem solving, and data use skills significantly improved after the intervention. These finding are supported by a scoping review (14). Similarly, the intervention enhanced the HIS processes, problem solving, and data use practices. The results were congruent with a scoping review done in LMICs (15) and studies conducted in Ethiopia (16, 17).

This study also demonstrated that the intervention improves the healthcare providers' skill in conducting data quality verifications, such as Lot Quality Assurance (LQAs), and in data visualization. There is a direct relationship between data quality and its utilization; improving data quality enhances its utility for decision making. Ensuring quality data in health facilities relies on health workers' practices and their understanding of the methods for conducting data quality checks and reviews on regular basis. However, In the Ethiopian healthcare system ensuring the quality of data and generating evidence based information for decision-making have often been neglected, leaving these responsibilities to a segment of the health care work force (HITs). Little attention has been given to

information revolution and evidence based decision-making in previous decades (18). The findings are supported by a quasi-experimental study conducted in the Amhara region (19) and a systematic review on the effectiveness of CBMP interventions (20). Additionally, the regular assessments conducted as part of the CBMP provided further opportunities to improve and ensuring data quality.

Our study also revealed that the actual practices of healthcare providers in identifying performance related problems, conducting root cause analysis, and developing action plans for identified gaps were increased significantly after the intervention. Thus the interventions included practical trainings and mentorship activities; which evidently enhanced healthcare providers in HMIS activities. The finding is also supported by a systematic review done in Ethiopia (18).

Moreover, our study showed that the intervention improved the utilization of routine data for performance reviews and evidence based decision making. Both the availability of data quality control mechanisms and the use of routine data for RHIS quality improvement increased after the intervention. These finding are corroborated by studies done in Ethiopia (21) and the five Sub-Saharan African countries (22). Thus, mentorship is a crucial step towards ensuring high-quality data and effective use of information (21).

Conclusion and recommendations

The capacity building interventions done by the DUP and CBMP significantly improved health professional's knowledge, competence to perform HIS tasks, and problem solving and data use skills. These interventions also enables healthcare providers to demonstrate their understanding of HIS rationale, conduct data quality verifications, visualize and interpret data, identify problems and solve issues and make informed decision. Therefore, supportive supervision, mentorship and onsite coaching are essential to improve data quality, fostering an organizational culture of information use, and facilitating evidence based decision-making.

Limitations

Since the study did not include comparative group and did not assess the difference of participants' knowledge, skill and practice on HIS at pre-intervention stage, the findings may not be solely attributable only to our intervention. Additionally, this is a descriptive study, making it is difficult to generalize the findings to other facilities and healthcare providers.

Reference

1. Nyamtema, A.S., *Bridging the gaps in the Health Management Information System in the context of a changing health sector.* BMC medical informatics and decision making, 2010. 10: p. 1-6.
2. World Health Organization, *Strategic plan for strengthening health systems in the WHO Western Pacific Region.* 2008.
3. Nicol, E., et al., *Human factors affecting the quality of routinely collected data in South Africa*, in *MEDINFO 2013*. 2013, IOS press. p. 788-792.
4. Mate, K.S., et al., *Challenges for routine health system data management in a large public programme to prevent mother-to-child HIV transmission in South Africa.* PloS one, 2009. 4(5): p. e5483.
5. Lau, F., et al., *"A review on systematic reviews of health information system studies." Journal of the American Medical Informatics Association 17.6 (2010): 637-645,*.
6. Chanyalew, M.A., et al., *The Effectiveness of the Capacity Building and Mentorship Program in Improving Evidence-Based Decision-making in the Amhara Region, Northwest Ethiopia: Difference-in-Differences Study*. JMIR Medical Informatics, 2022. 10(4): p. e30518.
7. Dondorp, A.M., S.S. Iyer, and M.J. Schultz, *Critical care in resource-restricted settings.* Jama, 2016. 315(8): p. 753-754.
8. Biru, A., et al., *Pathways to improve health information systems in Ethiopia: current maturity status and implications.* Health Research Policy and Systems, 2022. 20(1): p. 78.
9. FMOH, F., *Health Sector Transformation Plan (HSTP 2016-2020).* Addis Ababa, Ethiopia.[Google Scholar], 2015.
10. Ministry of Health Ethiopia, *Ethiopia Ministry of Health. Information Revolution,* . 2016.
11. JSI. *Ethiopia Data Use Partnership,*. May 21, 2024,]; Available from: https://www.jsi.com/project/ethiopia-data-use-partnership/.
12. Hotchkiss, D.R., et al., *Evaluation of the performance of routine information system management (PRISM) framework: evidence from Uganda*. BMC health services research, 2010. 10: p. 1-17.
13. Thaer, E. and M.G. Alrubaey, *Organizational and behavioral determinants of health information system performance in Iraq.* Al-Kindy College Medical Journal, 2015. 11(1): p. 36-39.
14. Lemma, S., et al., *Improving quality and use of routine health information system data in low-and middle-income countries: a scoping review*. PloS one, 2020. 15(10): p. e0239683.
15. Nicol, E., E. Turawa, and G. Bonsu, *Pre-and in-service training of health care workers on immunization data management in LMICs: a scoping review*. Human resources for health, 2019. 17: p. 1-14.
16. Tilahun, B., et al., *Strengthening the national health information system through a capacity-building and mentorship partnership (CBMP) programme: a health system and university partnership initiative in Ethiopia.* Health

Research Policy and Systems, 2021. 19: p. 1-11.
17. Tilahun, B., et al., *Improving Data Use at Facility level doesn't need fancy interventions: Capacity Building, Mentoring and Recognition can take us miles.* Ethiopian Journal of Health Development, 2023. 37(1).
18. Mekonnen, B.D. and S.B. Gebeyehu, *Routine health information utilization and associated factors among health care workers in Ethiopia: a systematic review and meta-analysis.* Plos one, 2021. 16(7): p. e0254230.
19. Alemu, M.B., et al., *Outcome evaluation of capacity building and mentorship partnership (CBMP) program on data quality in the public health facilities of Amhara National Regional State, Ethiopia: a quasi-experimental evaluation.* BMC Health Services Research, 2021. 21: p. 1-13.
20. DeCorby-Watson, K., et al., *Effectiveness of capacity building interventions relevant to public health practice: a systematic review.* BMC Public health, 2018. 18: p. 1-15.
21. Belay, H., et al., *Improving Data Quality and Information Use through Capacity Building and Mentorship Program in Ethiopia: Best Practices and Lessons Learned.* 2024.
22. Manzi, A., et al., *Mentorship and coaching to support strengthening healthcare systems: lessons learned across the five Population Health Implementation and Training partnership projects in sub-Saharan Africa.* BMC health services research, 2017. 17: p. 5-16.