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# Implementation of Human Development Model Impact on Data Quality and Information Use in Addis Ababa, Ethiopia

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## Abstracts

**Background:** Designing of human development model is a crucial role towards addressing data quality and information use at service delivery point and administrative level. A human development model is implemented through capacity building approach of competence-based training, mentorship, supportive supervision, experience sharing, and quality improvement initiative. This study aimed to synthesize the level and significance of a change in Routine health information systems (RHIS) structure, input data quality and information use because of human development model implementation.

**Methods:** A quasi-experimental study design was employed to assess the impact of the human development model on RHIS structure and implementation, data quality, and administrative data use in Addis Ababa city administration. A total of 31 health centers, three sub-cities, and three hospitals and 954 health workers from respective health facilities and administrative levels were included in this study. Standard Performance of Routine Information System Management data quality and information use assessment tool was used to evaluate the contribution of the model. The data analysis covers the period between 2018 and 2020, 2018 was the base year and 2020 is the end period. The difference in difference data analysis technique was used to capture any change between the two periods and to investigate significant differences in HIS structure and implementation, data quality, and information use at administrative and service delivery points.

**Result:** A total of 954 health workers were trained. The mean difference between pre- and post-training evaluation results was 9.3 with 95% (CI of 3.8-14.6, p-value, <0.001). Substantial changes were documented in the last mentorship session in data quality and information use. Data quality and information use was 96.4 with (95% CI, 94.4-98.4, SD, 5.6) and 80.6 with (95% CI, 76.8-84.4, SD, 10.5) respectively at service delivery point. The mean difference before and after implementation of the human development model for data quality and data use was 40.7 with (95% CI, 36.6-44.8, p-value, <0.0001) and 19.7 with (95% CI, 15.6-23.8, p-value, <0.0001), at health facilities level, respectively. The mean score of data quality and information use after implementation of the human development model was 93.0% and 85.0% at the sub-cities level, respectively.

**Conclusion:** The implementation of the human development model was very timely approach to ensure data quality and information use at all levels. Use of competence-based training, practical application with proper follow-up of application of knowledge and skills gained to real-life activities also contributed to the improvement of data quality and information use. [*Ethiop. J. Health Dev.* 2021; 35(SI-1):50-58]

**Keywords:** Human development model, Data quality, information use, capacity-building, mentorship

## Background

Health Information System (HIS) is a system that integrates data collection, management, processing, reporting, and use of information for decision making to improve health service effectiveness and efficiency (1). In the early days, efforts to restructuring HIS to systematically collect, analyze, and report data for improved management in developing countries were undertaken by national program managers of vertically structured programs (2). In recent years, however, HIS in developing countries, including Ethiopia, have gained more and more attention as more effort is made by different stakeholders to reverse disease trends in these countries (1).

The Ethiopia Ministry of Health (MoH) has made a major reform of the Health Management Information System (HMIS) and Monitoring and Evaluation

(M&E) system following the principles of the Business Process Reengineering (BPR) (3.)

Health Information Revolution (HIR) is one of the four transformation agendas in the current Health Sector Transformation Plan (HSTP) (4). It refers to a radical shift in the methods and practice of collecting, analyzing, presenting, and disseminating information for decision-making. The HIR is designed with two core

pillars, which are transforming and advancing the health sector information system through cultural changes on health information systems, digitalization, and scale-up of information systems (5).

The HIR aims at bringing fundamental change in data quality and information use culture. This shows that ensuring data quality, appropriate management, analysis, and meaningful interpretation, and cultivating information use culture at all levels remains a challenge in the health system of Ethiopia (5-6).

Studies revealed that poor data quality and low information use are continued challenges (6-9). Besides data generated at different health system tiers are very often shallow, incomplete, and lack analytic perspective due to several issues related to information use. Routine Data Quality Assessment (RDQA) findings showed that the overall system performance (M&E structure and overall capability, availability of recording and reporting guideline and tools, data management and analysis, and link with national data reporting system) was found to be partially complete at all levels (10). There is still considerable skill gap for preliminary and further data analysis, data triangulation, appropriate interpretation and use of information generated from rigorous data processing platforms for decision-making purposes. Existing capacity-building mechanisms are

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not practically – oriented and problem-solving. Poor mentorship and lack of timely feedback on the outcome of supportive supervision are widespread. Moreover, lack of timely exchange of manuals and guidelines due to poor communication between the health system tier and weak M&E system on data quality checking mechanisms and information use are common. Designing of human development model is thus a crucial step towards addressing these gaps as identified in a baseline assessment conducted in 2018. The model is planned to enhance knowledge, practice, and efficiency of health human resources to generate quality data and use the data appropriately through the provision of continuous capacity building activities by integrating and harmonizing existing practice of health information system.

The Human development model was implemented through capacity building approach of competence-based training, mentorship, supportive supervisions, experience sharing, and quality improvement initiative

in collaboration with regional health bureau and sub-city health department and respective health facilities. Capacity building through training and mentorships is often run focusing on theoretical aspect with limited practical application to improve data quality and information use. However, contribution of capacity building using action-oriented practical approach in routine health information system (RHIS) not yet implemented in developing countries, including Ethiopia. This study aimed to synthesize the level and significance of a change in RHIS structure and input data quality and information use as a result of human development model implementation. This model provides a strategic approach, which was tested and can be used by different stakeholders to improve data quality and information use.

In this model, thus an attempt is made to provide strategic approach to the human capacity development program, which can be adopted by the MoH or stakeholder for future human resources development.

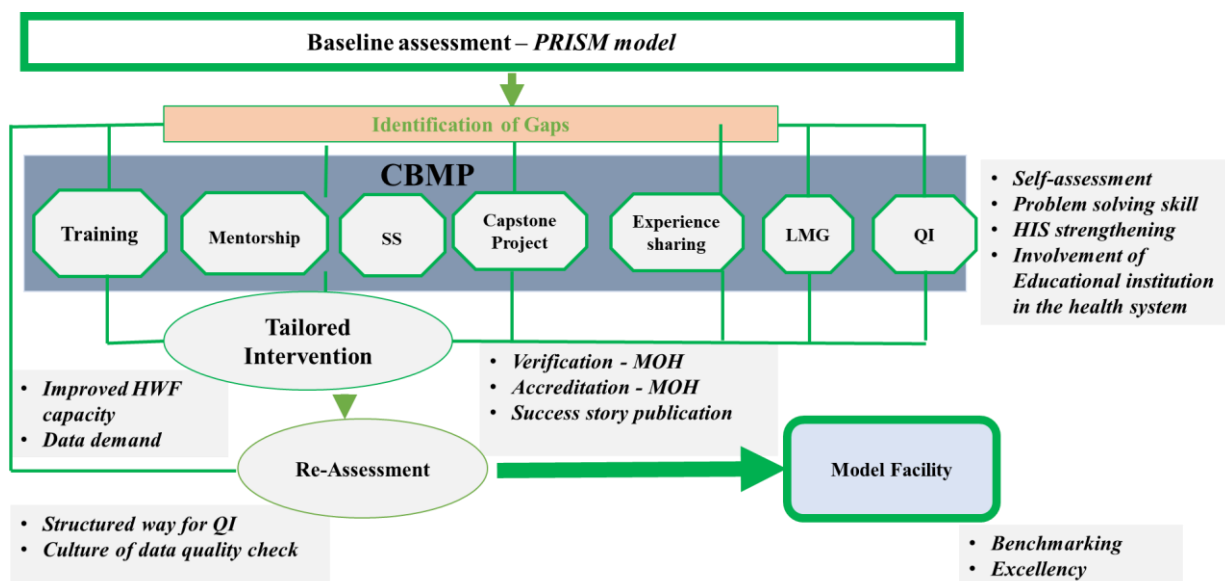


Figure 1. Human development model implementation approaches

## Method and materials

### Study area and period

The Human development model was implemented in three selected sub-cities (Akaki Kaliti Yeka and Lideta) in Addis Ababa City Administration. There are a total of 31 public health centres, three sub-cities health offices, one general hospital, one referral hospital, and one specialized hospital in the sub-cities. Currently, there are 3,965 health workers and 2,545 support staff serving at all levels. The model implementation was carried out from July 07, 2018, to July 07, 2020.

### Study design.

A quasi-experimental study design was employed using mixed quantitative and qualitative approaches to assess the impact of the human development model in RHIS structure and implementation, data quality, and administrative data use in Addis Ababa city administration.

### Study population

**Source population:** the source population was all sub-cities and public health facilities in Addis Ababa cities administration.

**Study population:** All health frontline health workers, sub-city and health facilities staff and management, including card room workers and HMIS focal were included from three sub-cities and 34 health facilities supported by capacity building and Mentorship project (CBMP) in Addis Ababa city administration.

### Study Variables

**Dependent:** data quality and information use

**Independent:** data quality and administrative data use.

**Independent:** availability of functional HMIS unit, availability of recording and reporting tools and guideline, RHIS data management process, information flow, data accuracy, completeness, timeliness, the functionality of Performance monitoring team (PMT), support supervision and training including trainee socio-demographic background and position, pre- and post-training result, type of institution,

**Operational definition and its measurements** *HIS input and structure*: thirteen questions of five dimensions with a total of thirty composite scores were identified and pulled together to measure HIS input and structure.

**Data quality**: Data quality was computed using an overall of thirty questions which have three data quality dimensions. These dimensions are data accuracy, completeness, and timeliness, each accounting for 10, 12, and 8 maximum scores, respectively.

**Information use**: refers to the actual behavior of an institution that is reflected in a regular practice of using existing information for decision making. The presence and functioning of the performance management team as per the standard, review of key performance indicator and gaps analysis, root cause identification, plan preparation and implantation, presence of displayed table and chart, PMT minutes, and reports were used to measure information use. A total of four composite scores used to categorize information use

### Sampling and sampling procedure

Of ten sub-cities in the city administration, three sub-cities (Yeka Akaki and Lideta) were selected using purposive sampling techniques. The Human development model was being implemented in 31 health centers, three hospitals (one comprehensive specialized, one referral, and one general) hospitals in the selected sub-cities. All Health centers and hospitals from three project targeted sub-cities were included in this study. Then, 954 health workers, who attended basic data quality and information use training and took pre- and post-training tests were included from respective institutions.

### Data collection procedure and instrument

A mix of quantitative and qualitative data collection methods was used to assess the contribution of the human development model on the RHIS structure, effectiveness and input, data quality, and information use. The quantitative data was collected using standard structured questionnaire adapted from PRISM data quality and information use assessment tool through interviewer-administered to evaluate the contribution of the model (11). This tool consists of three components: RHIS structure and implementation, data quality, and information use. In-depth semi-structured interviews were conducted with key informants to explore the contribution of the human development model. Mentorship checklist developed and used to review all relevant document availability; functionality of the PMT; pre- and post-training result; availability of resources, including compliance to standard and implementation consistency; and utilization of administrative information. For the qualitative data, an interview guide was used, and an in-depth interview was conducted with key informants to assess the availability of resources, compliance to the standard, and utilization of administrative information mainly focusing on the relevance, effectiveness, and impact of the model on data quality and information use during and after capacity building activities. Eighteen HIS mentors

were recruited and assigned as data collators, two each per institution.

### Data management and Analysis

The quantitative data were entered, cleaned, and coded and checked for missing values, outliers, and inconsistencies using STATA version 14. To ensure data quality, data collectors were trained, a pre-test was carried out at a health center with a similar setting to the study health facilities and filled-in forms were checked for completeness and accuracy and corrected accordingly. The data analysis covers the period between 2018 and 2020, 2018 was the base year and 2020 is the end period against which all indicators should be measured, quantified, and compared. The difference in difference model technique is used to capture any change between the two periods and to assess the change in HIS structure and implementation, data quality, and information use at administrative and service delivery points.

In general, the reflexive technique follows the following procedure. Differences in difference analysis were used to assess the effect of the model. Let  $I_{t_{2018}}$  is the value of indicator 'I' in 2018;  $I_{t_{2020}}$  is the value of indicator 'I' in 2020 and  $I_{nt}$  is the project impact (or the differences between the value of indicator 'I' in 2018 and 2020). Given the indicators, RHIS structure and input, data quality (accuracy, completeness, and timeliness), and information use practice using a mathematical (functional) formula of  $I_{nt} = I_{t_{2018}} - I_{t_{2020}}$  and T-test statistics was used to assess the significance of mean difference before and after implementation of the model. Overall, all RHIS structure, data quality, and information use were determined using composite analysis. Qualitative data obtained from field notebooks and recoded were transcribed, and coded, grouped to emerging themes. Then data analyses were carried out using emerging themes, what was used to supplement quantitative data analysis.

Ethical clearance was obtained from the Institutional Review Board of the College of Health Sciences of Addis Ababa University. No information obtained from the medical records was disclosed to any third person. This study did not inflict harm on or expose any study participant to unnecessary risk because of reviewing institution records.

## Results

### Training

A total of 954 health workers were trained (Table 1). Of these, 512(54%) were female. The majority, 629(66%), were trained on basic HIS, data quality, information use, revised HMIS and DHIS2; 128(13%) were trained on how to provide mentorship; and 78(8%) were trained on how to design and conduct capstone project, operational and implementation research. Regarding affiliation of trainees, 473(50%) were from health centers, 239(25%) from hospitals, 185(19%) from sub-cities and 57(6%) from the regional health bureau or Addis Ababa University. A total of 400(42%) trainees were clinicians, 239(21%) M&E officers from the administrative level, 169(18%) HMIS officers from the

service delivery point and 68(7%) were card room workers from the center's registry or card room.

The mean pre-test score of knowledge on data quality and information use was 63.9 with a 95% CI of 58.9-

68.9 with + 14.2. While mean Post-test score was 73.2 with a 95% CI of 68.1-78.3 with + 14.1. The mean difference between pre- and post-training evaluation results was 9.3 with 95% (CI of 3.8-14.6, p-value, <0.001).

**Table 1: Trainee profile and type of training provided service delivery and administrative level, Addis Ababa, 2020**

	Variable	Number	Percent
Sex	Female	512	54%
	Male	442	46%
Type of training	Basic HIS, Data quality, information use, revised HMIS and DHIS2	629	66%
	HRIS, Database management system	53	6%
	Mentorship	128	13%
	Capstone project, operational & implementation research	78	8%
	NCOD & HMIS Registry usage	41	4%
	Quality Improvement training	28	3%
	Working Position	Card room worker	68
Clinician		400	42%
Core process lead/head		117	12%
Facilities HMIS Officer		169	18%
M&E officer		200	21%
Type of organization	AARHB/AAU	57	6%
	Sub City	185	19%
	Health Center	473	50%
	Hospital	239	25%

Trainees were asked to provide their feedback on relevance, content, and methods of the last training session as well as give their views of the training. Accordingly, almost all respondents mentioned that the training was remarkably interesting and relevant. They emphasized that the practical examples and experience sharing sessions enabled them on how to use routine data for day-to-day activities. A card room worker said *“this training is special for me, I enjoyed it. Previously no one recognized our job and provided this kind of training for us. We used to carry out our day-to-day activities in the traditional mindset. I can now see how much I can contribute to the quality of care. I will be profoundly serious when recoding patient's/client information”*.

A trainee from Hospital stated that the training helped them to get new experience and came with a big responsibility to link data quality with quality improvement initiative: *“I learn how my performance depends on data quality that is collected from different sources. This training makes us responsible for the problems taking place in this regard and encouraged us to be part of the solution. Frankly speaking, I am motivated to change data quality and information use culture in my hospital in collaboration with the units and staff members.”*

A health worker from the health center stated that *“I have participated in different pieces of trainings, but this training is indeed incredibly special to me. It not only*

*shows me the gaps but also how to sort out the data quality problem encountered in my day-to-day activities and link it with the quality of the services. We learn that an error occurred in one unit affect the whole services in the facility”*.

Most participants stated that they are excited by the “history-telling” teaching approach, which helps them to link their day-to-day activities with data quality and information use. In this regard, one of the trainees stated that *“I learned new ways of promoting data quality and information use in my organization; I learned how data quality can impact on the quality of health care and overall performance of the organization”*?

#### **Mentorship and coaching**

All Public health centers, hospitals, and sub-cities received mentorships and coaching ten times during the project. In the first round of mentorship, several gaps were identified in all service delivery points and administrative levels in RHIS structure and input, data quality, and information use. Accordingly, consecutive mentorship and coaching were provided to respective staff at each level. Besides, the mentorship interface was designed, and an agreement signed with mentors at different institutional levels. Consultative Workshops and training were provided on mentorship findings to address gaps that were identified in each mentorship forum in the presence of all stakeholders. After the review is conducted and gaps identified, holistic support was provided based on the existing situations.

Accordingly identified gaps were addressed at all service delivery points. As indicated in the Table 2, substantial changes were documented in the last mentorship session in RHIS structure and inputs, data quality, and information use culture. However, lack of

adequate shelf and space in the card room, lack of functioning master patient index, and lack of allocated budget in the year for the implementation of HIS continued to be a problem and observed gaps unsolved in almost all health facilities.

**Table 2: 1st and 5th mentorship activities, observed gaps in HIS input, data quality and information use and improvements at Public Health Facilities (Health Center and Hospitals) in three Sub-cities of Addis Ababa Health Bureau, 2020**

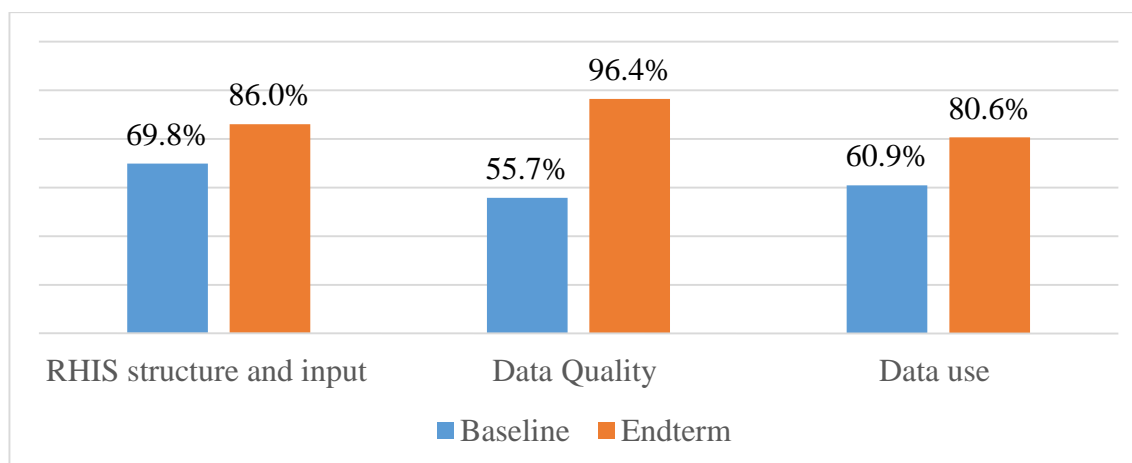
1 <sup>st</sup> round mentorship identified gaps (July 2019)	5 <sup>th</sup> round mentorship (June 2020)	
	Changes observed	Unchanged gaps
<ul style="list-style-type: none"> <li>✓ Shortage of HMIS focal person</li> <li>✓ MPI Box was not functional.</li> <li>✓ Shortage of recording and reporting tools</li> <li>✓ Lack of HIS capacity needs assessment</li> <li>✓ The budget was not fully allocated for HIS</li> <li>✓ Manuals of HIS were not in place</li> <li>✓ Not using Register and tally sheet properly</li> <li>✓ Summary sheets were not filled in properly</li> <li>✓ Lack of Ambulance and emergency register</li> <li>✓ Limited functionality of HealthNet</li> <li>✓ Poor culture of data quality assurance</li> <li>✓ Data incompleteness and inconsistency</li> <li>✓ No adequate shelf and space at MRU</li> <li>✓ The poor patient card culling process</li> <li>✓ Limited understanding of data elements</li> <li>✓ Low level of data use culture</li> <li>✓ PMT does not track key indicators</li> <li>✓ PMT Action plan not shared for case team</li> <li>✓ Root causes were not analyzed by the PMT</li> <li>✓ Poor information dissemination practice</li> <li>✓ A gap in HMIS data analysis and presenting</li> </ul>	<ul style="list-style-type: none"> <li>✓ Manuals of HIS were in place.</li> <li>✓ HIS capacity gap need assessment was done</li> <li>✓ Register and Patient Client attendance tally sheet properly used</li> <li>✓ Health Net become Functional</li> <li>✓ Data quality assurance at the facility level (LQAS) done for both service and OPD</li> <li>✓ RDQA performed quarterly</li> <li>✓ PMT convening every month</li> <li>✓ The PMT started tracking key quality and equity indicators</li> <li>✓ Action plan shared for case team</li> <li>✓ Root causes were analyzed by the PMT</li> <li>✓ Understanding of the data elements of the registry was improved</li> <li>✓ Level of data use culture improved by improving PMT functionality</li> <li>✓ data analysis and presentation were improved</li> <li>✓ Healthcare information dissemination practices were improved</li> </ul>	<ul style="list-style-type: none"> <li>✓ HIS related workforce not fulfilled</li> <li>✓ MPI Box was not functional</li> <li>✓ No budget was allocated for the implementation of HIS</li> <li>✓ Most of the patient folder summary sheets were not filled properly</li> <li>✓ No adequate shelf and space at MRU</li> <li>✓ Some hospitals PMT were not functional based on the standard</li> <li>✓ Low data use culture</li> </ul>

**Routine Health Information structure and input, data quality and data use at health facilities level,**

**RHIS Structure and Input**

At the baseline, the mean score for RHIS structure and input was 69.8% with (95% CI, 61.6-78.0, SD, 23.2), 55.7 with (95% CI, 46.5-64.9, SD, 25.9) for data quality, and 60.9 with (95 % CI, 51.5-70.3, SD, 26.4) for data

use at health facilities (Figure 2). After the implementation of the human development model through CBMP, the mean score improved to 86.0% with (95% CI, 82.7-89.2, SD, 9.1) for RHIS structure and input, to 96.4 with (95% CI, 94.4-98.4, SD, 5.6) for data quality and to 80.6 with (95 % CI,76.8-84.4, SD,10.5) for data uses at health facilities. (Figure 2)



**Figure 2. RHIS structure and input, data quality and use at baseline and end-term at health facilities in Addis Ababa city administration, 2020.**

The mean differences before and after implementation of the human development model for RHIS structure and input, data quality, and data use were 16.2 with (95% CI, 11.8-20.5, p-value, <0.0001), 40.7 with (95%

CI, 36.6-44.8, p-value, <0.0001) and 19.7 with (95% CI, 15.6-23.8, p-value, <0.0001), at health facilities level respectively (Table 3).

**Table 3: The mean difference before and after human development model implementation at service delivery level, 2020**

The mean difference at the health facility level		95% Confidence Interval		P-value
		Lower	Upper	
RHIS structure and input	16.2%	11.8%	20.5%	<0.0001
Data Quality	40.7%	36.6%	44.8%	<0.0001
Data use	19.7%	15.6%	23.8%	<0.0001

#### **RHIS and input, data quality, and data use at health administrative level**

The mean scores of RHIS structure and input, data quality and information use at sub-cities level were 76.0 (95% CI, 66.5-85.5.2, SD=17.1), 71.1(95%CI, 68.7-73.5 SD, 4.3),79.2(77.4-80.9, SD,3.2), respectively (Table 4). The mean score after implementation of human development model was 82.2 (95% CI, 78.3-

86.2, SD=7.1), for RHIS structure and input and 85.0 (95% CI, 81.0-89.1 SD=7.3) for data use at sub-cities level. The mean differences at sub-cities level were 6.2 (95% CI, -0.7-13.2, p-value, <0.075), 22.2 (95% CI, 19.9-24.6, p-value, <0.000) and 5.8 (95% CI, 2.9-8.8, p-value, <0.001) for RHIS structure and input, data quality and data use, respectively.

**Table 4: The mean difference before and after human development model implementation at the administrative level, 2020**

The mean difference at the sub-cities level		95% Confidence Interval		P-value
		Lower	Upper	
RHIS structure and input	6.2%	-0.7%	13.2%	0.075
Data Quality	22.2%	19.9%	24.6%	0.000
Data use	5.8%	2.9%	8.8%	0.001

#### **Discussion**

Strong health information is one of the building blocks of the health system. The human development model in a health information system is designed and implemented to improve data quality and information use culture at all levels. The contributions of human development model implementation on data quality and information use were assessed. We measured data quality and information use status before and after the implementation of the human development model at health facilities and different administrative levels. We observed that there was a significant change in data quality and information use at all levels. Improving health workers' knowledge and attitude will strengthen the effectiveness and quality of care through improving routine health data quality and information use.

This human development model implementation assessment has demonstrated that several less resource-intensive initiatives can play a crucial role in positively influencing the health information systems. The implementation of the model created the unique opportunity to educated over 954 frontline health workers on HIS, data quality, information use, mentorship, usage of DHIS2, development of capstone project, and operational and implementation research. Studies from different settings have shown that lack of awareness and shortage of trained human resources are a considerable challenge for maintaining data quality within health information systems. The human capacity development model developed and implemented through the CBMP and respective health offices at different levels appeared to be an initiative with

considerable influence on the RHIS, PMT, and the behavior of individual division heads and officers.

In the past four years, the MoH was engaged in strategic planning activity to improve the Ethiopian primary health care system such that high quality, equitable, sustainable, adaptive, and efficient health services in the long-term are ensured to meet the health needs of the growing population both in magnitude and profile. But the problems are complex, interrelated, and have different faces. The human capacity development model applied within this framework has attempted and come up with exciting results, although it cannot solve all the problems overnight (12-13).

The capacity-building activities were provided to a range of audiences together so that they share their experience, challenges faced, and feelings on data quality and information use, which create conducive environment for team learning. This approach also motivates and enables support staff, particularly card room staff, to develop confidence in carrying out their activities. Shortage of trained human resources is a critical gap that was identified during baseline and situational assessment to ensure RHIS structure, input, data quality, and information use culture at all levels. Our innovative designed model enabled us to address most of the challenges and gaps identified towards capacity building initiative. The new approaches also provided an opportunity to trainee frontline health workers and support staff, who are responsible for patient records or client data. The multidisciplinary training approach has high value towards knowledge

transfer and suitability of HIS capacities. The training is out of the ordinary, hands-on approach, practical oriented, and supported with post-follow up. Since it was designed after evaluation of the existing system and identification of gaps, implementation of the model is targeted and designed in such a way that most of the problems encountered in the HIS are solved. The feedback analysis in the model implementation revealed that there is a potential change in health worker behaviors to apply knowledge and skill gained in their day-to-day activities.

We found that the implementation of the human development model appears to be a potential intervention to impact behavior in a positive way on data quality and information use culture. We also found that the mean difference of trainee knowledge on data quality and information use showed significant improvement after implementation of the human development model. This was since training was competency-based, focusing on building knowledge and skills in data quality, information use through problem-solving, history telling, practice-oriented, and participatory. It was clear that storytelling and mindset approaches played a crucial role in changing a trainee's view towards data quality and information use. We have not been able to find a similar approach to compare with our findings at least within the sphere of literature we managed to access.

Overall routine information use was 80.6% after implementation of the human development model. This was higher than the findings of studies from different parts of the country: 41.7% in Addis Ababa (14), 57.9% in Oromia (15), 41.1%-62.7% in South Ethiopia (16-17), and 38.4-78.5% in Amhara(18-19). Similarly, the overall data quality by far higher than the national target of 90%(20). This was higher than findings from many developing countries that the data quality falls between 34-72% (21). The result was also higher than the finding of a study that reported 75.3% level of data quality from Eastern Ethiopia (22). Despite the variation in the practice of routine health information utilization and data quality among regions, training supportive supervision was found to be associated with information use and data quality.

This is finding concurred with other study that reported competency-based training played crucial role towards improving knowledge of trainee (23). Insisting a group discussion among trainees and, use practice approach as springboard opportunities to improve understanding and skill of trainee on data quality and information use including interpretation routine health data. The UNDP document states that countries, specifically developing ones, should, design implement and sustain the process of developing human capacity in such a way that it suits existing condition, because challenges in one country may differ from the other (24). This helps focus on empowering and strengthening the system using indigenous capabilities.

The baseline assessment revealed that the availability of basic RHIS structure and input, data quality, and

information use culture to be a major challenge at all levels. However, after the implementation of the human development model, RHIS structure and input showed a significant increase at health facilities in the sub-cities studied. Continued mentorship involving all actors of HIS during the implementation of the human development model is believed to have created a good opportunity to avail required inputs to strengthen RHIS structure and input at the service delivery point and administrative level. Study findings from Botswana showed that on-the-job training and mentoring were effective approach to improve RHIS structure and input particularly towards strengthening M&E capacity to ensure data quality (23). Continues mentorship is found to have a positive correlation between mentorship and availability of RHIS structure and inputs. The proportion of improvement on the RHIS structure and input was found to be higher at the service delivery point compared to the administrative level. This could be explained by the fact that RHIS structure and input were higher at baseline at the administrative level.

The WHO developed a "Human Capacity-Building Plan" for countries to follow. They proposed that this plan will help WHO and partners, to assist countries to develop and sustain the workforce necessary to achieve goals set by the organization. In this work, the human capacity was developed, outcome assessed and rated satisfactory as discussed earlier. However, sustaining the workforce was indirectly tackled; if officers are trained, a conducive environment created for them, regularly supported, mentored, and supervised, they would like to stay where they are in relative terms. We, therefore, believe that the WHO motto has succeeded in our capacity development plan.

Consequently, after the implementation of the human development model in the local thinking and setup, the overall data quality and information use showed significant change at the sub-cities and health facilities level. Use of competence-based training, practical application with proper follow-up of application of knowledge and skills gained to real-life activities may contribute to the improvement of data quality and information use.

The implementation of the human development model was very timely approach to ensure data quality and information use at all levels. The overall mean difference was higher on data quality followed by administrative data use. In the first-round mentorship, several gaps were identified in RHIS structure, data quality, and information use at all service delivery points and administrative levels. The consecutive mentorship and coaching together with competence-based training may contribute to a significant improvement. We found that there were substantial changes documented in data quality and information use culture. To some extent implementation of the human development model has succeeded in improving card room space and allocation of budget to strengthen HIS. The fact that re-innovation of card room and allocation of budget, to some extent, is resource intensive; they require the involvement of higher officials.



This study is the first study that implemented and assessed the effectiveness of a human development model in health information systems using various techniques in the country. The model uses practical approaches such as storytelling, mindset, and action-oriented training and mentorship through the involvement of all health actors such as frontline clinical service providers, unit and department heads, facility, and sub-city management, HMIS focal persons, and card room workers. The fact that the model was implemented in the urban setting where accessibility of infrastructure and resources is fair, applying the intervention activities to a rural setting with low access may require further adaptation. This study used a quasi-experimental design, which has limitation to establish causal relations between intervention and outcome.

### Conclusion and recommendations

The implementation of the model created a good opportunity to educate many health workers through applying practical approaches of storytelling, mindset up, and action-oriented training and mentorship. The model contributed to the improvement of health workers' knowledge and attitude on data quality and information use. The health information system inputs and structure, data quality, and information use showed significant improvement after the implementation of the human development model. These findings are an indication of the need for more efforts to improve health workers' attitude and knowledge on data quality and information use.

### Conflict of Interest Statement

The authors declare no competing interests.

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### Author Contributions

WAEP, GT, TH, designed the study, performed analysis, interpreted the results, wrote the manuscript, and approved the final version.

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