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# Exploring the Information and ICT Skills of Health Professionals in Low- and Middle-Income Countries

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**Abstract.** Information is at the heart of healthcare because all stakeholders need fit-for-purpose information to make decisions. However, producing and utilizing information in the data-intensive and ever-changing health environment requires various skills. In the particular context of low- and middle-income countries, this study, consisting of a scoping review and a qualitative case study, explores the information and ICT skills of health professionals. Our review identifies challenges in several areas of health professionals' skills, including computer skills; skills required for using the routine health information system; data security skills; and data management and analysis skills. Our South African case study, based on interviews, adds a more nuanced understanding of the different types of training needs. This assessment shows that training and education aimed at improving the ICT and information skills of health professionals have to be versatile and cater to different groups with varying needs.

**Keywords.** ICT skills of health professionals · low- and middle-income countries · scoping review · South Africa · case study · training needs

## 1 Introduction

Health professionals in low- and middle-income countries (LMIC) in the 21st century are facing new challenges as a result of the increased need to be able to collect, capture, report and use data alongside the care delivery duties. Besides clinical skills, an ability to understand and analyze data and, increasingly, digital literacy and Information and Communication Technology (ICT) skills are in high demand. The significance of information in healthcare is by now well recognized in public and global health. For instance, the World Health Organization's (WHO) framework for strengthening health systems identifies six building blocks of a health system [1]. "Health information" is one of the building blocks, but "production, analysis, dissemination and use of reliable and timely information" also informs decision-making in each of the other building blocks, namely, health workforce; health

services; health financing; governance and leadership; and medical products, vaccines and technologies [1, 2]. In other words, high-quality data is essential in health care because it is required basically at every corner of the health system from the clinical decision making in the case of individual patients to the monitoring and evaluating (M&E) of health programs, surveillance of diseases, planning of services and resources, informing policy-making, for global reporting purposes and ultimately, improving population health [3].

In the LMIC context, it is usually the doctors and nurses that are the source of such data, since they are often responsible for collecting and recording it [4]. Unfortunately, research suggests that in the developing world well-trained health professionals are unevenly distributed as well as insufficient in aggregate numbers, and there are serious challenges in their information and ICT skills [5]. This is no wonder, since even in high-income settings various cadres of health professionals struggle to keep up with technical developments in the ever-changing health environment.

The need for systematic assessments focusing on health information systems (HIS) with a view to identifying underlying factors affecting performance has been noted in the literature [6]. Addressing challenges in the health professionals' capacities related to information and ICT is vital for several reasons. First, issues related to human resources are a significant challenge for maintaining data quality in HIS, as has been found in many LMIC countries (e.g., [6,7]). Second, it is important to understand and appreciate the rationale of health information systems (i.e., why the data is collected and reported) and the importance of the quality of data, because these are likely to affect the extent to which the collected data is used [4]. Health information should be utilized in various ways from health interventions to program evaluation, but a poor use of data in LMIC settings has often been reported (for instance, [8]). It is therefore critical to ensure the sufficient skill levels and understanding of those who provide the data and those who are supposed to use it in decision-making. Finally, health professionals' information and ICT skills have been linked to the utilization of ICT tools and eHealth [9] and the readiness to use electronic medical record systems (EMR) [10].

In order to identify the key issues regarding the information and ICT skills of health professionals we conducted a scoping review on the topic. A scoping review is a specific type of review which can provide a snapshot of the existing literature, as well as background information for further inquiry [11]. Specifically, we focused on limitations in health professionals' information and ICT skills, i.e., the skills required to collect, report, understand and utilize data required in the health systems in low- and middle-income countries (LMIC). In addition to the review, a qualitative case study was conducted in South Africa. For the case study we interviewed South African health professionals whose duties included working with health data.

For the purpose of this study, "health professional" refers to a range of people working with health information in the health system. In other words, it includes the frontline health workers, such as nurses and doctors, but also data capturers and clerks working in the clinics, and it refers to managers and other health officials at the different levels of the health system whose tasks require the utilization of health information for resource allocation and better services. As noted by previous LMIC research [6], the M&E and data management responsibilities are not always clearly

assigned at field level in a low-resource context, and the responsibility for certain data may be assigned to an M&E officer in one place and a community health nurse or program officer in another place.

Over recent decades, the quality of healthcare has become increasingly connected to the systematic application of information processing; thus, a health worker needs to be skillful in the efficient use of the available information systems (IS), technologies and tools [12, 13]. Therefore, this study seeks to explore the skill levels of health professionals in relation to information and ICTs and to propose measures to address challenges related to this.

## **2 Methodology**

In order to map the existing evidence base regarding our research topic, we conducted a scoping review. Such reviews are an increasingly accepted methodology for reviewing health research evidence [14], and they have been successfully applied in a variety of fields relevant to this study, such as assessing e-health programs in LMIC [15]. Additionally, further characteristics of scoping reviews support this approach: the scoping process benefits from an analytical reinterpretation of the literature, while it does not usually require assessing the quality of the studies included, and it may be especially relevant in disciplines with emerging evidence. Furthermore, scoping reviews allow the incorporation of a variety of evidence and study designs and may produce novel findings [14]. Two researchers (AK and NM) conducted searches of electronic databases in January and February 2016, including PubMed and Academic Search Complete (all databases) from the year 2000 to the present. Given the interconnected ways in which the terms “skills” or “information” are employed in health-related literature and their relationship to other multi-dimensional concepts, such as “data quality”, “health system”, “health workers” and so on, we kept the search terms broad to warrant a sufficiently wide coverage of the topic. These initial searches yielded many non-relevant papers, so an additional search string was included to increase the relevancy of the results, and this returned 519 articles that were reviewed by title or abstract. The database searches were complemented with additional searches on relevant organizational websites, reference lists of key papers and hand searching of journals online. We limited our search to full-text studies published in English and focusing on LMICs. Our review identified 18 studies that captured the key ideas relevant to the research question [16].

In addition to the scoping review, we interviewed a number of key informants involved with HIS in under-privileged settings in South Africa. This component of the study was conducted in 2012 by AK and was approved by the Trinity College Research Ethics Committee (in Dublin, Ireland) and the Western Cape Provincial Research Health Committee (in South Africa), as well as by the local health authorities. More specifically, the interview data was obtained from 28 informants, who worked in various roles at four levels (clinic, sub-district, district and provincial level) of the Western Cape public health system. Since each informant was in a role that involved collecting, producing, recording, reporting or using health data, they could inform us on how they perceive challenges in the HIS, including the human

aspect of it. The semi-structured interviews were conducted face-to-face, predominantly at the place of work of each informant, as 18 individual interviews and 4 group interviews with 2 to 3 informants. The informants included females and males, as well as people of black, coloured and white origin. Not all informants were asked the same questions. Some of the informants did not focus primarily on the information skills of the health professionals, whereas others raised that as a key issue. Nevertheless, they all provided rich data relevant to the research question.

### **3 Information and ICT Skills of Health Professionals – Literature Review**

Studies that have examined the health professionals' role in health information systems in an LMIC context have generally focused on the availability of human resources rather than on competence [17]. Furthermore, while the importance of human capacity building for the efficient functioning of various HIS in under-privileged settings is long acknowledged in academia [18], most studies merely mention the challenges in this area as a matter of course. In line with that notion, our review found a limited number of relevant articles on limitations in the information and ICT skills of health professionals.

#### **3.1 Computer Skills**

Despite the obvious benefits of ICTs to healthcare, their adoption has been problematic and the rates of use have been limited, particularly in many resource-restricted settings. Two large-scale surveys have been conducted in Ethiopia recently. In Addis Ababa hospitals, out of 270 participants, 91 (34%) showed an adequate knowledge of computers, while 108 (40%) had fair knowledge and 71(26%) inadequate knowledge [19]. In northwest Ethiopia, 356 (59%) of the 606 health professionals studied were computer literate [10]. A smaller-scale assessment in Kenya found that approximately half (58 out of 121) of the health workers had no knowledge on how to use computers, which contributes to further limitations in data analysis and utilization skills [20]. Studies in Iran [21], Nigeria [13] and India [22] have found variation in nurses' computer skills, the Iranian study reporting the mean of 43% of computer skills based on the International Computer Driving License (ICDL) [21]. In Nigeria, approximately one fifth of the 180 nurses studied rated themselves as "novices" in information technology and claimed to possess little or no skill in the use of computers, with 68 (38%) maintaining that they had never had formal training in information technology [13]. Similarly, an earlier Nigerian study [23] reports that approximately one fifth (22%) of the surveyed 148 health record officers, medical students and doctors showed poor knowledge of computers, while a majority (59%) had average knowledge and 19% demonstrated a good knowledge. Conversely, in Uganda, 82% of the 68 investigated self-reported being good or very good at using PCs, but reported significantly lower skill levels in using fax, printers or

specific software, such as Microsoft Excel [9]. The authors suspect that the self-reported figures reflect the doctors' confidence and some understanding of ICT, but that the level of skills demonstrated in the study may nevertheless form a significant barrier to the use of ICT.

### **3.2 Skills and Understanding of the Routine Health Information System**

While it is important to possess a set of basic skills to be able to use computers in general, sometimes it is a specific health information system that health professionals need to work with. These systems may be routine health information systems (RHIS) that "provide information at regular intervals of a year or less through mechanisms designed to meet predictable information needs" [24]. In Benin, a data quality assessment including a health worker survey (n=116) noted that the health professionals were inadequately qualified, as few had been trained on RHIS and the training received had not always been fit for purpose [25]. Kenya established their RHIS in 1984; however, 55% (67) of health workers had no knowledge about it [20]. In South Africa, researchers call the lack of knowledge about the RHIS rationale "disturbing" [17]. Since the average knowledge of the RHIS rationale was 22%, this suggests a limited understanding of the significance of the health data collected. Correspondingly, more than half of the surveyed 161 health professionals claimed that they had not received RHIS training in the last six months prior to the study [17]. There is a need to allocate, train and support management and end users in RHIS use in South Africa [26].

### **3.3 Data Security Skills**

A further category which is connected to the daily use of computers and the RHIS are data security skills. Confidentiality and data security, amongst other issues, are seen as an important part of any health record system both in the developed and the developing world, but literacy rates and cultural differences may influence the application and relevance of these concepts in LMIC [27]. A Botswanan [6] and an international study [28] report a lack of standard practices for backing-up the data, storing source documents and safeguarding confidentiality. Health data may not be backed up, and if it is, memory sticks are a customary method, which may result in the loss of data [6].

### **3.4 Data Management Skills and Analysis Skills**

The ability to use a computer or a RHIS is closely connected to the ability to manage, manipulate, validate and analyze data. Hence, these overlapping categories are not distinguished as separate entities in all studies, though they may not necessarily be the same thing, either. Besides the health professionals' computer knowledge, the

aforementioned Kenyan study [20] also evaluated the health workers' ability to perform basic information management functions. The study revealed that the majority were not able to perform such tasks: only 17% of the 121 health professionals could check for data accuracy, compute trends from bar charts or convert the collected data into meaningful information for use. This discovery is consistent with their finding that 91% had never received training for information management [20]. These figures show no progress compared to earlier evidence from a 15-country study: 13 out of 21 LMIC sites studied included personnel trained in data management or data quality control [28]. In South Africa, 64% of the 161 health professionals had poor numerical skills as regards being able to calculate percentages, amongst other things. Although the average confidence levels at performing routine tasks related to health information was 69%, only 22% actually displayed a competence above 50%. Furthermore, the average ability to check data quality was 36% [17]. Similar challenges have been experienced elsewhere [6], [29-31]. A study on the Kenyan HIV information system describes the staff's ability to check data quality, undertake basic data analysis and interpretation, and utilize the data for decision making as "limited" [29]. Likewise, in Botswana, most monitoring and evaluation (M&E) personnel at the national and district levels had received basic training in M&E, but their analytical skills were reported to be notably weak [6].

#### 4 Empirical Findings

In addition to the scoping review, interview data was collected in South Africa in connection to a case study. There are ways to measure the actual skill and confidence levels of health professionals for information tasks, but such assessments were not made within this study. Rather, the empirical component of this study reports issues that are perceived as challenges by South African health professionals whose tasks include working with health data.

The first finding that was not revealed by the scoping review, but which feeds into all the further limitations in information and ICT skills is the issue of **language skills**. For a large proportion of the population in South Africa, the language barrier continues to compromise the quality of and access to healthcare [32]. The data of the current study suggests that such challenges may occur at every level, but the issue is particularly pressing at the facility level: a lot of time is spent "*getting information out of people*" (Informant, field level). In the clinic and sub-district investigated in the case study, most patients speak Xhosa as their first language and therefore recruitment at the facility and sub-district levels has been done locally. However, all the forms, registers and information systems that the staff is required to use, are in English.

A second finding, which did not emerge directly in the evidence reviewed but which is nevertheless consistent with the limitations reported in the literature, relates to the fact that a sizable number of South Africans still lack an adequate basic education. Amongst them are individuals who work in the health system or with a close connection to it (such as tuberculosis community workers). They may be providing lifesaving care, but still have rather **limited basic mathematical, reading**

**and writing skills.** According to the informants, this may create challenges in understanding very basic concepts.

*“... a lot of people don't even have proper mathematical literacy skills. ... a lot of people are struggling with words ... so how can they interpret data?”* (Informant, Province)

This reinforces the message from research from elsewhere in South Africa [17] and can be considered an underlying factor that contributes to further limitations in ICT and information skills.

Not surprisingly, several informants indicated that **poor computer literacy** prevails at the hospitals and clinics.

*“Most people who work in the hospitals are not computer literate when it comes to Microsoft Office ... Most of them can't work with pivot-tables, or most of them can't work well with Excel ...”* (Informant, M&E position)

While the majority of the facility managers do have email, it was reported that they are not always confident about using it or other modes of electronic communication. Whilst most challenges were reported at the clinic level, it was also maintained that the higher-level health authorities have difficulties in understanding and utilizing technology.

Therefore, many agreed that while further computerization would be beneficial in terms of data quality and in reducing reporting duties, it should not be attempted until staff are a lot more information savvy. **Weaknesses in data security skills** were also reported. According to the informants, facility staff members use their own memory sticks on the computers, introducing viruses. Since many frontline health workers in under-privileged settings do not have computers at home, we assume that when they need to, they may be inclined to use the computer at work for non-work activities.

In the setting of our case study it was not possible to make a distinction between the skills and understanding of the RHIS and the overall data management and analysis skills. However, we did find challenges in this area. An informant argued that the utilization of data is limited by the lack of skills required to manipulate the data so as to make it easily usable for decision-making.

*“[People cannot] ... do the manipulation to get whatever information you want. So, it is a headache in that sense and the managers are not prioritizing this dataset ... because they can't get anything out.”* (Informant, M&E position)

We also found that **concepts that help in interpreting data might be unfamiliar.** This is consistent with the South African studies reviewed [17], [30]. In our case study setting, shortcomings in this area became particularly evident in the context of the feedback loop. Informants described how, after attending meetings, coordinators feedback the key messages from the printouts in such a way that the lowest-level staff and community workers can understand the trends. This requires that the concepts that communicate the information in ratios or visually are also explained. For instance, a field-level informant reported: *“Sometimes they don't understand this percentage thing. So, I have to explain to them”*. Or: *“Graphs gotta be very basic, bar graphs, you can't go for pies or anything just bar graphs, just plain and simple”* (Another informant) and even the bars need to be fully explained: *“This bar means this. This bar means that. What we are looking for is to see this bar going up”*.

Finally, we also identified **a lack of epidemiological or clinical understanding of the data elements and indicators required.** Those whose role was within a single

health program (such as management of the antiretroviral medication (ART) program for HIV) were keen to point out a difference to those who mainly work with general health information:

*“they don’t pick up the errors, so they are not Program people; they’re just punching numbers ... because for us from Programs you can very easily spot something that looks funny ... whereas someone who’s just punching number; if they punch 1, 2, 3 ... 1, 2, 3, 48 they won’t necessarily think about the 48, whereas you would immediately realize that, that 48 can’t be.” (Informant in Program Management)*

This is consistent with the results from another South African case study [33]. The researchers assessed the degree to which general health service (horizontal) managers exercise authority over the HIV program’s M&E function, namely, HIV data collection, collation, analysis and use. They found that compared to vertical managers, i.e., managers working in a disease-specific (HIV) position, horizontal managers had lower HIV M&E knowledge, and were more likely to produce HIV data but less likely to use it [33].

## **5 Discussion**

Our study illustrates that there are various weaknesses in health workers’ skills in an LMIC context and it is vital to address them, whether they relate to the ability to use computers in general or to the RHIS concerned or to capabilities to convert that data into meaningful information. Therefore, our study reinforces earlier evidence of a need to identify effective solutions and simple interventions to address the human competence and other underlying factors in order to improve data quality and to strengthen the health systems [6].

How to address the weaknesses identified? A global vision to develop informatics has been proposed by the American Medical Informatics Association. It recommends a system-wide approach where education and training should be offered at the leader/policy level (for instance, in the form of seminars); to health professionals (degree and certificate programs; short courses); and ICT technology and support level (degree and certificate programs; short courses) [5], thus echoing other studies that have highlighted the importance of educational strategies, curricula development and tertiary training programs to improve the level of informatics knowledge, skills, and attitudes in both formally and informally trained health professionals [6], [18].

However, this approach should be complemented with a decentralization of mentoring and training initiatives from the national to the district levels for the health work force delivering care at the facility level [6]. On-the-job training and mentoring and short interventions have yielded positive results in LMICs [34].

## **6 Conclusions**

Healthcare is an ever-evolving and profoundly information-based discipline. It is vital that health professionals have sufficient capabilities to respond to the increasingly

complex information needs. These needs may be particularly pressing in settings where the resources are already thinly spread. Our findings reinforce the message from previous research [5]: a basic-level information/ICT training is essential for all practicing health professionals, and more effort should be invested in it, especially at the field level, but also at other levels of the health system. What our study adds is a more nuanced understanding of the different types of training needs that exist. Moreover, it highlights the challenges related to language and basic literacy skills that undermine any improvement efforts, unless addressed first. Therefore, the training and education aimed at improving the ICT and information skills of the health professionals have to be versatile and cater to varying groups with differing needs, and approaches should be adapted to the local context. It is only then that the benefits of the information collected can be utilized to strengthen the health system.

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