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Accelerating implementation of District Health Information Systems: Perspectives from healthcare workers from KwaZulu-Natal, South Africa

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Background: Although electronic health record systems are critical for healthcare management, there has been genuine concern about the quantity and quality of data generated by these systems inhibiting its full implementation.

Objectives: The purpose of this article was to explore the experiences of healthcare workers (HCWs) and challenges facing the acceleration of the District Health Information System (DHIS) in the KwaZulu-Natal (KZN) province of South Africa.

Methods: In this study, an interpretive research paradigm was followed to explore the current state of electronic health in South Africa from the experiences of HCWs in the KZN province. Semi-structured focus group interviews conducted with 20 participants drawn from the district office, clinical nurse practitioners and data capturers allowed thematic analysis of data using a systems approach to link the perspectives HCWs to the design of the DHIS.

Results: The participants held the view that e-health is crucial for monitoring disease trends, policy development, planning and allocation of infrastructure, information technology (IT), financial and human resources. Nevertheless, the participants highlighted a concern surrounding e-health regulations, ethics and data confidentiality; data quality and lack of interoperability of Health Information Systems (HIS). This concern was attributed to data fragmentation, internal politics and lack of coordination of the data system.

Conclusions: The study suggests that good quality data – from an integrated DHIS, is highly critical for the effective utilisation, implementation and acceleration of e-health systems in the province to support epidemiological surveillance and modelling of outbreaks, such as the COVID-19 pandemic.

Keywords: e-health; data quality; KwaZulu-Natal province; DHIS; Health care workers.

Introduction

In an attempt to improve the quality of data, the South African National Department of Health (NDOH) developed a District Health Information System (DHIS) to collect monthly facility-based data from the public sector primary health services and district hospitals (Nicol et al. 2013). Whilst Shaw (2005) has highlighted the need for health information for policy, planning and management, Mahlangu and Ruhode (2020) have underscored the need to be cautious about e-government and to identify service delivery gaps from such systems. Kiwanuka, Kimaro and Senyoni (2015) have described the evolution of DHIS to its current web-based DHIS2 form and have identified the critical challenges of acceptance of the process of implementation in Vertical Health Programmes in Tanzania.

The DHIS, which facilitates the disease surveillance process is a continuous process of data collection, analysis, interpretation and dissemination of information that is essential for immediate public health action (Ahanhanzo et al. 2014; Dureab et al. 2020; Pourbohloul & Kieny 2011). Moreover, recurring epidemics, particularly the current global coronavirus disease 2019 (COVID-19) pandemic reinforced the need to strengthen national disease surveillance systems that could predict the pattern of disease and quickly develop a strategy to mitigate against the spread to other countries (Dureab et al. 2020).

In South Africa, primary health services are mostly provided at community centres and satellite clinics (Wright et al. 2014). As per the mandate of the Department of Health (DOH), the various centres in the provinces are required to report data for evaluation of the services provided (Wright et al. 2014). Whilst the e-Health 2012 strategy for South Africa stipulates that all indicator data derived from patients be captured electronically at the point of care, data collected by nurses in the clinics are historically recorded in paper-based registers (Wright et al. 2014).

Dehnavieh et al. (2018) explained that the DHIS is associated with data collections for decision-making and information management. According to Manya et al. (2012), the DHIS was aimed to establish a centralised database with reporting capabilities at health centres, define and determine the standards for local and national health centre reports and connect service delivery and other health system input databases. Nonetheless, the challenges identified in the literature, particularly from other countries, suggest infrastructure and system-related issues are the main concerns facing the DHIS (Dehnavieh et al. 2018). However, there is a dearth of empirical evidence on the state and use of the DHIS system acceptance amongst healthcare workers (HCWs) in South Africa, as also limited information on its state of implementation, coverage and challenges.

The purpose of this article was to explore HCWs experiences and challenges of the DHIS in the KwaZulu-Natal (KZN) province of South Africa. From a systems approach (Pickup et al. 2018), this study highlights the importance of HCWs' user perspectives in ensuring that all the components of the DHIS are considered. These include design, training and feedback to HCWs at the initial input phases; adequate resource allocation for an integrated seamless service and rigorous monitoring and evaluation of the immediate health information outputs to ensure that quality standards of the Health Normative Framework and the e-Health policy are fulfilled (Centre for Scientific Industrial Research 2014). The HCWs' identified several designs features that can, directly and indirectly, improve the DHIS functionality.

Research method and design
Study design

Using an interpretive paradigm, which followed a qualitative research approach, this study explored the acceptance of electronic health systems amongst HCWs – this provided an in-depth understanding of the state and current development of an electronic health system in KZN province, South Africa. According to Cooper and Schindler (2014), an interpretive paradigm is centred on people's behaviours and how people make sense of the world through sharing their experiences with others through the medium of language.

The perspectives of the HCWs from the operational level were interpreted intrinsically, as well through a systems approach, which allowed us to independently investigate

specific components of the DHIS and consider its impact to improve the effectiveness and efficiency of the entire DHIS. In addition, it also consists of inputs from other stakeholders (managers, policymakers, funders); resources (technical, financial, human) and outputs, outcomes and impact.

Study population and sampling process

Key informants were purposively selected from the district health office (information officers) and at the primary healthcare (PHC) facilities (clinical nurse practitioners and data capturers). Over a two day workshop, participants were assigned into four focus groups ($n = 5$) with two facilitators to guide the focus group interviews, clarify points and encourage continuous dialogue. An experienced epidemiologist and data scientist developed the focus group questions. The questions were reviewed and revised by an experienced clinical nurse practitioner with knowledge of e-health. The following research questions guided the group interview process:

1. Please can you share with us how you and your institution are using information and communication technology (ICT) and e-Health applications and their value in the public health sector?
2. What is the current status, extent of use and application of the DHIS at your institution?
3. What is the quality of data/information collected by the DHIS, and its impact on health status?
4. What do the health and information technology (IT) professionals need the data from these sources for?
5. What are the major challenges facing HCW for the acceleration of e-health in KZN?

Data collection

Data were collected via semi-structured face-to-face focus group discussion. The focus group interview lasted from 45 min to 1 h depending on the dynamics of each discussion. The interviews were audio-recorded using a smartphone (Samsung) and notes were written as back-up for the recordings. All recordings were transferred to a Universal Serial Bus (USB) Immediately after the interview and deleted from the phone to ensure confidentiality and security of data.

Data analysis

The data generated from the focus group interviews were transcribed verbatim and analysed using thematic content analysis in line with the guideline process by Saldaña (2021). In this process, the researcher began the analysis using operating coding to create categories in order to organise the date according to themes. Here, the researchers read the transcripts in full and then derived codes from the data. Thereafter, the transcript was read again and sections of the text were highlighted and deductively coded as per the appropriate code and quotations were then placed in separate documents. Elms et al. (2018) suggested that this process allows for overarching themes and subthemes to be identified across, between and within each group. All analysis was performed with the aid of Nvivo v12 software

(QSR International Pty Ltd 2015). In addition to the focus group data, the socio-demographic variables of the participants, as well as their job description, were collected, and descriptive frequencies calculated.

Trustworthiness

The trustworthiness of the study is supported by describing the findings in detail using the data generated in verbatim during the discussion. Furthermore, the accuracy of the transcription was ensured by listening to the recordings again before data analysis. Before data transcription and analysis, a debriefing session with the participants was performed. A participant from each focus group participants was asked to give a summary of his or her dialogue and discussion.

Ethical considerations

Before the collection of data, ethical approval was obtained from the Durban University of Technology (DUT) Ethics committee. Permission to conduct the study was obtained from the Directorate, DOH Province of KZN. An information letter was provided to the participants and written informed consent was obtained from all participants. The confidentiality of the participants was assured by assigning a code in place of their names.

Results

Socio-demographic characteristics

The socio-demographic characteristics of the focus group participants in this study are presented in Table 1. The majority of the participants were females, within the age group of 46–60 years, Africans, and hold a doctorate qualification.

Job description

The participant's job description and tasks including analysing health indicators, health information and professional nursing services are presented in Table 2.

Table 3 highlights the focus group and the description code assigned to each of the groups.

Table 4 highlights the theme and subthemes that were extracted from the study's findings. These themes and subthemes are discussed next.

Theme 1: E-health data

Subtheme 1: Need for health profession data

Good quality data are highly essential for epidemiological studies, particularly for surveillance, disease control and monitoring. It was established from the focus group discussion that the main reason for the health data is for epidemiological assessment:

'Well I think for health professionals, we would need the data for us to know the disease trends in the area, for planning

TABLE 1: Socio-demographic characteristics and profile of the participants.

Characteristics	Frequency (*n* = 20)	Percent (%)
Age (in years)		
20–30	1	5
40–45	5	25
46–60	14	70
Race		
African	11	55
Indian	6	30
White	3	15
Gender		
Male	4	20
Female	16	80
Education		
Bachelor's degree	2	10
Master's	8	40
Doctorate	10	50

TABLE 2: Job description of the participants.

Job description
1. Head of the Nursing Department and Lecturer – B Tech PHC Programme
2. Healthcare Information Technology officer
3. Program Manager – Planning. Monitoring & Evaluation within the iLembe Health District
4. Postgraduate research co-coordinator, lecturer research and nursing administration
5. Professional nurse in an Oncology clinic

PHC, primary healthcare.

TABLE 3: Focus group.

Focus group	Abbreviated	Number of participants
Focus group 1	FG#1	5
Focus group 2	FG#2	5
Focus group 3	FG#3	5
Focus group 4	FG#4	5

FG, focus group.

purposes, infrastructure, human resource planning, etc.' (FG #1)

Another focus group participant reinforced the importance of quality data for epidemiological assessment:

'Now the only way that is going to work is if you get data in a usable form. So I think the problem is all the health professionals might be recording these things but unless they are getting it back in a processed form, it is of no use to them.' (FG #2)

Subtheme 2: Current development in e-health

Given the importance of good quality data in the healthcare sector (Aqil & Lippeveld 2011), it was reasonable to know from the participants what their various departments have been doing to improve the quality of data. It was uncovered that the DOH is in partnership with other countries such as Brazil in strengthening the e-health system. For example, both countries are collaborating in e-health App for patient surveillance and monitoring:

'With our core project, we are working with Brazilians. Last year they were developing an app where patient's information could be filled. The purpose of this app is that wherever that patient goes it can be seen who they are, what treatment they have been on, but this year they are developing an app, which is going to be used for patient education and prevention of chronic illnesses.' (FG #2)

TABLE 4: Identification of themes and subthemes.

Theme	Subtheme
1. E-Health data	a. Need for health profession data
	b. Current development in e-health
	c. Improving the quality of data
	d. E-health regulations and ethics
2. Challenges of e-health	a. E-health challenges for health workers
	b. ICT challenges
3. Recommendations for e-health	-

ICT, information and communication technology.

Adding further to the given narrative, it was found that the e-health surveillance system is now in use in some public and private hospitals in the KZN province. In the public hospital, for example, Albert Luthuli Hospital has already implemented e-health systems:

'Inkosi Albert Luthuli Central Hospital (IALCH) is already doing it, I think on the largest scale. With the municipality, they have started.' (FG #1)

In the private hospital, the participants disclosed that City Hospital has introduced an e-health platform, particularly in maternity care:

'At City Hospital, we have the midwives anti-natal clinic it is a low-cost anti-natal clinic, it is for patients who have no medical aids. You pay a certain fee and it includes everything, you do not have to pay anything extra. So we are actually on the electronic system; from the time the patient is registered till the time she delivers, the only paper that we have now is in the labour ward, because we cannot put the partogram and other examinations onto the system.' (FG #1)

It was established that medical insurance providers and hospitals in the province are teaming up to provide a comprehensive e-health platform:

'Currently, in KZN we've got MediTech at Addington and Inkosi Albert Luthuli hospital and then at McCords hospital we've got a different system, St. Aidan's have got a different system and King Edward have got the same as McCords.' (FG #4)

Subtheme 3: Improving the quality of data

In the quest to improve the data in the province, the participants revealed the introduction of a digital pen at the district level as it is beneficial in capturing and adding information directly into the DHIS system:

'With the digital pen, there is no transcription, it goes on to the system immediately, as you tick. It is a digital pen and a digital book.' (FG#2)

In some of the participant's views, the use of a digital pen helps to eliminate chances of error in the data captured:

'We found we have the immediate recording, we have immediate capture, and there are no error rates.' (FG #3)

Whilst explaining how the process of using a digital pen works, one of the participants voiced this:

'Yes, but we gave them a pen and a cell phone. Therefore, it is Bluetooth from the phone to the pen and back to the phone and from there it goes on to the web.' (FG #3)

Sharing a similar view, another participants added the following process of using a digital pen at the district level:

'On the pen itself, you can save about 40 A4 sized pages. On the forms, most of them are ticks, except the demographic information. So you can store about 40–50 forms at any given point, on the pen itself and you can go to the nearest clinic and dock it and it uploads.' (FG #3)

Although it can be gathered from the given narrative that electronic devices such as digital pens improved the quality of data capturing, some of the participants, were, however, uncertain if these technologies have truly transformed the e-healthcare system:

'There are these digital pens that were introduced because it's some form of technology also at the primary healthcare level. I do not know whether it has yielded any results or we are getting the quality. When we are hearing from the maternal side at the hospital, at least you can hear that there is some quality sort of that you are measuring, that you are looking at but I do not know with the digital pens that have been introduced whether they do give also the quality that is expected.' (FG #2)

Subtheme 4: E-health regulation and ethics

Whilst the introduction of digital pen and other ICT technology in the healthcare system is a welcome development, patient's privacy and data securities are, however, a big concern when it comes to e-health. As a consequence, it is important that sensitive patient's information is protected and the doctor's and patient's confidentiality is strictly adhered to. To ensure this, some semblance of regulation has to be introduced in the e-health system. Fortunately, it was revealed that the Health Normative Standard Framework is delegated with the responsibility to regulate the e-health system (Centre for Scientific Industrial Research 2014; Department of Health 2012):

'The Health Normative Standard Framework was developed by CSRI to address the fragmented systems that were developed to address the systems in the country. Each system now has to be checked against the Framework, if it complies with this.' (FG #4)

In terms of the ethical concern of the patient's information, another participants illuminated:

'For me, the understanding is that patient confidentiality is, for instance, if you are a clinician you cannot talk about your patient to the person outside the health domain. But for me talking to people within the health system, then I'm still maintaining patient privacy.' (FG #1)

What can be deduced from the given statement is that although healthcare clinicians are bound by ethical conduct about patient's confidentiality, they are, however, obliged to disclose this information to other colleagues within the healthcare system. However, for students in training, it becomes very difficult to maintain ethical conduct:

'We tell the students about confidentiality and whatever but to the student. However, it is still like Greek. The excitement of being a student, the excitement of being exposed to information – which is what we have been currently emphasising to say as they will get into the ward, they will want to be taking pictures with patients and whatever, they will want to share with the

public – 'I've seen there's a patient who had this and this. So that excitement calls for us to revisit our ethics and traditional practice modules so that the learners are questioned regarding the importance of confidentiality and what shared confidentiality means.' (FG #1)

A salient point emerging from the given statement is that the ethics and traditional practice modules have to be revisited when it applies to e-health. Two of the participants also supported this view:

'In all curriculums, whether it is radiography, whether it is nursing or IT needs to be revisited. Because even the IT technician needs to know patient confidentiality and you know this is so important.' (FG #2)

'That is very, very important and if you look at the health sciences, in a psychosocial aspect it is very, very important. So that again needs to be brought in somewhere, somehow in terms of e-learning or e-health – it's very, very important.' (FG #3)

Given the importance of patient's confidentiality and the need to protect this information (Singh 2014), it was important to know who had access to the confidential information in the e-health system. It was uncovered that data capturer and other cleric staff do not have access to clinical information in the e-health system:

'Clerical and administrative staff do not have access to any clinical information; they only go as far as demographics. There is some sort of measure in place and like I said clerical and administrative staffs have no access to any information, they only see the first page of the first screen and then after that access is blocked.' (FG #4)

As such, it was mentioned that the information available to the clinician is different from those that could be accessed by other non-medical staff on the e-health system:

'The access as you were saying that is given to support staff is different from the information accessible to the doctors and nurses, etc.' (FG #4)

Theme 2: Challenges of e-health

Subtheme 1: E-health challenge for healthcare workers

Despite the laudable benefits of e-health, particularly its perceived improvement in the quality of data capturing, there are, however, challenges faced by the HCWs. Some of these challenges include poor knowledge of IT and extra workload for clinicians who in addition to their clinical duties have to capture patient data themselves:

'Because it becomes a double job, you are getting this nurse who is coming to do nurse training for the first time, she has never seen a computer; whilst she is worrying about the school modules she will also be worrying about using technology on the other side. Maybe that is what has been compounding our problems.' (FG #2)

'Also considering time and resource management, where you look at one person who is sitting consulting and capturing at the same time as opposed to us having this person plus another person doing capturing, that is, more time, etc.' (FG #4)

Subtheme 2: Challenges of information and communication technology

Despite the benefits associated with e-health, particularly as it concerns the quality of data for healthcare needs, it is, however, still limited to two districts and few hospitals within the KZN province. This may be concerning given that skills possessed by the data capturer cannot be equated with the weight of the information they are required to process. saddled with. Hence, this theme explores the challenges that are limiting the widespread implementation and acceleration of e-health in the province. It was found that the lack of poor ICT coordination, lack of access to information, politics, were amongst the challenges confronting the widespread implementation of e-health.

Fragmentation of e-health: It was found that e-health within the province is highly fragmented and poorly coordinated, thereby posing a great challenge for the health workers. Of concern is the poor ICT coordination, as illuminated by one of the participants:

'E-health strategy should cover everything. It is just that there is poor coordination of ICT. There are three units that are different, but they all deal with ICT, in the department. [*I am with e-health actually.*] They report differently.' (FG #4)

Sharing similar sentiments, another participant voiced the following concern on e-Heath fragmentation in the province:

'I think just to add on what he has just said it is that we have been having some fragmented services within one umbrella.' (FG #2)

The consequence of the poor ICT coordination amongst the district has an overreaching effect. For example, it suggested that ICT workers in healthcare may use their gadgets such as cell phones to capture and store patient's information:

'[… *T*]he equipment they are using, apart from the other hospitals and facilities, they are using their smartphones and tablets, but that information is staying on the phones and tablets.' (FG #2)

Another consequence mentioned as a result of poor ICT coordination is that it will hinder the district manager to get a clear picture of the burden of disease or healthcare intervention in the municipalities:

'[…*L*]ack of interoperability and therefore if the District manager in EThekwini wanted to get an overall picture of what's happening in the hospital, they can't.' (FG #1)

Added to the given concern, poor coordination and fragmentation of patient's data across the province negatively affect referral services:

'[…*T*]he problem was when iNkosi (Luthuli Hospital) then refers patients to the other hospitals, the lower levels, they do not have access to information about the patient because it is only kept at iNkosi and it is an electronic system to access that data that you have at iNkosi. So if it was like you said across the system and implemented it would be better.' (FG #1)

Politics: On the use of internal politics, it was mentioned that the financial cost involved might become a barrier to implement e-health systems:

'But to get it to go across when people look at finances and costs somehow it just dies off, the decision-makers just say no.' (FG #3)

This also suggests that financial constraints limit the full implementation of the DHIS.

Theme 3: Recommendation for e-health from healthcare workers perspectives

Given these limitations and challenges that the e-health system presents to clinicians, the following recommendation was proposed by the participants.

Training of nurses on the District Health Information System

'So the thing is the responsibility is now on you people when the nurses are there; they need to be trained, we should train them on this. Nevertheless, it should be part of the curriculum, not an extra subject module.' (FG #2)

'I think when it comes to nurses or anybody that is going to be working in the health sector it comes down to training.' (FG #1)

'What we motivated for were champions and super users, so in the absence of IT people, we have somebody or 1 or 2 people who are well trained and can address and troubleshoot and relating it to the IT and they get to see to the bigger things, so to speak.' (FG #4)

Implementation of an Integrated District Health Information System

Participants observed that different hospitals and levels of service delivery used different software, IT systems and companies, causing lack of interoperability of Health Information systems (HIS) and data, thereby negatively impacting surveillance, continuum of care, referrals and epidemiological analysis to monitor outbreaks:

'One system for the whole province.' (FG #4)

Public and private partnership

In addition to the duplication and fragmentation of different HIS providers, internal to the public health sector, it was also observed that there was limited interaction and support from the external IT service professionals, providers and users:

'So that we can link up public-private. Because that is where we find gaps in terms of the management in all those things; it means the department needs to bring them along also so that we can see that everything is coming right.' (FG #4)

Discussion

The purpose of this study was to explore the experiences and perspectives of HCWs on the status and challenges of the DHIS in KZN, South Africa. Wright et al. (2014) had suggested that the use of electronic data sources in healthcare has the potential to streamline data gathering and improve public health reporting, provided that all components of the systems approach are fully operational.

From the data extracted from the focus group discussion, it was revealed that HCWs need data for disease surveillance, control and monitoring. According to Kabuya et al. (2014), the value of health data is its availability, reliability and validity for those who are interested in that data for disease surveillance, resource allocation and other applications. A similar sentiment was uncovered in the interview as some of the participants stressed the importance of the quality of data for epidemiological assessment and surveillance. Healthcare workers lamented the fact that individual hospitals were using different software tools and proprietary information systems (FG#1, FG#4, FG#2). It was further noticed that whilst the e-health tools saved time in collecting, storing, retrieving and compiling health information at the individual hospital and clinic levels – because there were no interoperable systems across the DHIS – they could not be aggregated for use at district, provincial or national levels. Thus, from a systems perspective at the input level, developers, IT professionals and policymakers must build into their software interoperability capability to allow seamless importing and exporting of output health information, across a common IT platform to accelerate its implementation.

Moreover, and corroborating with other authors (Aqil & Lippeveld 2011; Pourbohloul & Kieny 2011), quality data are essential in assessing clinical encounters and allocating resources for effective day to day health policies and practices. From a South African perspective, this is highly important as the nation can easily measure the country progress in terms of meeting the Sustainable Development Goals (SDGs) milestone (United Nations 2017). Thus, there is a need for data quality improvement generated from the provinces. Ali et al. (2018) hinted that a strategy for successful data quality improvement should involve people, processes and current technology. Consistent with this, it was uncovered that the province is in partnership with other countries such as Brazil to improve the quality of data for patient monitoring and surveillance.

There was also a public-private partnership for e-health applications in the province. Based on this partnership, several technologies such as digital pen and e-health App were introduced in the province for data quality improvement. However, some of the participants highlighted the concern surrounding e-health regulations and ethics and concern for the patient's confidentiality. Whilst the DHIS is premised on open access to the data, Dehnavieh et al. (2018) acknowledged that data security is a noticeable concern in its application. Nevertheless, the finding from this study suggests that there are varying levels of access available to users. It was uncovered that non-medical staff has a limit and restriction to certain patient confidential files, which is only accessible to the medical team. Current developments in e-health technology can address some of these HCW concerns around data confidentiality through algorithms, clinical care and management pathways using artificial intelligence (AI) (Davenport & Kalakota 2019; Esmaeilzadeh 2020).

Whilst another study suggests that the use of IT will save time and cost for the health workers (Wright et al. 2014), this study, however, uncovered that many of the participants complain of excessive workload and stress attributed to doing the double job of routine clinical duties and data capturing. O'Mahony et al. (2014) argued that the cost of generating and summarising data is costing nurses valuable time that could be used for patient care. Besides, nurses in low and middle-income countries have multiple responsibilities, which may interfere with the time they allocate for data collection (Nicol et al. 2013). The consequence of this is that nurses may prioritise their patients over data collection, which could impact the quality of the data generated (Nicol et al. 2013). Hence, the need for data capturers delegated with the responsibility of data capturing will be highly beneficial to avoid overworking and burnout, which could jeopardise the quality of the data captured.

In reviewing the literature on ways to address the perceived operational challenges of data quality and the implementation of DHIS, it emerged that political pressures, lack of technical knowledge, workforce capacity, amongst others are some of the challenges hindering the implementation of DHIS in developing countries resulting in a chaotic and fragmented system making the data collected inconsistent and disorganised (Dehnavieh et al. 2018). This study confirms that data available in the DHIS in the KZN province are highly fragmented and the process lacks coordination. This, perhaps, might be attributed to the confidentiality issues raised by some of the participants. It is revealed in this study that there are different levels of access to patients' data available for the medical and non-medical staff. This is a major challenge that may lead to the unavailability of patients' data at other medical centres where the patient could benefit from its use. The consequence of this is that data needed for decision-making, particularly for epidemiological assessment may be unreliable, irrelevant and ineffective (Karuri et al. 2014) whilst internal politics within the province blocks adequate financing of the DHIS and its full implementation in the entire district, which currently stands at 2 districts out of a total of 11 districts.

Given the above-mentioned concerns and challenges, the participant's suggestion for the training of HCWs becomes highly important. According to Dehnavieh et al. (2018), the lack of education of the DHIS system is amongst the most challenging issues hindering the implementation of DHIS. Hence, the study highly recommends that education and training of HCWs at both the facility and district level will be most helpful in improving the quality of data.

Accelerating the implementation of District Health Information System

It is recommended that the system features identified from the HCW perspectives at the operational level could be incorporated in the following re-design of the DHIS to enhance its interoperability. Specifically, the design elements at the input level must be restructured to offer algorithms and options such as drop-down menus to reduce input time, improve data accuracy and produce customised data tables and clinical reports as outcomes. Healthcare workers specifically requested that the data must be in a 'usable form' (FG#2), shared with them in a 'processed form' (FG#1), to be used for surveillance, disease monitoring and ensure continuity of care (FG#4).

Incorporating the HCW perspectives in the re-design of the DHIS would enhance functionality at the levels of health management (for reporting, financial and stakeholder accountability). Hence, healthcare management should provide data capturers and support staff with clear standard operating procedures (SOPs) to ensure patient confidentiality, data quality inputs and outputs. A hierarchical system with delegated functions at different levels of the system and professional groups to access relevant and appropriate clinical data would ensure compliance with the Protection of Personal Information (POPI Act 2013) legislation and ethical standards. This would ensure that the data-information-knowledge-wisdom (DIKW) cycle is fully integrated into the DHIS (Jennex & Bartczak 2013; Priestley & McGrath 2019).

Conclusion

The findings from this study suggest that healthcare data are critical for public health monitoring and diseases surveillance. Despite the importance of quality data, it was uncovered that the e-health system in the province is highly fragmented, politicised and poorly coordinated, thus posing a serious concern for HCW. Training of HCW and data capturers, and implementation of an integrated information system was therefore recommended as a key to improving data quality for effective utilisation and implementation of e-health in the province. Including HCWs perspectives in the input designs, would ensure that the outcomes and impact of e-health tools are enhanced. Improved epidemiological surveillance functionality and accelerated DHIS implementation contributes to research and development for epidemic modelling and managing pandemics.

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Author's contributions

C.C.J., M.N.S., S.T and S.C.O. developed the research concept. S.C.O. performed the literature review and thematic analysis. All authors contributed to the final version of the manuscript. C.C.J. supervised and coordinated the project.

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Data availability

The data that support the findings of this study are available from the corresponding author, S.C.O., upon reasonable request.

Disclaimer

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