

Designing a robust public health management information system (phmis) for improved health outcomes in lesotho

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ABSTRACT

The paper presents research findings and recommendations on the study of the phenomenon that, the healthcare service delivery in Lesotho is fragmented and therefore risky to the lives of patients. The research was conducted through interviews and focus group meeting discussions with participants (potential patients, healthcare professionals, and administrators). The results reveal that the challenges encountered by healthcare professionals during the provision of care are mainly caused by the non-sharing of medical records by healthcare facilities. Moreover, the medical records of patients are fragmented. Therefore, during the provision of care, the patient's medical record is never complete, which increases the chances of medication errors by healthcare professionals. Consequently, the research recommends the design of a web-based, electronic Public Health Management Information System (PHMIS) that should be accessible by authorised, registered, public and private healthcare professionals. The design of a system should adopt technologies and techniques that support sharing of decentralised healthcare services nationwide, within the confines of the laws/policies of the Government of Lesotho. Furthermore, the paper recommends a future study to establish the extent to which Artificial Intelligence (AI) can be used to support the envisaged PHMIS by enhancing healthcare service delivery and medical research.

Keywords: Healthcare facilities; Healthcare professionals; Medical records; Electronic medical records; Health information system; Health systems fragmentation; Integration; Critical success factors; Healthcare services; Medical information

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INTRODUCTION

The purpose of the paper is to present the research findings, the analysis of the findings, and the recommendations, for the research that is intended to conceptualise a design for an electronic Public Health Management Information System (PHMIS) for Lesotho. The case study research design was used to solicit ideas and experiences of the key stakeholders of the healthcare service delivery, through interview questions and focus group meeting discussions, which are related to the research questions. A total of 44 participants provided insights into the phenomenon being studied:-

- a) Healthcare professionals: doctors and nurses (8)
- b) Healthcare administrators (6)
- c) Potential patients (30)

The collected data was analysed using thematic analysis techniques, and the results are presented analysed in relation to the research questions to ensure that the objectives of the study are met. The results reveal that challenges that the healthcare professionals encounter are that medical information for the patients is always incomplete during the provision of care because;

- a) Patients' medical records are paper-based;
- b) The medical records are fragmented across healthcare facilities, such that one patient has as many records as the number of facilities he/she has received care from; and
- c) Healthcare facilities do not share patients' records. Therefore, the research recommends the following solutions:-

- a) Migration of medical records by all facilities from paper-based to electronic systems
- b) Adoption of a theoretical model known as OmniPHR, which is about one patient having one medical record. This model must be supported by Blockchain Technology to ensure that medical records are securely shared across healthcare facilities [1].
- c) Design and development of laws and/or policies that allow sharing of medical records by authorised institutions and professionals and protect the medical records from unauthorised access and usage by authorised groups.

Finally, the research recommends future research that would establish the extent to which Artificial Intelligence (AI) can be used to support the envisaged PHMIS by enhancing healthcare service delivery and medical research.

METHODS AND MATERIALS

The research design is a Case Study, which facilitates the study of a phenomenon through interviews and a focus

group meeting as the methods for the collection of data. The participants' selection was done through purposive sampling, where participants were selected to provide insights into a phenomenon being studied, because of their experience or expertise on the subject. Therefore, it indicates the participants and the selection criteria, while Figure 1 below illustrates the highlands and lowlands of the Lesotho districts:-

Participants' selection criteria

The terrain divides the country into highlands and lowlands. Some facilities in the highlands are hard to reach resulting in services delaying to reach them. Therefore, the researcher has made an assumption that the life experiences, of people leaving in the highlands, especially regarding health, differ from those in the lowlands. Therefore, ensuring the representation of people from both terrains in the research may increase the reliability of research data. The rationale is that all the healthcare professionals and administrators are managed, monitored, and controlled by the Ministry of Health, through the national health policy (Ministry of Health, 2018). But for potential patients, every district needs to be represented as the patients are free to interact with any facility nationwide. Therefore, the different experiences of potential patients from all districts may increase the validity of the results [2].

Data collection

Due to the Covid-19 pandemic restriction protocols, data collection was conducted virtually, through interview questions and focus group discussions.

Data analysis

The data analysis was performed through the Thematic Analysis Techniques using the software known as Taguette. The analysis was guided by the Thematic Analysis Framework below. Following the transcription of the responses, phrases and sentences containing ideas related to the study, were identified through the process called coding. Similar coded phrases and sentences were grouped into categories, which were then grouped into themes in relation to the research questions. The relationship between the themes forms the basis for the results of the research as they provide phenomena from the participants' perspectives.

RESULTS

The results are categorised by research questions, to ensure that the objectives of the research are met.

Research question 1

What Challenges do Healthcare Professionals encounter when providing care in Lesotho?

According to the participants, the main challenges that healthcare professionals encounter during the provision of care, are related to the way medical records are managed from one facility to the other. The results indicate that problems encountered by healthcare professionals during the provision of care are mainly caused by medical records

that are paper-based, as most of them are not easily retrievable when required because their storage is not reliable. One Admin Officer said the hospital stores files for the in-patients, "but", she continues, "it is not always possible to find the same files when you need them" or if you do, "some page is missing". Other than records being paper-based, the participants believe that fragmented patients' medical records make it difficult for healthcare professionals to provide care as there are gaps in the data recorded. This is due to the fact that healthcare facilities don't follow a similar system for storing records. Moreover, healthcare facilities do not share the patients' medical records. For example, public facilities record medical information in health booklets known as "bukana" in Lesotho, while other facilities use physical files that are stored at a facility. Therefore, when a patient has been to different facilities over time their records would be scattered as such. For example, one participant said "If a patient was admitted at the hospital, management information is left with the hospital, and other healthcare facilities don't have access to it"; while the other participant asserted that: "the facilities are independent and they don't share my records in any way" [3].

Notwithstanding the overall result indicating that the main problem is due to paper-based records, the healthcare professionals see the main challenge for them as missing information, in whatever form, during the provision of care. For example, a healthcare professional said, "Patients are from far places, and they lose their health booklets". The other participant said, sometimes patients hide information, especially when they have defaulted from their scheduled visit to the facilities, either for a routine check-up or ongoing chronic disease treatment.

Research question 2

What critical success factors would strengthen the design and implementation of a sustainable PHMIS for Lesotho? The participants believe that the envisaged Public Health Management Information System (PHMIS), would be made more successful by the best organisation of patients' medical records, such that there is a central database, which is updated with patients medical information during or after the provision of care, in all facilities in the country, regardless of the proprietor. Thereafter, the participants indicate that the medical records must be managed systematically with a robust and comprehensive electronic system, that must be managed professionally to ensure its efficient functionality. For example, one participant said, "There must be a central database for medical records, so as to minimise interviewing patients regarding what they could remember about their illnesses". For one participant, it seemed very important that the central database should be accessible only by authorised healthcare professionals [4].

While the overall highest ranking critical success factor according to the research participants is the development of a central database for patients' records, the healthcare administrators consider a comprehensive system that would be able to capture all the services offered by the facility, most critical. However, healthcare professionals consider

the availability of full historical data as the most critical success factor, especially during the provision of care. Therefore, a central database without full historical data would not facilitate care. On the other hand, the potential patients consider a functional central database of patients' records a critical success factor for the envisaged PHMIS.

Research question 3

What Policy/Legal Framework would be suitable to support the design and implementation of a PHMIS for Lesotho?

The research participants believe that the best policy/legal framework that can support the design and implementation of the envisaged PHMIS must facilitate sharing of medical records across healthcare facilities in Lesotho, regardless of being public, private or otherwise. For example, a participant said, "there must a law to ensure that healthcare facilities share patients' records". While the other said, "I would recommend laws that remove the silo mentality of healthcare facilities, so that patient info could be accessible amongst all facilities". Following by importance, the law to facilitate sharing of medical records by facilities is the law that protects patients' records from damage or misuse by those who have access to the patients' records management system, followed by the law that would manage the registration of healthcare professional to ensure that any wrong doing could be traced back to the individual when the need arises [5].

Though, the overall most important law or policy according to the research participants seems to be the one that facilitates sharing of medical records, unlike all other groups, the healthcare administrators consider the most crucial law or policy as the one that guides how the patients' records must be protected, followed by the law that facilitates sharing of medical records and the one that provides access to the patients' records by authorised users.

DISCUSSION

Challenges encountered by healthcare professionals during the provision of care

The inability to share patients' medical records by healthcare professionals inhibits the provision of care, so much that the quality and safety of the healthcare service are compromised. This is a result of paper-based and fragmented patients' medical records across the facilities that the patients have visited to seek medical attention. The following are examples of challenges caused by the inability of facilities to share medical records:-

- a) If a patient has been to more than one facility to seek medical help, the patient will have more than one medical record at different facilities, which are not connected. The patient medical record will remain incomplete, and make the provision of care a very risky activity. They suggest that in Indonesia medical records are defined as files containing notes regarding patient identity, clinical examination, treatment, and any clinical information related to the patient or has been done on the patient. The complete patient information will assist the next healthcare professional to provide

quality care timely [6].

- b) If in the previous visit, medical tests were conducted and results are kept at a facility, the same test would be conducted again if required at another facility, because the facilities are independent and do not share medical records been done previously in another facility. This is costly to the patient and could cost a life due to the delay in treatment.

If a healthcare professional has to depend on the information from a patient because of unavailable medical history or the patient is incapacitated, issues related to allergic reactions to medicines may not be easily found out until she/he is given the same medicine, to which they are allergic and may worsen the health condition or even cause death. Therefore, this situation would cause a healthcare professional to commit a medical error due to missing information.

The results above confirm the problem being studied, which states that the healthcare service delivery in Lesotho is not integrated and therefore risky to the patients' lives. Having identified through the research that in Lesotho like in many other countries in Africa or Europe, there are different factors that contribute to incomplete patients' medical records, the following factors are true to the Lesotho health service delivery:-

- a) **Man:** Some healthcare professionals do not elaborate enough in their clinical notes, while others do not write notes at all in the health booklet; or further, illegible handwriting causes medical errors; or patients misplace, forget or leave the health booklets at home purposely or by mistake; or at some facilities, healthcare professionals misplace physical files. For example, one participant said: Sometimes when a patient has been to the hospital, "discharge summary is not eh.., doesn't give you enough information about what treatment the patient received"; the other said: "most people lose their bukana".
- b) **Materials:** In Africa the patient records are still paper-based. From the research, the participants said public healthcare facilities use health booklets and if not available, the patient has to buy a new one. Private facilities use physical files or electronic systems that capture only a few details of the patient, when the file is misplaced or lost, the facility opens the new file [7].
- c) **Method:** Since each facility keeps medical records in its preferred method – nothing standardised, the healthcare systems and patient records are fragmented i.e. pieces of a patient record are in as many healthcare facilities as he/she has been to.

Therefore, the research recommends the following:-

- a) Usage of an electronic Public Health Management Information System, which will be web-based and accessible nationwide, by all authorised and registered healthcare professionals. This will eliminate illegibility errors in the clinical notes written by healthcare professionals, and improve the quality of medical records for the benefit of the patient health and also for using records as evidence in legal issues that may arise.
- b) Registration of each licensed healthcare facility at the

ministry of health

- c) Registration of each healthcare professional
The Ministry of Health must propose a law that defines the structure of a patient's medical record, which must be embraced by healthcare facilities to facilitate sharing of medical records across the healthcare facilities.

Critical success factors of the PHMIS

The literature exists that supports one patient and one medical record, which is the theoretical framework that this research has adopted, known as OmniPHR. Moreover, to ensure that shared medical records maintain their integrity, Blockchain Technology must be used to support the OmniPHR model [8].

An Electronic Medical Record (EMR) in an integrated healthcare system, which facilitates sharing of patients information, is considered highly sensitive and critical information from which both the patient and a healthcare professional can benefit. In an integrated environment, the EMR would contain medical information that assists the healthcare professionals to have full information regarding the patient and be able to provide quality and safe care. However, in fragmented health systems, as it is in many countries, the EMR will still be incomplete as it would be facility-oriented instead of patient-oriented. For example, if the healthcare system is integrated, the record may have clinical notes, management of current ailment treatment, and medical tests results, that are critical to healthcare provision and accessible by all facilities that are part.

The research, therefore, recommends that the Critical Success Factors suggested by the participants be considered, with particular attention to the following issues:

- a) The design of an electronic Public health management information system (PHMIS), which is comprehensive enough to capture data generated throughout all the services that healthcare facilities offer.
- b) The design of the PHMIS must adopt the OmniPHR framework model, which is about ensuring that one patient has only one medical record. The OMniPHR must also be supported by Blockchain Technology, which will ensure that sharing of records across the healthcare facilities maintains the integrity, privacy and confidentiality of the shared patients' medical records.
- c) Integration of PHMIS across the facilities, to ensure complete patient medical information during the provision of care, which is an advantage to both the healthcare professionals for quality care and the patient to receive safe care because medical documentation would be properly recorded.

Legal/policy framework that should support and guide implementation of the PHMIS

The design and implementation of a system that is recommended to be used nationally to address the healthcare services of the country need a policy/legal framework for guidance and support. Therefore, having discussed with the research participants through interview questions, the following are recommendations by the

research for a suitable policy/legal framework to guide and support design and implementation of the PHMIS, in order to facilitate a positive change in healthcare service delivery:-

- a) The healthcare service delivery, which is guided by the existing legal framework, must be incorporated into the design of the PHMIS because the legal framework indicates three levels of healthcare (Ministry of Health, 2018). Level 1 is Primary Health Care, which is at the level of Healthcare Centres at the community/village level; Level 2 is Secondary Healthcare, which is at the level of the District Hospitals where Health Centres refer patients they are unable to assist; and finally, Tertiary level where district hospitals refer patients for cases they are unable to resolve (Ministry of Health, 2018).
- b) Ministry of Health must develop and implement a policy that standardises the structure of a patient health record, and disseminate the policy for implementation by the key stakeholders i.e. all healthcare facilities in the country, healthcare professionals, and proprietors. This would support the integration of healthcare service delivery as the facilities would be having similar medical record structures. Fragmented healthcare systems of a country make it impossible for the country to respond to severe attacks on the health of its citizens such as those brought by a pandemic. Therefore, the research recommends the integration of healthcare systems for any country to improve the tackling of diseases in a unified healthcare service delivery system such as through the integration of healthcare systems [9].
- c) MoH must advocate for a law that allows sharing of medical records across all the healthcare facilities in the country. The law should include, as a minimum, the factors that appear suggested by the participants.
- d) As the envisaged system of managing patients' records is electronic, blockchain technology makes it possible for the medical records to be accessible by patients, but still maintain the privacy of records among patients. Therefore, the research recommends sharing of records across healthcare facilities and the accessibility of records by the patients. The participants indicated that they only have access to their medical records that are in the healthcare booklet, for as long as it is available, but do not have access to their records that are kept at the private facilities.
- e) According to the participants, abuse of medical records by those authorised and registered to access the medical records, must be punishable by law.
- f) The records must be elaborate to facilitate future reference, in case of further research or when legal evidence is required.
- g) The system must be auditable to establish actions by authorised users as necessary.

Recommended solutions and future research

To mitigate the established problem of fragmented patients records, the research recommends the adoption of the theoretical framework model known as OmniPHR, which is

about ensuring that one patient has only one Patient Health Record (PHR). However, to ensure the security, privacy and integrity of shared data across healthcare facilities and other care providers, OmniPHR must be supported by block chain technology, illustrates how blockchain technology supports OmniPHR. It is important to note that the solution recommended would be implemented within the confines of the laws and policies of Lesotho, to ensure that usage of the system does not jeopardise either the healthcare professionals or the patients' lives.

Therefore, having to pull and push information across the healthcare providers requires no distraction as medical records are a very sensitive piece of information and if not accurate or complete, can jeopardize the life of a patient.

There are two recommended solutions. First is a tested and appropriate ICT technology approach that can address the identified problem.

OmniPHR model, which is supported by block chain technology, where patient information is shared across care providers through the internet. This arrangement requires reliable telecommunication coverage, which most African countries do not have, especially in rural areas where it is very hard to reach. However, with the notion of Universal Health Coverage (UHC), advocated by the World Health Organisation together with the Primary Health Care that Lesotho is very serious about, there is a national pressure to provide healthcare services free of charge the nationwide including the hard to reach areas [10].

The second suggested solution is to establish techniques that can support the PHMIS such that when large amounts of data are collected or move across the telecommunication networks, across the healthcare facilities, are quickly interpreted to fast-track clinical diagnosis and facilitate accurate timely care. But this solution is beyond the scope of this research. Therefore, the research recommends a future study to establish the extent to which Artificial Intelligence (AI) can be used to support the envisaged PHMIS by enhancing healthcare service delivery and medical research. Moreover, the suggested solution aims at collecting data from many sources countrywide and facilitating one medical record per patient, it would be critical for data to be put together timely, diagnosis provided and much-needed care cure administered. Therefore, AI is seen as a good transformation of healthcare services, and suggest that it will revolutionise the medical practice. AI is believed to have the ability to recognise patterns in data that can help to diagnose conditions, faster than healthcare professionals can.

CONCLUSION

The problem that the research intends to address is that the healthcare service delivery in Lesotho is not integrated and therefore risky to the lives of the patients. The study is very significant to the nation because the Ministry of Health could use the results of the research as an informed basis

for the design of a Public Health Management Information System, that may be easy to implement as it is informed by the key stakeholders of health care service delivery in the country.

The study revealed that to resolve the problem of fragmented healthcare service delivery, medical records should be migrated from paper-based to electronic format to facilitate proper and reliable storage and easy retrieval of information when required. Secondly, sharing medical records should be a priority for the Government of Lesotho, such that one patient has one record regardless of the number of healthcare facilities that have provided him/her care, both public and private. This would ensure that healthcare professionals have access to the full medical record of each patient, which could be accessed from any facility. The basis for such an arrangement is a theoretical model that has been adopted for the research known as OmniPHR. To ensure that the medical records are secure and remain confidential and private, the OmniPHR should be supported by Blockchain Technology, which allows decentralised healthcare service delivery, using cloud technology but still protecting the patient medical information, because medical records contain sensitive and private information.

Notwithstanding the technology that could support the integration of healthcare services, securely, the whole process still needs a Legal/Policy framework within which the system should operate. This would ensure that both the patient and the healthcare professionals get full benefits from the envisaged system. The laws must exist that not only allow sharing of medical records by authorised and registered healthcare facilities and professionals but also protect the usage of such medical records to the benefit of all the stakeholders of healthcare services.

Finally, the research recommends future research that would establish the extent to which Artificial Intelligence (AI) can be used to support the envisaged PHMIS by enhancing healthcare service delivery and medical research. The successful AI techniques would ensure that healthcare service delivery is safe and of high quality to facilitate timely diagnosis and treatment.

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CONFLICT OF INTEREST

None

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