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A Framework to Assess the Impact of Information and Communication Technologies on Patient Records Management in Healthcare: A Case of Windhoek Central Hospital

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Abstract: ***The Namibian healthcare has invested significantly in the use of ICT for healthcare, which includes automated Patient Records Management (PRM). However, Namibia's Ministry of Health and Social Services (MoHSS) has not conducted an impact assessment of the investment in electronic PRM as no Namibia-specific impact assessment frameworks exists for this purpose. This makes it difficult to justify such an investment in the healthcare sector. The aim of this research is to design a framework to assess the impact of information and communication technologies on PRM in the Namibian healthcare sector using the Windhoek Central Hospital as a case study. For this research the modes of data collection consisted of semi-structured interviews and questionnaires. Sen's capability framework, Rural ICT comprehensive evaluation framework (RICT-CEF), e-Governance framework, Assessment of ICT pilots projects and An extended framework for investigating ICT impact towards development were identified, whose assessment criteria feed into the questions to assess the impact of ICT on PRM. The core of the framework which is the result of this research consists of four elements which are the effectiveness of the PRM system, the value of using ICT in the PRM, internal and external factors that influence the use of ICT in PRM.***

Keywords: impact assessment; impact assessment frameworks; health information systems, patient records management

1. Introduction

In recent years, there has been a focus on Health Information Systems (HIS) in developing countries. This focus was primarily perpetuated by efforts from NGO's, governments and development partners desiring enhanced healthcare services via different methods and approaches [1]. HIS is defined as links between people, processes and technology, aiding operations for betterment of healthcare services [2]. In further support, HIS is described as being a system consisting of a collection of software, hardware, data, processes and reports for optimal management of healthcare activities [3].

Health services are managed nationally through the Ministry of Health and Social Services (MoHSS). These services are categorised in two, public and private healthcare [4].

The public health structure in Windhoek, Namibia consists of two main hospitals. The Katutura hospital is an intermediate hospital and the Windhoek Central Hospital, a referral hospital. The intermediate hospital is the receiving point of public patients within the city and around the country. Under certain circumstances, patients could be referred to the referral hospital for further treatment. The referral hospital additionally accommodates patients from private doctors.

The Namibian healthcare has invested significantly in the use of ICT for healthcare, which includes PRM [2]. However, the results of such an investment are not always visible when visiting public hospitals [5]. The problem however is that the MoHSS has not conducted an impact assessment to support the huge investment in electronic patient records management and no frameworks exist for this purpose [6]. This makes it difficult to justify such an investment in the healthcare sector. A significant part of the healthcare system includes management of patient records. Patient information is vital in decision making concerning a patients' health. It is important that medical practitioners have up-to-date information to help with diagnosis or treatment of patients. Furthermore easy access, faster processing and storage is key in providing enhanced healthcare services.

This research examined the various frameworks that are available in other parts of the world for this purpose and developed an impact assessment framework on PRM that can be used in Namibian public hospitals. The study's aim therefore was to develop a framework to assess the impact of ICT on PRM in Namibian public hospitals.

2. Literature Survey

This section examines existing literature related to the research. The study focused on key topics namely definitions of impact assessment, impact assessment frameworks, health impact assessment frameworks, and patient records management.

A. Definitions of impact assessment

Impact assessment studies span across different fields. Some examples include environmental, ecological, political and health related fields. A study conducted in community health science defines health impact assessment as "an assessment of the health effects, positive and negative, of a project, program, or policy" [7]. Impact assessment is about "identifying and evaluating change" [8]. Considering the context of the study, impact assessment is defined to focus on the change brought about by health related activities

performed by medical practitioners and hospital administrators when using the PRM system. The change can be assessed or measured by adopting qualitative and/or quantitative methods [7].

Several impact assessment frameworks have been identified and briefly described in this section. Due to scope constrains of the research paper the following frameworks were selected, Sustainable livelihoods approach, Sen's capability framework, Rural ICT comprehensive evaluation framework (RICT-CEF), e-Governance framework, Assessment of ICT pilots projects and An extended framework for investigating ICT impact towards development. These frameworks are listed with brief descriptions as follows.

B. Sustainable livelihoods approach

The concept of sustainable livelihoods (SL) comes from the work of Robert Chambers in the mid-1980s [9]. It has since been mentioned in matters related to rural development, poverty reduction and environment management [9]. Sustainable livelihoods approach is termed as a "people's capacity to access options and resources and use them to make a living in such a way as not to foreclose options for others to make a living, either now or in the future" [9]. He argues that there are other tools such as rural development, participatory development and sector-wide approaches, but that SL considers the people linked to an environment that affects the results of livelihood strategies. As such SL concerns itself with individuals in a society when considering development in such a society.

C. Sen's capability framework

Amartya Sen looked at two key areas, namely Functioning's and Capabilities and how they are linked to livelihood in a community [10]. Functioning's termed to "reflect the various things a person may value doing or being", whereas Capabilities "refers to the alternative combinations of Functioning's that are feasible for her [a person] to achieve" [10]. Capabilities are further described as availed liberal choices or opportunities individuals have [11]. Therefore in Sen's words "the concern is with the capability to function, rather than with achieved functionings" [12]. The capability approach is known to be a framework of thought and touches on socio-economic matters such as well-being, poverty, freedom, development, justice and social ethics [13]. The framework can be used to measure and evaluate these socio-economic matters.

D. Rural ICT comprehensive evaluation framework (RICT-CEF)

ICTs are increasingly depicted as aid toward development, more so development in rural communities. Despite this perception there is little empirical evidence supporting this notion. It has been documented that there are benefits brought about by ICTs socially and economically, at the same time there are cases where ICT projects that were implemented in communities turned out to be futile [14]. For reasons such as this comprehensive evaluation that encompasses the different stages of a project, from inception to testing and beyond was deemed necessary [15]. The outcome being the Rural ICT Comprehensive Evaluation Framework (RICT-CEF) [15]. According to the authors RICT-CEF is based on "a multi-method analysis of ICT4D and Information Systems evaluation frameworks and the fundamental concepts of programme evaluation, to determine the multiple components associated with rural ICT evaluation" [15].

E. E-Governance framework

E-Governance is explained to be processes that change slowly over time involving interaction between the people, public services and the government [16]. There is no specific framework that has been identified as the general solution to effective e-governance [16]. Literature shows that there are different frameworks that could be used to attain effective e-governance [16]. For one the Oman e-governance framework is described to be the most comprehensive framework not seen in other countries [16]. It is understood to align itself with the mission of the Information Technology Authority (ITA) and is set to be a set of standards or best practices and process management for government service delivery [17]. The framework enforces standards to ensure government IT projects maintain and contributes to the ITA's objectives [17]. The framework further validates the value of IT and produces a framework for IT related risks by setting controls.

F. Assessment of ICT pilots projects

ICT pilot projects are projected to contribute towards development in a society. To contribute towards development the importance of evidence based interpretation from a forward looking perspective is emphasised [18]. It is argued that ICT pilot projects should be seen as applied research [18]. Thus a certain hypothesis should be addressed and data generated accordingly. Monitoring and evaluation at project level is not sufficient making applied research necessary [18]. Monitoring and evaluation is normal practice used for learning. The aim being to determine if project purpose has been achieved by looking at certain activities and results [18].

3. Methodology

A. Research design

A case study approach was adopted in this research. The Windhoek Central Hospital, which is a public hospital, was used as the case study in this research. The public hospital is situated in Windhoek. The hospital was selected because it is a national referral hospital that receives patients from all regions across the country. For this research an interpretivist approach was selected as the research paradigm. The interpretivist paradigm allows for the study of things in their natural setting, for interpretation in an effort to make sense of the phenomenon in relation to the meanings brought about by the individuals. Qualitative data gathering from participants of a public healthcare was possible because of this approach. This type of data helped provide understanding of the interaction which took place between the participants, more specifically the users of the PRM system, and interactions between the users and the PRM system, in the delivery of healthcare services.

B. Participants' sample

A random sampling of healthcare personnel was done. The healthcare participants consisted of two groups. The first group were the primary users of the PRM system namely

nurses and administrative officers. The second group were the support group to the users of the system namely a chief IT technician, a chief systems administrator and a nurse quality health improvement officer. These two groups of participants were selected based on their roles and relationship to the PRM system. The first group are the end users of PRM system and the second group are the support to the users of the PRM system. A total of 49 participants were selected. Of the 49, 38 were nurses and eight administrative officers. A total of 43 questionnaires were distributed to the primary users of the PRM system. The reason for the sample size is that a point of data saturation was reached as these participants are using the same system within the same healthcare. As such the answers to the questions or statements were becoming the same reaching a saturation point.

C. Data collection

The modes of data collection included semi-structured interviews and paper based questionnaires. The questionnaires were conducted to gather data that would produce the criteria needed to formulate the impact assessment framework in the use of ICT for PRM. The questionnaires followed a Likert scale that aided with gauging perceptions, attitudes and values of the participants in that they indicated their level of agreement or disagreement with the statements. There were a few open ended questions included in the questionnaire to allow for descriptive explanations by the participants and possible follow ups on these questions. The questionnaires were only distributed to nurses and administrative officers, as they were the primary users of the PRM system.

4. Results and Discussion

The following were the findings of the research.

A. PRM system at the healthcare

The ICT system used at the hospital for PRM is called the Integrated Healthcare Information Management System (IHCIMS). The IHCIMS is also referred to as the E-Health system that is web-based [19].The administrative officers use the system for patient admissions, discharges and billing. Nurses use the system for pharmacy orders and ward stock orders. Additionally the system can also capture and manage HIV information for HIV patients as well as their dispensing information [20]. When the system was implemented, the users of the system were informed that it was mandatory to use the system during training that was provided. One nurse stated that it is a good system for administrative purposes but not practical for them. They conduct and record nursing care reports on paper files and find it impractical to capture this information on the IHCIMS again as it would be double work.

B. ICT policies in the healthcare

At the time of this research study it was unclear if ICT policies existed in healthcare as interviewed nurses and administrative officers alike were not sure or unaware of such policies. However all of them were of the opinion that should there be such policies that it be followed in using the IHCIMS. A policy can help produce an optimised creative work force and encourage health personnel learn the necessary and required skills [21].

C. Process involved in using the PRM system

Before using the IHCIMS, the user must login to the system with a user name and password. The IT administrators provide users with login credentials. A username is created for the user and thereafter the user can create his or her own password and change the password at will. Login is a requirement for all users to ensure security of information on the system. The IT administrators provide technical support to the users of the IHCIMS, in this case the nurses and administrative officers. The system was implemented to be used by healthcare staff including nurses and administrative officers. However nurses use the system minimally. It is the administrative officers who mainly use the system as they do patient admissions, discharges and patient transfers on the IHCIMS system. Nurses mainly use the system to place pharmaceutical orders and ward stock orders. The capturing of patient demographics by the administrative officers is referred to as patient registration on the IHCIMS.

D. Manual filing used concurringly with the PRM system

Filing is however still done manually and used concurrently with the IHCIMS. Nurses use patient paper files to record patient demographics. These files are handed over to the administrative officers to capture patient information, such as discharges on the IHCIMS. This is a challenge as these files get lost in the process. The administrative officers only work during the day and thus receive files of patients admitted during the night, the following day for capturing patient information from files to the IHCIMS. In this process patient files can get lost. Active patient files are kept within the administrative officers' office storage and inactive ones kept in a store room that is kept locked. The inactive files are kept minimal five years for patients and twenty years for maternal patients before they are send to archives.

E. Perception of nurses and administrative officers about the PRM system

Though some changes could be welcome, the system is suitable for the Namibian healthcare context thus effective on one hand as it meets the Namibian healthcare user requirements. According to one administrative officer, the system is especially effective for revenue collection and tracing of patient records. On the other hand there is a need for the nurses and doctors to use the system fully. Nurses should use the system for capturing and managing patient nursing care, whereas doctors should use it for patient diagnosis and more. Only patient demographics are recorded on the IHCIMS. Capturing on the IHCIMS is rated highest effective compared to retrieving patient medical records because capturing is done using a patient registration number field on the IHCIMS but not according to the MR number which is a patient identification number. Though the system creates an MR number one cannot use the MR number to search for patient records. You can only use the MR number to do patient account billing, or checking if a patient was admitted or discharged. As such PRM has not improved as it is still done manually. The IHCIMS is mainly used for patient registration which is the recording of patient demographics. This in turn is double work as these same

demographics are recorded on paper files. From literature reviewed, medical practitioners generally have been indicated to have negative perceptions about the technologies used in healthcare [22]. These perceptions have been attributed to a lack of training in the use of ICT in most cases [22]. However the healthcare personnel are open to the idea of using ICT to carry out their duties as they perceived ICT would not affect their style of work [23]. In a study by Adeyeye (2015) the healthcare personnel participants perceived that the PRM related system would aid workflow processes and communication in the healthcare organisation [24].

F. Challenges in using the PRM system

There is a lack of interest in using the system by some medical personnel. Some nurses are computer illiterate and slow in typing thus resort to writing manually. This is the case mainly with older nurses. Double work for nurses contributes to discouraging the use of the PRM system, as the nurses would need to report patient nursing care on paper files and recapture it on the IHCIMS. A lack of training in using the system additionally contributes to nurses drawing back in using the system.

G. Suggested resolutions in using the PRM system

According to an administrative officer, since the registration of the patients demographics can be achieved on the IHCIMS, there is a need to capture all medical information related to the patient on the system such as doctors diagnosis and nursing care reports.

H. Effectiveness of existing PRM as viewed by nurses and administrative officers

As main users of the PRM system a collective perspective in percentage was presented using the questionnaire feedback, related to the effectiveness of the PRM. Out of 43 participants 72% of the participants agreed that the PRM was effective for capturing patient medical records, with 21% undecided and 7% disagreed. 69% agreed that the PRM is effective for managing patient records whereas 19% were undecided and 4% disagreed. As for the effectiveness of accessing patient medical records, 65% agreed that it is effective with 30% undecided and 2% in disagreement. 70% agreed that storing patient medical records is effective whereas 26% were undecided and 2% disagreed. With the collective view as it relates to the effectiveness of the PRM, capturing patient medical records was rated the highest, followed by storing, managing and finally accessing. Literature reviewed showed that health care organisations increasingly capture patient information electronically [25].

I. Effectiveness of existing PRM according to the patients as perceived by nurses and administrative officers

The participants were asked to comment on how the patients viewed the effectiveness of the existing PRM system. Out of the 43 participants 51% of the participants agreed that patients find the existing PRM system effective, with 30% undecided and 14% disagreed. As such according to over 50% of the participants, patients viewed the existing PRM system as effective. Patients viewed the use of ICT in healthcare to be beneficial in that it would contribute to their wellness [23]. Some of the perceived benefits by the patients included easier access and storage of information and that doctors could be aided in diagnosis of complex ailments.

J. Value of using ICT in PRM

The analysis of the data shows that out of 43 participants 91% of the participants agreed that there is a need to use ICT in their PRM system, with 2% undecided and 7% disagreeing. Equally 91% agreed that ICT will help improve their PRM system whereas 2% were undecided and 7% disagreed. 88% of the participants agreed that ICT will make their work easier, faster and efficient as it relates to the PRM system, with 5% undecided and 7 disagreed. The use of ICT in healthcare organisations have the potential to improve productivity that optimises quality, reduce time spending, and enhance communication and efficiency [24].

K. Internal factors which influence the use of ICT in PRM

From the 43 participants that completed the questionnaires 70% agreed that patients will benefit from the use of ICT in the PRM system with 14% undecided and 11% disagreeing to the statement. Two participants did not answer this question. 91% of the participants agreed that financial resources must be allocated to purchase and maintain ICT for PRM with 7% undecided and 2% in disagreement. Equally 91% said that the ICT utilised for PRM must suit the Namibian hospital context, whereas 7% were undecided and 2% disagreed. 61% of the participants agreed that the infrastructure in the Namibian hospitals is sufficient to support the use of ICT for PRM at the time of this research study with 19% undecided and 21% in disagreement on the matter. 47% agreed that the hospital has sufficient staff to use the ICT for PRM, 9% were undecided and 42% disagreed that there were sufficient staff to use the ICT. 96% agreed that training to use ICT for PRM must be provided where 2% were undecided and 2% disagreed. Furthermore 95% of the participants agreed that the ICT for PRM must be easy to use. Two participants did not answer this question. Finally 47% agreed a salary increment would encourage them to use ICT for PRM with 9% undecided and 45% disagreeing with the statement.

L. External factors which influence the use of ICT in PRM

The analysis of data depicts that from the 43 participants who completed the questionnaire 54% agreed a culture of using ICT in the PRM exists in Namibia at the time of this research study, with 16% undecided and 30% in disagreement. 72% of the participants agreed that healthcare ICT policies must be followed when using ICT for PRM. 23% were undecided and 5% disagreed. 61% agreed that the Namibian health sector encourages the use of ICT for PRM and 21% were undecided on the statement and 19% disagreed. 52% of the participants agreed that the Namibian government is willing to invest in ICT for PRM, 44% were undecided and 4% disagreed. Lastly 74% agreed that there is a satisfactory level of internet infrastructure in the hospital and Namibian health sector to support the use of ICT in PRM whereas 9% were undecided and 16% disagreed.

M. An ICT impact assessment framework for PRM

The above findings from the questionnaires provided the elements and subjects making up the framework as seen in

Fig. 1. The framework is specific to healthcare, consisting of healthcare personnel and patients as subjects. The core of the framework linking the two subjects is the PRM system. As such both subjects have a relationship with the PRM system. The healthcare personnel are the users of the system, thus have a direct relationship whereas the patients are affected by the use of the system therefore having an indirect relationship with the system. The PRM system elements are the effectiveness of the PRM system, value of using ICT in the PRM, internal factors and external factors. These elements are discussed as follow.

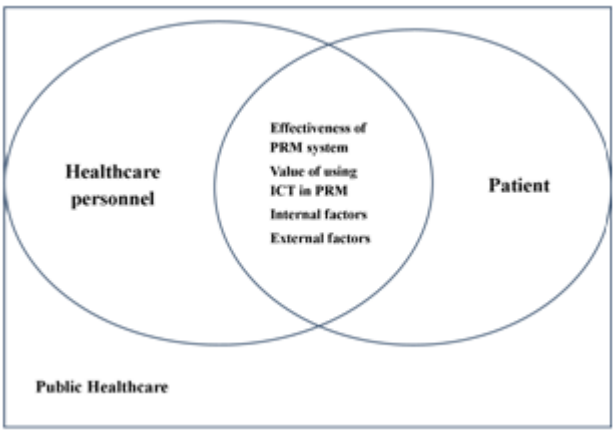

Figure 1: Framework to assess the impact of ICT for PRM in a public healthcare.

N. Effectiveness of existing PRM

The effectiveness of the system consist of two viewpoints, namely the effectiveness of existing PRM as viewed by nurses and administrative officers (healthcare personnel) and the effectiveness of existing PRM according to the patients as perceived by nurses and administrative officers (healthcare personnel). The latter is discussed in the next section. As for the former, effectiveness of the PRM consists of capturing, managing, accessing and storing patient medical records. These processes are effective when it can be done without difficulty or hindrances (internally or externally). Internal hindrance refers to the user of the system being incompetent in using the system whereas external refers to technical problems as it relates to the PRM system. In the study capturing patient medical records using the PRM system was rated highest effective by administrative officers and nurses, as such it indicated ease of use for patient data entry, followed by storing, managing and finally accessing. These components are therefore an important aspect of PRM effectiveness and must be assessed.

O. Effectiveness of existing PRM according to the patients as perceived by nurses and administrative officers

In this section data was not collected from the patients, but the participants were asked how the patients viewed the system. It was found that 51% of the participants said that patients found the system effective. Thus it can be said that the effectiveness of the PRM system indirectly benefits the patients, in that faster admissions, discharges, etc. could be realised. It was therefore necessary to consider patients in the framework as a subject in assessing the impact of ICT for PRM. Questions such as how does the use of the PRM system benefit patients directly or indirectly should be asked.

P. Value of using ICT in PRM

The findings show that 91% of the participants indicated that the use of ICT for PRM is needed. The participants equally indicated that the use of ICT will aid in improving the PRM system. 88% of them indicated that it will make their work easier, faster and efficient as it relates to PRM. It is therefore vital to assess the value addition brought about by the use of ICT for PRM in the healthcare. Questions such as what PRM system is used for PRM and how does this system make work easier, faster and efficient for the user, should be asked.

Q. Internal factors

Internal factors refer to factors that influence the use of ICT in PRM. Lists of these factors are:

- Patient benefits: Findings show that 70% of the participants indicated that patients would benefit from the system. If the system does not benefit the patient as the customer to the healthcare, the system would be unnecessary.
- Financial resources: 91% of the participants indicated that financial resources must be allocated by the healthcare towards purchase and maintenance of ICT for PRM. It is important to assess the budgeting or availability of financial resources at the healthcare to determine affordability and up keep of the technologies.
- Customised PRM system: 91% of the participants indicated that the ICT utilised for PRM must suit the healthcare context. Healthcare PRM requirements assessment is necessary to determine if the system meets the local healthcare requirements.
- Hospital infrastructure to support the use of ICT: Healthcare infrastructure to support the use of ICT for PRM should be assessed to determine if these technologies can be housed and supported.
- Sufficient healthcare staff: Staff to use the ICT for PRM must be assessed to determine the support efforts from the IT administrators for the users of the system.
- Training to use the system: 96% of the participants agreed that training must be provided to the users of the PRM system. Assessment of training needs is necessary to ensure competency of the users of the system and help boost interest in using the system.
- User friendliness of the system: 95% of the participants indicated that the ICT for PRM must be easy to use. Assessing user friendliness of the system would encourage healthcare personnel to use the system.
- Incentives such as salary increment: 47% of the participants agreed that an incentive such as a salary increment would encourage the use of the system. Hence assessments on whether incentives are necessary to motivate the use of the PRM system would be needed.

R. External factors

External factors refer to factors that influence the use of ICT in PRM. A list of these factors is:

- Develop a culture of using ICT for PRM: 54% of the participants indicated that there is a culture in using ICT for PRM. Assessing an existence of such a culture will help determine why it is that healthcare participants use or does not use the system and help emphasise the importance of a good working environment.

- ICT policies: 52% of the participants agreed that the healthcare encourage the use of ICT policies. Assessment of existing ICT policies are needed to determine the presence and extend to which these policies are applied. Additionally whether this policies are plain enough to be followed. The policies would be a control mechanism in determining the does and don'ts of using ICT for PRM.
- Healthcare must motivate the use of ICT for PRM: 61% of the participants agreed that healthcare encouraged the use of ICT for PRM. Assessment of what mechanisms by the healthcare are in place to encourage the use of ICT for PRM.
- Government to prioritise investing in ICT for PRM: 52% of the participants agreed that the Namibian government is willing to invest in ICT for PRM. Assessing the need to motivate investment of ICT for PRM by reporting on effectiveness of the PRM system would be necessary.
- Internet infrastructure to support the use of the PRM system: 74% of the participants agreed that there is a satisfactory level of the internet infrastructure in the healthcare to support the use of ICT for PRM. Assessing the internet infrastructure in the healthcare for availability and effectiveness as it would be the backbone in connecting different departments in the healthcare for PRM would be vital.

5. Conclusion

Namibia has invested heavily in HIS in an effort to enhance the quality of healthcare in its public institutions. What is missing though is a framework to assess the impact of this massive investment in ICT. This is the gap that this research is filling through the design of an impact assessment framework to measure the benefit derived PRM system. The emphasis of the MoHSS is on ensuring that public healthcare which was designed for those who cannot afford private healthcare services is of the right quality. PRM automates the process of admission, hospitalisation and follow-ups. A number of impact assessment frameworks ranging from Sen's capability framework, Rural ICT comprehensive evaluation framework (RICT-CEF), e-Governance framework, Assessment of ICT pilots projects and An extended framework for investigating ICT impact towards development feed into the impact assessment framework of ICT on PRM which is the output of this research. The core of the framework consists of four elements which are the effectiveness of the PRM system, the value of using ICT in the PRM, internal factors that influence the use of ICT in PRM and external factors that influence the use of ICT in PRM.

6. Future Scope

For future research work this study recommends that aspects that were not covered as a result of the scope and focus of the study be considered by researchers. This could include investigating the functionalities of the system to determine if the system is being fully utilised, in other words are the final work outputs related to PRM equivalent to the full system potential. Additionally testing the framework at any healthcare is recommended for further studies. Finally research studies on usability issues related to the framework is recommended. The developed framework would aid decision makers in investment related decisions regarding ICT for PRM. The Framework can be used to assess impact on the use of ICT for PRM.

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