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Good practices to enhance the perceived usefulness of computerized hospital information systems – case study in Nigeria

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Background and Purpose: Information systems that are not perceived useful, might not be used optimally. This can be seen as a waste of valuable resources and investments. The theoretical objective of the study was to see how Hanmer's Model of Computerized Hospital Information System (CHIS) Use and Perceived Usefulness could be applied in a case in Nigeria. The practical objective was to build experiences of usefulness into good practices to motivate further CHIS use.

Methods: Hanmer's model of CHIS use, developed and validated in South Africa, was used as a framework for this qualitative empirical case study. In-depth thematic interviews with clinicians (N=8), medical records officers (N=6) and hospital administrators (N=5) were conducted in spring 2011 at two Nigerian hospitals. Combinations of deductive and inductive content analysis were applied.

Results: The narratives of the respondents (N=19) fit into Hanmer's categories of *Knowledge and understanding about CHIS*; *Appropriateness of design*; *Performance*; *Availability and allocation of resources*; *Management commitment to success*; and *Effective use of CHIS outputs*. However, poor infrastructure, interrupted power supply, political and cultural climate, historical aspects and environmental issues such as dust, moisture, heat, and compromised work ergonomics repeatedly emerged.

Conclusions: A new category *Acknowledgement of the environmental context* is proposed. As a practical contribution, 58 good practices to enhance the perceived usefulness of CHIS were retrieved from the narratives. Examples include adhering to the system hardware and network requirements, maintaining on-site technical staff and service contracts, involving different professional groups in ICT projects to initiate ownership of projects, and developing solutions for long-term archiving. These could be helpful not only to motivate the effective use of the current CHIS implementations and to lengthen the life cycle of systems in a sustainable manner but also to be utilized in future CHIS implementations.

Keywords: Computerized hospital information system, Perceived usefulness, Hanmer's model, Nigeria

1 Introduction

1.1 ICT in health care in Africa and Nigeria

Since the 1990's, the trend to deploy information and communication technology in the health care setting in order to strengthen and modernize health services has been growing globally. There is a significant increase in the efforts made in many developing countries including sub-Saharan Africa to develop health care by improving the documentation, statistics and work practices and thus to manage

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vulnerable resources with ICT. In the past many Nigerian hospital information systems have been robust, non-commercial and often developed by the local universities and university hospitals. The diffusion and usage of computers in Nigeria has been fairly low in the past because PC costs were too high for an average Nigerian. Currently the technology sector of Nigeria, especially in mobile solutions, has been rated the fastest growing in Africa. [1]

With a population of 160 million people, Nigeria has approximately one-sixth of Africa's population. Africa's most populous country faces enormous infrastructural challenges [2]. It has been stated that any country that finds it difficult to provide uninterrupted power supply for its citizens will have problems with the deployment of good ICT services, including ICT in health care [1].

An interest in computer literacy, technology acceptance capacities, the attitudes of health professionals and other stakeholders in the health sector in developing countries demonstrate a need for change [3]. The arrival of computer systems and technology in many sub-Saharan countries preceded the availability of computer skill and knowledge in the educational system. Many health professionals and health policy makers who graduated before the late 1990s received little formal training in computer or internet usage during their studies. Even those who had applied ICT to healthcare systems do not always get the maximum benefit from ICT advancements due to both inadequacies in data quality and a lack of data utilization [4, 5]. Research on Nigerian users' experiences in deploying ICT and their perceptions of ICT usefulness for their work, their patients and organizations is scarce.

In this study the term *information systems* is understood in the way that Alter [6] defines it and Mursu et al. [7] use it: work systems, the processes and activities of which are devoted to processing information: capturing, transmitting, storing, retrieving, manipulating, and displaying information. The work system itself is a system, where people on their own or together with machines performs work activities using information, technology and other resources to produce specific products or services for specific internal or external customers. Health care related ICT is exemplified in computerized hospital information system (CHIS), which typically consist of patient admission, discharge and transfer modules, billing, laboratory data and e.g. clinical information and order entry modules of medication and other treatment and therapies. Electronic medical records (EMR), electronic patient records (EPR), radiology information systems (RIS) and picture archiving and communication systems (PACS) [8, 9] are also types of CHIS.

People tend to use or not to use an ICT application or information system based on the extent that they believe it will help them to perform their job better. This phenomenon is called *perceived usefulness* [10]. It has been proposed that perceived usefulness influences the *user acceptance and usage behavior* of the user acceptance of information technologies in general [11]. *Usefulness* and *utility* can be seen also as steps on the way toward practical acceptability and full system acceptability. Usefulness means that the user feels he or she can use the system in order to achieve some desired goals [12]. Thus information systems that are not useful might not be optimally used. This can be viewed as waste of valuable resources in any economy. This is especially true in the case of developing countries or any environments where the resources are scarce [13, 14]. Hence it is feasible to examine and understand how users perceive the usefulness of information systems.

The theoretical objective of this study is to see how Hanmer's model of computerized hospital information system use [14] fits into Nigerian cases. The practical objective is to assess the experiences of usefulness and how they could be built into good practices to motivate CHIS use.

1.2 Hanmer's conceptual model of computerised hospital information system (CHIS) use

Lyn Hanmer [14] has developed and validated a conceptual model of CHIS use in the South African health care setting. On the hospital level, Hanmer identified six factors (Figure 1) contributing to the perception of usefulness and thus influencing the successful implementation and use of CHIS: 1) *Knowledge and understanding of information system*; 2) *Appropriateness of design*; 3) *Performance*; 4) *Allocation and availability of resources*; 5) *Management commitment to ensure success*; 6) *Effective use of CHIS and/or outputs*. Decisions on information system and health ICT application investments, implementation projects and roll outs in South Africa are launched at the level of provinces based on the ICT policy – individual health care facilities are not in the position to be involved in the decision making on which systems to implement.

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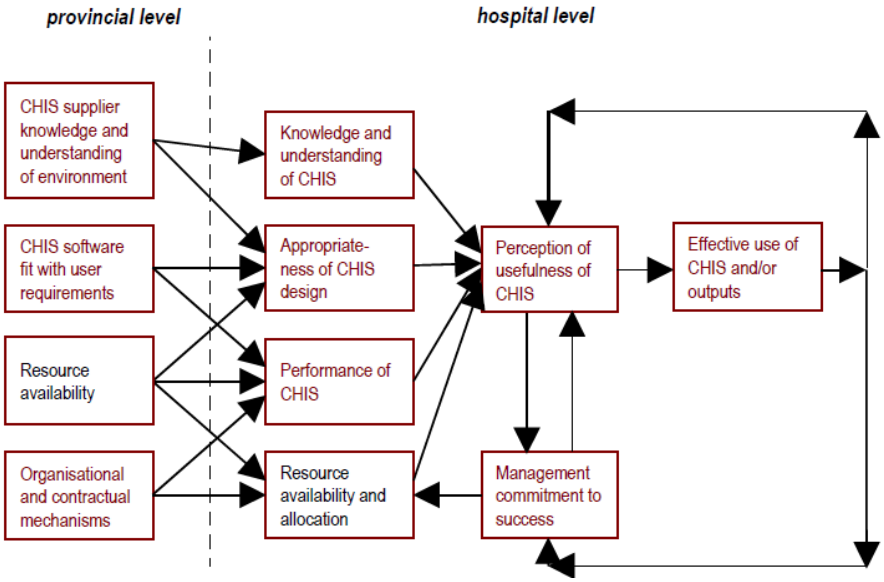

Figure 1. Hanmer's conceptual model of CHIS use [14]. Only the hospital level was used in this study in Nigeria.

In Nigeria, there are three tiers of government responsible for health care: Federal, State and Local government [15]. The individual health care facilities make decisions about the ICT to implement, thus a modified version of Hanmer's model was used as a framework for this study, with the hospital level assessment only.

In his paper on the barriers to the adoption of hospital information systems in Nigeria, Ayodele [16] [17, 18] suggests that government policies might constitute the major barriers hindering the adoption of hospital information systems in Nigeria. The heterogeneous solutions might explain the interoperability and integration challenges of various implementations described in literature [15, 19] resulting from the tradition of individual hospital deciding on which systems to purchase and implement.

2 Materials and methods

2.1 Research design

The research was designed as a qualitative single case study with an interpretive approach. The case study approach was selected because the particular CHIS application that had been developed by Nigerian and Finnish researchers in collaboration provided existing contacts in Nigeria and thus access to CHIS users in this environment. The empirical part, in the form of data collection through thematic in-depth interviews of CHIS users was conducted in Nigeria during spring 2011, during a three month North South South student exchange period of the first author dedicated to MHSc thesis writing [20]. Hanmer's model of CHIS use was selected as a framework for the study due to it being developed in an African country and thus having some potential to be applied in Nigerian context, too. It was acknowledged that Nigeria and South Africa might differ, e.g. concerning infrastructure and health service delivery system, but Hanmer's model was seen worth experimenting on as a framework rather than using a framework developed and tested outside Africa.

The six themes of Hanmer's hospital level model (Figure 1) were used in the interviews. Also, the respondents were asked to provide basic demographics and evaluate on a scale of one to five how useful they saw the CHIS for their work at the time of the interview.

The approval for the study was obtained from the Chief Medical Directors and Nursing Managers of the two hospitals. The two hospitals were both purposively and convenience selected out of the eight hospitals using the CHIS in question. Hospital A had been using the CHIS since the beginning of 1990's and was selected because of accessibility. Hospital B, much further north from hospital A, had been using CHIS since the mid 1990's and, as described by the software package developers, demonstrated the most extensive use of different modules and functionalities of the CHIS. The confidentiality and use of data for

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academic purposes was explained to the management of the organizations when interview permits were obtained through the existing local connections of the researchers. The participation to the interview was voluntary. Informed consent was confirmed verbally from each respondent when the study was explained to the interviewees. It was made explicit the thematic interview is not to assess or to evaluate the use of CHIS or compare institutions and there would be no right or wrong way to describe usefulness. The interviewees could withdraw from the interview at any time. All respondents were professional adults. Some of them were not willing to share demographics like age, educational or ethnic background, so this information is excluded from results. They were assured that once digital recordings were transcribed into text, the recordings would be erased and only transcripts which did not have any identification would be stored and analyzed.

The protocol did not require a clearance from a hospital ethical commission or equivalent because patient data was not handled. The selection of the different professionals for the interviewees at the hospitals was done by the managers and CHIS system administrators purposefully as instructed by the researchers based on the insight and interest in the topic. In purposeful sampling people, organizations and communities are selected because they are information rich and provide a useful insight of the phenomenon of interest. Selection is aimed deliberatively at individual experiences on the job and the intention is not to generalize from the sample of population [21]. Out of digitally recorded thematic interviews 146 pages of narratives of usefulness were transcribed.

2.2 Research environment and the case CHIS

The case software is one of the first CHIS in Nigeria and locally developed since the 1989. It is a result of the information management needs of a hospital's medical records staff and taken as a joint project of Nigerian and Finnish researchers and the local teaching hospital staff [22]. The objective was to develop a low-cost application with sustainable, indigenous capabilities. Public-domain software developed by the U.S. Department of Veterans Affairs (VA) and its Admission-Discharge-Transfer package was used as the basis and the requirements of the local hospital were processed to suit the information management practices [22, 23, 24, 25].

The original plan was to not only market the software to all teaching hospitals in Nigeria but later possibly introduce it as a commercial product to other areas, too. However, some interested potential customers were in the opinion that the package was not yet at that time ready for large commercial release as the hospital testing was not extensive enough [1]. Later there have also been some discussions between the developer team and the test hospitals on how the pricing, marketing, services and maintenance should be organized [25].

Although the commercialization of the software package might have been slow, new modules and functions have been continuously developed based on user requests over the years. The technical architecture of the first version was originally based on the MUMPS language, FileMan database management system, and Kernel software platform [24, 26]. Since then the software architecture and database structure has been modernized several times. Currently this CHIS is implemented in eight federal hospitals in Nigeria. At the time of the data collection, version number 3.0 was going through a complete re-engineering to produce the next generation thin browser-based user interfaces. The application will be accessed through browser by clinical staff, medical records personnel and administrators. At the time of the interviews, a Java platform was planned to be the backbone of the system. Each hospital would have dedicated servers in the hospital premises running the system and the databases. User consoles would connect to the server through intranet. Besides, the server could be connected to the Internet, enabling remote access from anywhere that there is Internet connectivity [20, 26].

2.3 Data analysis

Both inductive and deductive content analysis methods were applied. Deductive content analysis was used when the interest was to see if Hanmer's model will accommodate the topics retrieved from the narratives of Nigerian CHIS users, thus in a new environment. Inductive content analysis was used when looking for patterns, themes and categories in the data to allow new insights to emerge inductively from

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the data. This inductive analysis method was used to group together common themes of usefulness when building the good practices to enhance usefulness.

Figure 2 demonstrates an example of an inductive phase of analysing how the original expressions of interviewees were step by step formulated into good practices. Original expressions from digital recordings transcribed into text were first summarized, then built info sub-concepts and further grouped into good practices. This was done by using the categories of *Knowledge and understanding of CHIS*, *Appropriateness of design*, *Performance*, *Availability and allocation of resources*, *Management commitment to success*, and *Effective use of CHIS outputs*.

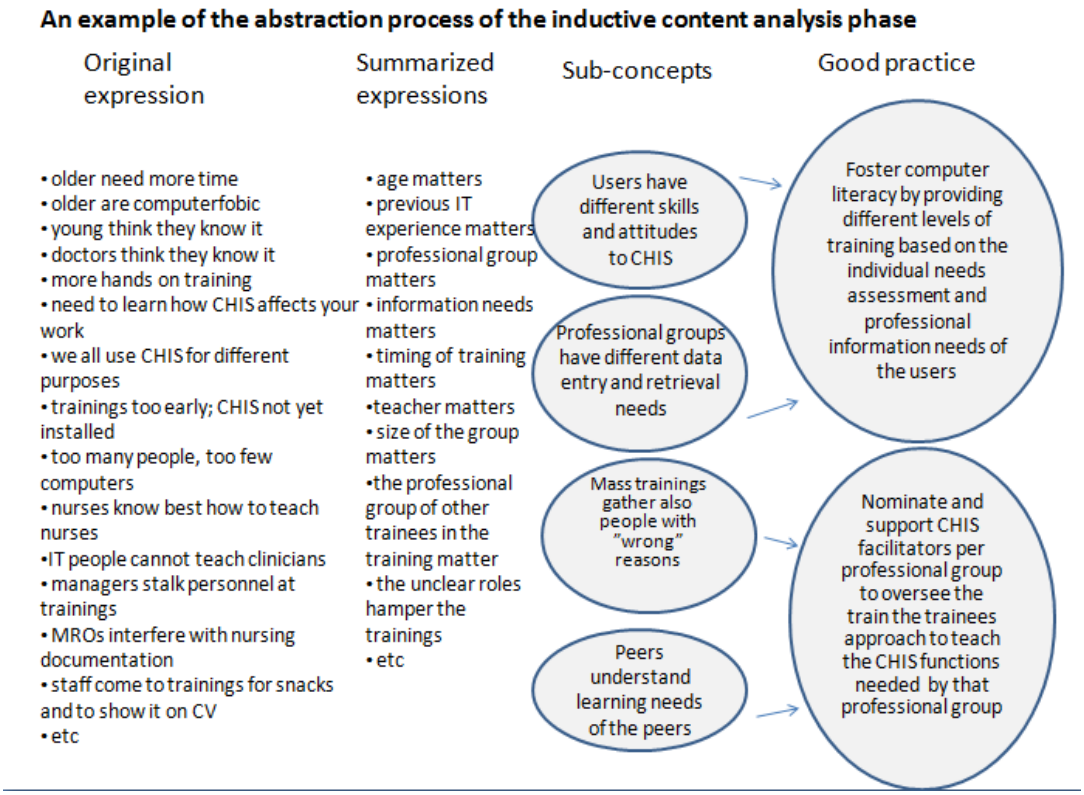

Figure 2. An example of the inductive content analysis abstraction process on how a good practice to enhance the perceived usefulness of CHIS was retrieved in the category of *Availability and allocation of resources*.

3 Results

3.1 Narratives and how they fit into Hanmer's original categories

The respondents (n=19) consisted of nurses (4), doctors (4), medical records officers/information officers (6), representatives of managements and administrators (4) and a software developer of the CHIS. There were 15 male and 4 female informants. All but one had been using CHIS at least at some point during their work routines; 15 of them currently actively. All medical records officers used CHIS every day. Computer literacy and CHIS use was achieved through a combination of self-study and learning on the job. All but one respondent had a computer at home. Respondents stated that there were tailored CHIS end user trainings for different hospital employee groups, but the trainings might be at irregular intervals.

The current mean overall score of usefulness of CHIS given was 2/5. Respondents voluntarily wanted to explain that the CHIS usefulness was 4/5 in the mid 1990's, but it had deteriorated gradually over the years. Issues with data quality and maintenance problems were stated as the main reason why the overall score of perceived usefulness had been decreasing. As estimated by both the hospital top management and by the developer, due to these challenges only 20-40 percent of personnel used the CHIS at the time of the interviews in 2011. The CHIS was used mainly for the Admission, Discharge and Transfer (ADT)

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functions, mostly handled by the medical records officers, including the documentation of patient diagnosis by using ICD-9. Also, some nursing documentation was conducted at both case hospitals, but there were still wards without computers. The core of the patient file was in paper format at both sites. It was explained by the administrators and management of both hospital A and B that institutions had not yet planned to stop using the paper documentation because paper is still the juridical form of a patient document.

The interviewed physicians explained that the majority of physicians are using only the manual paper based information system or tailored databases on their own laptop computers. The interviewed physicians thought CHIS is not reliable and stable enough due to power blackouts and network challenges. Some medical records officers (MROs) acknowledged that data on the CHIS database might not be complete because of parallel manual and electronic information systems and the isolated data repositories of physicians. MROs also explained that they dedicate a considerable amount of time in transferring patient information from paper files to the CHIS for statistics e.g. at the patient discharge time, because physicians are reluctant to enter diagnoses to the CHIS. In practice, MROs feel that they end up maintaining two information systems, the manual paper based documentation and the CHIS, to guarantee a good quality of statistics.

It was brought up by several MROs that in the beginning of 1990's the statistics were easily retrievable from the CHIS whereas now it was again done partly manually to re-check data quality. Increasing the number of computers in wards and modernizing and improving the hospital network system has been done in sync and per hospital IT strategy, yet staff voiced out their concern that the network would not tolerate more users at this point. An inadequate number of licenses for simultaneous users was suspected to cause some of the problem. When having no access to the network, clinicians and MROs had to rely on paper documentation and then once the network was up again, they had to remember to document the same data into the CHIS. Sometimes they forgot – or had no time to do so.

There were two clear layers in the narratives: on the one hand the potential and theoretical usefulness of any given CHIS in general or in future as a "dream CHIS", and on the other hand the usefulness of the current CHIS. Especially two interviewed super-user nurses who also train others and run the computer club for nurses, were well aware of the capabilities of the current system and the growing potential of it once used extensively:

> *"CHIS is a powerful tool to improve our patients care and our work, too. We should see it as an achievement, not as a burden."*

> *"It has been proved scientifically in many studies, that the number of errors is reduced when computerized systems are being introduced because notes and prescriptions are more legible. You continue data collection and utilization from where the previous staff member finished: continuity of health care. So another important feature of usefulness is the support for our workflow."*

However, not all clinicians were as convinced of the usefulness of the current implementation, targeting their criticism not towards the software package and design but rather towards infrastructure:

> *"When the lights go off and you are in the middle of documenting something, you are never 100 percent sure how much of that was saved even if the generators would start immediately. And they do not."*

Especially physicians were concerned and expressed frustration because of the gap between the expected usefulness of the CHIS implementation and the reality. Maybe if the ICT strategy and computerization plan of the hospitals were shared with the staff, some of the frustration could be voiced out to the right address:

> *"We are 75 % paper and 25 % electronic. It is inefficient. We need to computerize. Current system needs to be utilized more, in a structured manner. Now we are not sure if the data is complete."*

Clinical usefulness was experienced to be compromised because nurses have their nursing module and assessment sheets, whereas physicians did not seem to have support for their work activities in the same way. Or maybe their user requirements were still in the list of new features to be designed for the future versions but the status of the needed feature did not reach them for a reason or another:

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> *"Medical progress notes or a case note module would be the most to us. Currently it just does not yet support the doctors' work flow here. Progress notes should be available simultaneously by different professionals when needed."*

Even in the case of the current CHIS, two basic types of narratives of usefulness were reported: how useful the system was in the beginning in the 1990's after the initial implementation, and how useful it is now. The breaking point of usefulness, described by the ones who had been using CHIS from the very beginning of the development, had taken place some three-four years earlier as what the interviewees understood as a combination of uncoordinated software version updates and a lack of maintenance culture. After that, data entry and retrieval problems started to appear more frequently. The concern for data quality was the most frequently mentioned threat to usefulness regardless of the professional group of the interviewee.

Many of the issues mentioned affecting the perceived usefulness of CHIS were not directly due to the design of the CHIS software package. Especially the users who had a long history of using the system, actively brought up that the design was not the reason for the somewhat low perceived usefulness. Main reasons appeared to be the insufficient or unstable infrastructure, especially the power supply and network, the partly manual partly computerized HIS system and parallel health records, the data completeness and retrieval concerns, unclear responsibilities between clinicians and medical records officers, the lack of system integration, missing CHIS features causing a lack of support to the workflow, a lack of technical support and maintenance culture, and challenges in the collaboration with the developers.

3.2 New category: Acknowledgement of the environmental context

Although Hanmer's model appeared to accommodate the narratives well, interviewees brought up repeatedly the issue of a developing country having special features that the outsider would not necessary acknowledge. Some of those might affect the usefulness of a system which was known to be robust, reliable and easy to use. Users expressed that those issues should be taken into consideration when addressing the issue of perceived usefulness of applications and information systems in general in such an environment.

> *"Because we are in Nigeria, in one of these developing countries in black sub-Saharan Africa, we have our own unique problems. We must tackle also the infrastructure and environment when we discuss the concept of the perceived usefulness of it. Uninterrupted power supply is not self-evident."*

These themes relating to the environment and context were brought up most frequently by the hospital top management and administrative staff; less so by clinicians, medical records officers and CHIS developer. Many of these issues were associated with the physical, natural environment or the challenges of infrastructure, system maintenance or serviceability. The common concern was that the environment, especially in case of a developing country, in itself has some internal and external factors that the outsiders need to grasp in order to address and understand the concept of CHIS use and usefulness or when making assumptions about it. These themes, varying from straight forward climate issues to political instability and basic ICT education of staff, technical know-how and brain drain of medical and IT personnel to abroad, could not be accommodated comfortably in the previously existing categories of Hanmer's framework. Thus, a new category of "*Acknowledgement of the environmental context*" could be proposed. Naturally, the proposed category requires further research.

When proposing the *Acknowledgement of the environmental context*, the term *environment* would, in addition to the natural environment, cover also the socio-political environment including historical and cultural phenomena explaining e.g. the challenges in infrastructure and the considerably new tradition of IT maintenance. Thus it becomes closer to the concept of *context*. Context can be seen as the entire human environment including culture, history, and natural environment. Scopes of context can be based on the anthropological definition of three layers of contexts: cultural context, historical context, and immediate context [27] [28]. In information system development the nature has to be taken into consideration to maintain durability, sustainability and the continuation of the system use to utilize recourses to its best, thus the natural environment is added to the scopes of the context map.

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The importance of the environment regarding to the appropriateness of information systems is not unique. For example Tiihonen [27] points out that partners and observers from different cultural and historical heritages, for example the first author of this paper as a Finnish-speaking white woman in a Nigerian health care setting, do not easily grasp the socio-technical features in ICT implementations in developing countries. For example the environment in the form of the natural environment or the historical events that have led to a certain situation and the tacit knowledge of the employees, is not easy to recognize by outsiders. Therefore the intention is by no means to generalize any of these findings based on the narratives of CHIS usefulness collected in the case sites.

However, it might be interesting to try to combine these acknowledgements of the environmental context and Hanmer's existing six categories of CHIS usefulness into one unified figure as attempted in Figure 3.

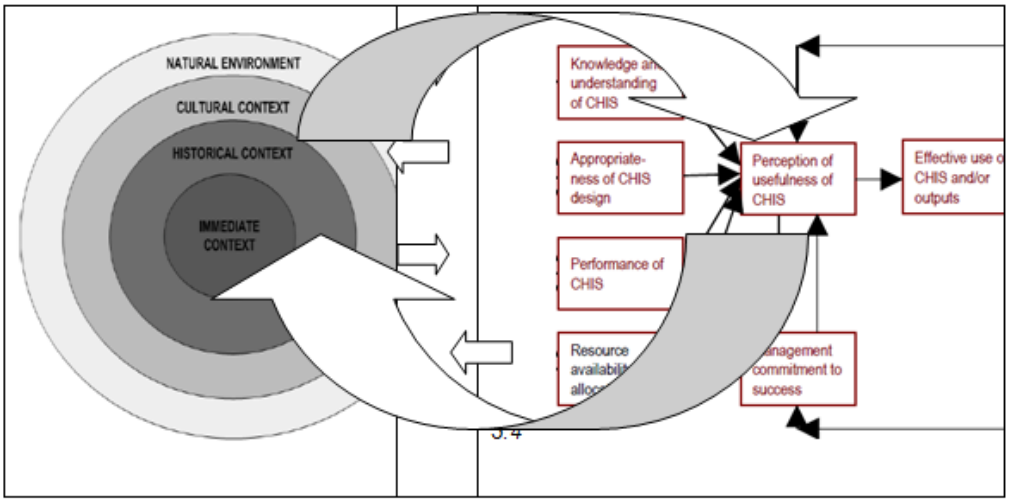

Figure 3. Continuous dialogue between the context and the perceived usefulness. Adapted from [27] and [14].

The different layers of context from immediate to historical, cultural and up to the natural environment embrace the immediate health care and hospital settings of CHIS use and the experience of usefulness. The health work and health information processing activities conducted in the immediate context of the hospital setting with the help of the CHIS are always surrounded by and dependent on the historical and cultural contexts and at the end of the day always surrounded by the natural environment which gives the extra challenges to ICT, whether in Nigeria or in Iceland.

The narratives of the interviewees can also be accommodated into Tiihonen's [27] different layers of context and cross-cutting sectors of organizational culture, infrastructure, economy, human resources and social-political structure. There is a continuous dialogue between Tiihonen's LACASA approach and Hanmer's model. The conclusion might be that they complement each other as proposed in Figure 4.

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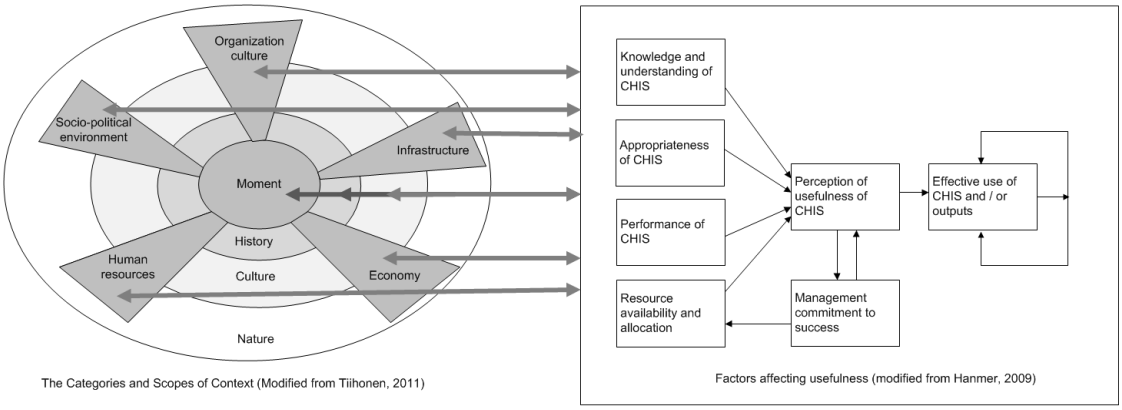

Figure 4. The relationship between Tiihonen's LACASA approach and Hanmer's model. The new factor *Acknowledgement of the environmental context* could enhance Hanmer's model.

The acknowledgement of the overall environmental context can be seen as a prerequisite to any successful ICT use and perceived usefulness. The developing country context and the resource restricted environment came up repeatedly in the narratives, thus the new category of *Acknowledgement of the environmental context* could be considered to enhance Hanmer's model.

3.3 Good practices to enhance the experiences of usefulness and to promote the more extensive use of CHIS

Altogether 58 good practices as how to enhance the experiences of usefulness could be derived from the narratives. Good practices include practical issues such as adhering to system hardware and network requirements, procuring service and maintenance contracts, working on data completeness, collaboration with developers and a national user club, a "train the trainers" methodology, recognition and incentives to CHIS facilitators, and communicating system integration based on ICT strategy.

All the 58 good practices are presented in the Appendix. The new category of *Acknowledgement of the environmental context* is discussed in more detail here. The main type of a good practice in *Acknowledgement of the environmental context* is to develop and maintain policies, protocols and routines to prepare for unwanted and unexpected scenarios (see Table 1).

Some of the good practices are directly related to the physical natural environment (e.g. moisture, sand, rain, floods), some of them to infrastructure (erratic electricity, blackouts, need for surge protectors), some to economic and political instability (potential strikes, violence, riots, even terrorism). Also, some good practices in this category do not necessarily at first glance appear to be associated with the environment. The respondents brought these challenges in their narratives as something typically taking place in resource constricted environments: rapid staff turnover, difficulty in hiring skilled personnel due to the brain drain of trained IT staff and clinical staff to private business or emigration to better paid positions in the US or Europe were voiced and ideas on how to retain and recruit skilled staff were initiated.

One could of course argue that many of the good practices in the category of *Acknowledgement of the environmental context* could also be squeezed into some of the existing categories of Hanmer's model. However, I believe presenting them together as special features resulting from the unique combination of the natural environment, cultural, historical and immediate contexts in a developing country would give an outsider at a glance some understanding of the challenges of the CHIS use in the developing country settings.

> *"The software itself is and could be useful – this is all now due to local technical challenges, infrastructure and miscommunication."*

> *"We do not want to give up. We have invested so much – work, time, funds. We cannot afford to abandon it. We have had a beautiful project. We'll show that we can take care of this and make this work, make it even better."*

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Table 3. Good practices to enhance the usefulness in the category of Acknowledgement of environmental context

	Good practices: Acknowledgement of environmental context
1	It is acknowledged that the software applications and solutions developed abroad are not necessarily applicable to the local needs and requirements as such but need local tailoring.
2	Robust, easy to maintain and locally developed open source software applications and solutions to hospital information system portfolio are favored.
3	The importance of remote access IT maintenance and service to get quicker service in areas out of reach is communicated with the developers and service providers.
4	(Policy how to protect the servers and workstations from excessive moisture, heat, dust, particles of sand etc during seasons of rain and harmattan is maintained.
5	Policy of protecting the computers and network switches from surge during irregular power service by providing adequate number of surge protectors is in place.
6	(Policy of adequate number of generator / generator farms and fuel reservoir to ensure uninterrupted power supply during electricity breaks and strikes is in place.
7	Risk assessment plan and protocol how to run information system in case of violent political conflict, riot or a catastrophe, which might produce large number of admissions in a short time is in place, is in place.
8	Risk assessment plan and protocol how to run information system in case of natural disaster is in place.
9	Policy how to operate CHIS during strikes of clinical and technical staff when hospital operations are run with minimum staff is in place.
10	Policy how to operate during strikes that affect to the availability of electricity, fuel and service delivery of other basic supplies needed at hospital is in place.
11	Retention plan for staff turnover and brain drain of ICT experts to private businesses and overseas due to of attractive job prospects and better pay is in place.
12	Staff recruiting and retaining policy that utilizes CHIS as one of the magnet hospital feature to call forth new hires is advertized.

The respondents did not use phrases such as “reluctance to use” or “resistance to change” – all in all there appeared to be a strong commitment to use the CHIS even after hiccups. Many of the big obstacles appeared to lie in the layers of the immediate, cultural, historical, and environmental context rather than in Hanmer’s categories of *Knowledge and understanding about CHIS*, *Appropriateness of design*, *Performance*, *Availability and allocation of resources*, *Management commitment to success* or *Effective use of CHIS outputs*.

4 Discussion

The narratives of 19 respondents as concerning the experiences of CHIS usefulness accommodated the categories of Hanmer’s model of CHIS use fairly well. Additionally, a separate category of *Acknowledgement of the environmental context* was proposed to be considered. Further study will be required to see if this category of the environmental context is applicable to other cases, too. Also, as stated earlier, no generalization to the Nigerian context or any other developing context can be made based on these findings. This is merely an attempt to understand the factors that might have an effect on the experiences of the usefulness of ICT in health care, in this case the usefulness of a CHIS, and thus might have an influence on the use of the system.

The findings in the study, however, are consistent with some of the observations in earlier research. The power supply and connectivity problems appear to be unavoidable in developing courtiers. Also, lack of maintenance culture and not yet having a tradition or resource to invest on service and technical support before problems arise can seriously damage the perceived usefulness when systems are down for hours or days [1, 13, 14, 16, 29, 30, 31]. In addition, if the ownership and control of the project in the beginning rests with the top level managers or external initiators but the professionals using the CHIS for their daily work have no feeling of being influential, it might be difficult for the end-users to build commitment to the project [30]. On the other hand, the experiences and attitudes of the interviewed CHIS super-user nurses and medical officers in these two hospitals supported Hanmer’s conceptual model: understanding and acknowledging the purpose and value of the CHIS and being ready to struggle to stabilize it will have an enforcing effect on the perceived usefulness. Despite of the pitfalls respondents

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mentioned, they had a positive attitude. They continued to motivate their peers to use the CHIS through the train-the-trainers method. As noted also by Hanmer, if users believe that the CHIS is useful for them, they will make an effort to ensure that the system works and will also try to use the outputs of the system. On the other hand in case that the CHIS is not perceived as useful, the commitment becomes compromised and users might want to neglect the correct use of the system. This might have been the case of some of the interviewed physicians, who expressed that they would rather use their own, separate databases for their research data because at times they did not trust 100% on the data on the CHIS. This vicious circle of partly documenting patient data on some other systems whether paper based or electronic, could then in the long run result in challenges to data completeness.

Still, it has to be taken into consideration that even with the hospital's greatest interest and commitment to take action on some of the challenges brought up by the users in this study and the good practices formulated based on their experiences, it might not be realistic simply because of the lack of funds, resources and qualified, affordable ICT personnel. This is a complex challenging situation between the CHIS users, hospital leadership and developers where everybody still is working towards a mutually satisfying solution. The re-engineering of the platform and database structure and the all-in-all usability optimized software package has been developed and deployed to these interview sites, so currently the experiences of usefulness and the level of use might be on a much higher level. At the same time hospital leaders and administrators have been looking for a balance between the manual paper-based documentation and full computerization. It would be interesting to go back now to assess the perceived usefulness.

Regarding the practical contribution of the study, 58 good practices were derived from the narratives on how to support the CHIS usefulness and use. Those good practices demonstrate the tremendous knowledge and commitment that the interviewed personnel have about the strengths that a CHIS has. Good practices can be helpful as such to motivate more effective use of current systems but also helpful in future implementations.

In the future it would be interesting to assess a CHIS project more profoundly from the procurement or in-house development process throughout the implementation and system maintenance phases to understand the life cycle of sustainable CHISs, not only in Africa but in any resource constricted environment.

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References

[1] Idowu P, Cornford D, Bastin L. Health informatics deployment in Nigeria. Journal of Health Informatics in Developing Countries. 2008;2(1): 15-23. Available from http://www.jhidc.org/index

[2] Nigeria: World Bank Country brief statistics. Available from http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/NIGERIAEXTN/0,,menuPK:368906~pagePK:141132~piPK:141107~theSitePK:368896,00.html

[3] Adeyoyin S, Imam A, Oladapo Y. Health workers' ICT literacy in a Nigerian University Teaching Hospital. The Information Technologist. 2009;6(2).

[4] Simba DO, Mwangu M. Application of ICT in strengthening health information systems in developing countries in the wake of globalisation. African Health Sciences. 2004;4:194-198.

[5] Uneke C, Ezeoha A, Ndukwe C, Oyibo P, Onwe F. Enhancing health policymakers' capacity to use information and communication technology in Nigeria. Journal of Health Informatics in Developing Countries. 2011;5(2):228-246. Available from http://www.jhidc.org/index

[6] Alter S.. Defining information systems as work systems: Implications for the IS field. European Journal of Information Systems. 2008. 17(5), 448-469.

[7] Mursu A, Luukkonen I, Toivanen M, Korpela M. Activity Theory in information systems research and practice: theoretical underpinnings for an information systems development model. Information Research. Vol 12. No 3, April 2007. Available from http://informationr.net/ir/12-3/paper311.html

[8] Coiera E. Guide to Health Informatics, 2nd edition, Hodder Arnold. Chennai. India. 2004

[9] Kuhn KA & Giuse DA. From hospital information systems to health information systems. Problems, challenges, perspectives. Methods Inf Med. 2001; 40(4):275-87.

 DOI: 10.12856/JHIA-2014-v2-i2-109

[10] Davis FD. Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. 1989. MIS Quarterly Vol. 13, Issue 3, pp. 319-340
[11] Venkatesh V. Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation and Emotion into the Technology Acceptance Model. Information Systems Research. 2000. Vol. 11, No. 4, December 2000, 342–365.
[12] Nielsen Jakob. Usability Engineering. Boston Massachusettes Academy Press.Boston. 1993-
[13] Heeks R. Health information systems: Failure, success and improvisation. International Journal of Medical Informatics 2006 (75), pp. 125—137.
[14] Hanmer LA. Factors Associated with the Successful Implementation of Computerized Hospital Information Systems in South Africa. Doctoral thesis. University of Cape Town. Cape Town. 2009.
[15] Oluwagbemi O & Achimugu P.. Lack of Integration in Software Systems for Health Practitioners in Nigeria: The Way Forward. Journal of Health Informatics in Developing Countries. 2010 Vol.4 No.1. pp 47-51. Available from http://www.jhidc.org/index
[16] Ayodele CB . Hospital information systems in Nigeria: A review of literature. Journal of Global Healthcare Systems, 2011, 1(3):1-26. Available from http://jghcs.info/index.php/j/article/view/71
[17] Ayodele CB. Adoption of Hospital Information Systems in Nigeria. Journal of Global Healthcare Systems, 2011, 1(3): 1-38. Available from http://jghcs.info/index.php/j/article/view/73/74
[18] Ayodele CB. Assessing barriers to Adoption of Hospital Information Systems in Nigeria. Journal of Global Healthcare Systems, 2011, 1(3): 1-33. Available from http://jghcs.info/index.php/j/article/view/72
[19] Gambo I, Olugwabemi O & Achimugu P. Lack of Interoperable Health Information Systems in Developing Countries: An Impact Analysis. 2011 Vol 5, No 1 pp. 185-196. Available from http://www.jhidc.org/index
[20] Vainikainen V 2012. Perceived usefulness of a Computerized Hospital Information System (CHIS) in a developing country context – Case study in Nigeria. MHSc. Thesis. Department of Health and Social Management. University of Eastern Finland. Kuopio. Finland.
[21] Patton M. Qualitative research and Evaluation methods. 3rd edition. Sage Pub-lications. USA. 2002
[22] Makanjuola ROA, Daini OA, Soriyan HA & Korpela M.Low-Cost Hospital Infor-matics in Africa: The Ile-Ife Experience. MIE 1991 Conference Proceedings. In: Adlassing et al (Eds.) Medical Informatics Europe 1991 Proceedings, Springer-Verlag p. 111-115.
[23] Daini OA, Korpela M, Ojo JO & Soriyan HA. The Computer in a Nigerian Teaching Hospital: First-Year Experiences. HELINA conference 1993. Ile-Ife. Nigeria
[24] Korpela M. Moving a valuable heritage to the network computing architecture. Proceedings of the 1999 Annual HIMSS Conference, Atlanta, Georgia. Vol. 3, pp. 405-419.
[25] Soriyan HA. A Conceptual Framework for information System Development Methodology for Educational and Industrial sectors in Nigeria. Doctoral dissertation. ObafemiAwolowo University. Ile-Ife. 2004
[26] Päkkilä T. Re-engineering of software architectures.A Case-study on a Nige-rian Hospital Information System. M. Sc. Thesis. School of Computing.University of Eastern Finland. Kuopio. 2010
[27] Tiihonen Tuija. Information Systems in Context. Building a Tool for Analysing Sociotechnical Context of Organizational Information Systems. PhD Dissertation. Un-versity of Eastern Finland. Kuopio. 2011
[28] Tapaninen, A-M. Sosiaaliantrolopologian perusteet, Homepage of Helsinki Open University. 2005 Available at http://www.avoin.helsinki.fi/Kurssit/sosAntr/materiaali/ [Coursematerial, in Finnish]
[29] Mengiste SA. Analysing the Challenges of IS implementation in public health institutions of a developing country: The need for flexible strategies. Journal of Health Informatics in Developing Countries, 2010 4(1),1-17,. Available from http://www.jhidc.org/index
[30] Avgerou C. Information systems in developing countries: A critical research review. Journal of Information Technology. 2008 23. 133-146.
[31] Kimaro HC. & L. Nhampossa José. The challenges of sustainability of health information systems in developing countries: comparative case studies of Mozambique and Tanzania. Journal of Health Informatics in Developing Countries 2007. (1) No.1. pp. 1-10.

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Appendix: Good Practices to Enhance the Usefulness of CHIS

	TABLE 1: Good practices: Acknowledgement of environmental context
1	It is acknowledged that the software applications and solutions developed abroad are not necessarily applicable to the local needs and requirements as such but need local tailoring.
2	Robust, easy to maintain and locally developed open source software applications and solutions to hospital information system portfolio are favored.
3	The importance of remote access IT maintenance and service to get quicker service in areas out of reach is communicated with the developers and service providers.
4	(Policy how to protect the servers and workstations from excessive moisture, heat, dust, particles of sand etc during seasons of rain and harmattan is maintained.
5	Policy of protecting the computers and network switches from surge during irregular power service by providing adequate number of surge protectors is in place.
6	(Policy of adequate number of generator / generator farms and fuel reservoir to ensure uninterrupted power supply during electricity breaks and strikes is in place.
7	Risk assessment plan and protocol how to run information system in case of violent political conflict, riot or a catastrophe, which might produce large number of admissions in a short time is in place, is in place.
8	Risk assessment plan and protocol how to run information system in case of natural disaster is in place.
9	Policy how to operate CHIS during strikes of clinical and technical staff when hospital operations are run with minimum staff is in place.
10	Policy how to operate during strikes that affect to the availability of electricity, fuel and service delivery of other basic supplies needed at hospital is in place.
11	Retention plan for staff turnover and brain drain of ICT experts to private businesses and overseas due to of attractive job prospects and better pay is in place.
12	Staff recruiting and retaining policy that utilizes CHIS as one of the magnet hospital feature to call forth new hires is advertized.

	TABLE 2: Good practices: Knowledge and understanding of CHIS
1	Staff knows the value of CHIS: what are the functions and benefits of CHIS for patient care, individual employee, organization and community.
2	Staff acknowledges CHIS could be more than an ADT admission-discharge-transfer module. Depending of the implementation and interoperability of systems, in addition to clinical data all operations in hospital could be part of CHIS and thus provide important information for decision making and planning.

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	TABLE 3: Good practices: Appropriateness of CHIS design
1	The features and modules of CIS support the workflow of the users.
2	Users are able to give feedback and request new features in a structured manner as per service and maintenance contract.
3	Developers maintain database of errors and user requirements. Decisions and schedules are communicated to the users.
4	All changes, new features and functionalities to clinical modules are hospital tested to ensure patient safety.
5	Developers ensure the continuity of information and sustainable IS development cycle by documenting all changes made to the CHIS.

	TABLE 4: Good practices: Performance of CHIS
1	Hospital based on-site IT specialist maintains CHIS as per ICT strategy.
2	Continuous service and maintenance contracts of hardware, software and network are in place.
3	Minimum system hardware, network and virus protection and data security requirements provided by the developer are committed to.
4	Hospital maintains appropriate number of software licenses to guarantee successful simultaneous log in for users.
5	Hospital maintains uninterrupted power supply and network conditions.
6	Hospital formulates and shares a protocol how to handle power and network failure.
7	System Audit & Analysis protocol with Logbook and instructions how to contact CHIS facilitator, system administrator, in-house IT and developer depending on severity of the problem is in place.
8	Routine protocol of taking back up and database dumps at regular intervals in case database corruption or system failure and how to re-install the system from backup media is in place.
9	Procedure and protocol for long term e-archiving is in place.
10	Protocol for legacy data separation to warehouse database to enable adequate performance of the system is in place.
11	In case performance issues or incomplete data is suspected, the data input and retrieval queries to verify problem sources are tested by hospital IT and developers.
12	Developers and IT service organization maintain up to date installed base documentation with frequently asked questions (FAQ) database, Call Tracker and service delivery database

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	TABLE 5: Good practices: Availability and allocation of resources
1	Hospital based on-site IT specialist maintains CHIS as per ICT strategy.
2	More resources are allocated to units active in ICT strategy implementation to work as an example to other units.
3	Responsibilities of hospital IT department, in house IT specialists, Sys admins, CHIS facilitators / super users are communicated clearly to avoid overlapping tasks and parallel processes.
4	Incentives are initiated for individuals and units committed to the ICT strategy.
5	Adequate number of ergonomic work stations is provided in wards to ensure documentation of patient care in a timely manner.
6	Computer literacy of health professionals is fostered by providing different levels of training based on individual needs assessment and information needs of the professional
7	CHIS facilitators and super users are nominated and recognized per professional groups to give and oversee "train the trainers" approach to teach the core functionalities and modules needed by that professional group.
8	Regular CHIS trainings with hands on use of applications to cover skill deficit due to staff turnover is organized.
9	Professional initiatives such as hospital based laptop clubs and internal user groups are encouraged on the hospital premises to motivate CHIS use.

	TABLE 6: Good practices: Management commitment to ensuring success
1	Representatives of all professional groups are involved in formulating the ICT strategy to initiate ownership.
2	ICT strategy covers the future plans of migrating from paper based information system to the computerized system and the protocol for the transition period of double documentation.
3	ICT strategy is communicated to the professional groups and stakeholders: for example how integration and interoperability of systems change work practices.
4	Both external and internal motivation is fostered among professional groups to enhance CHIS use.
5	Positive feedback for individuals and groups committing to CHIS used is initiated in form of staff awards and nominations.
6	Participation to an ICT seminar or workshop is introduced as an incentive and reward.
7	Hospital encourages senior medical staff to act as role models in CHIS use.
8	Centralized trainings in the form of user meetings and workshops are organized to collect user feedback or share latest enhancements together with the developers.
9	A joint national CHIS user group with the developers is organized so share good practices.
10	Management works actively to change the impression of CHIS being a tool for medical records officers: CHIS is presented as a valuable tool for all professionals.

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	TABLE 7: Good practices: Effective use of HIS and outputs
1	Users are trained to understand the importance of complete quality data input in order to retrieve quality data statistics.
2	Users are trained about the risks of maintaining separate, isolated, private databases.
3	Hospital maintains protocol how to document during system down time and how to transfer the manual documentation retrospectively to CHIS to guarantee data completeness.
4	Data retrieval training update is organized as per need to ensure retrieval of statistics.
5	Statistical, reporting, data retrieval and research query needs are communicated to and assessed with the help of IT service or the developer as per agreement.
6	Staff is encouraged to utilize HIS outputs in research papers and seminar presentations.
7	Success stories of effective decision making based on use of CHIS outputs are shared within the organization or in the community (e.g. in epidemiological planning).
8	To support the workflow of clinicians to create more effective use of outputs, more CHIS modules for active use based on ICT strategy will be introduced (e.g. Laboratory, Radiology and Pharmacy integration)

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