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RESEARCH ARTICLE

INTRODUCTION OF PICTURE ARCHIVING AND COMMUNICATION SYSTEM AT DISTRICT GENERAL HOSPITAL TRINCOMALEE: ISSUES AND CHALLENGES

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ABSTRACT

Background: The introduction of Picture Archiving and Communication System (PACS) at District General Hospital (DGH) Trincomalee has ensured the timely availability of radiological images, increased scope for precise diagnosis and thus promoting the effective patient management, but it was an uphill task. This research illustrates the issues, challenges and the barriers that were encountered by the project team during its implementation and thereafter.

Methods: This was an institutionally based study to identify the issues, challenges, and barriers that surfaced during the introduction, implementation and functioning of PACS at DGH Trincomalee. The data was gathered in three stages beginning from the project proposal, securing funds, procuring, installation of the system and commissioning and functioning for six months after installation. All issues and challenges were documented, analysed and discussed with the parent organisation to enable the smooth implementation and functioning of PACS.

Findings: Although the hospital management anticipated challenges associated with the acceptance and adaptation of a new technology and training of the Healthcare staff, these proved to be in contrary. The major issues that surfaced were acquiring substantial capital investment and recurrent expenses for installation and functioning of PACS, the requirement of good knowledge in implementation, the need of reliable Information Communication Technical (ICT) support, safeguarding the confidentiality of patient information and incorporating them in the patient register.

Recommendations: A good understanding and foreseeing the issues and challenges associated with the implementation of PACS for the success of the project.

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INTRODUCTION

Healthcare worldwide is facing significant challenges in adapting to new technologies and innovations. One such challenge is the introduction and implementation of an Information, Communication and Technology System (Berg, 2001). Hospitals worldwide are introducing Medical imaging technologies in order to overcome the increasing demand for Radiological services. These technologies include the PACS (Picture Archiving Communication System), Radiology information system (RIS) and the Hospital Information System (HIS) interfaced and connected to a network (Mohd-Nor, 2011). The conventional method was Screen Film Radiography (SFR) where radiological films are obtained for diagnostic purposes. PACS has replaced these films by digitally storing these images economically, transmitting them and providing rapid and convenient access from more than one terminal, simultaneously (Choplin, et al., 1992).

This electronic data handling has improved the efficiency in Radiological diagnosis as it has eliminated the necessity of filing and transporting of images (Arora & Mehta, 2014). In addition, it eliminates the misplacement or loss of radiological images thus preventing duplication (Hayt & Alexander, 2001). The PACS consists of a number of modalities or subsystems interfaced together; an image acquisition device, data management system, image storage device, transmitting network and display stations (Choplin, et al., 1992). The Image acquisition device provides the electronic inputs for the PACS. These inputs are usually in the digital format and sometimes from an analogue image that has been converted to a digital format (Choplin, et al., 1992). The devices mainly include Digital X-Ray Machine, Computed Radiography System (CR System), Computerized Tomography Scan (CT Scan), Magnetic Resonance Imaging (MRI), Ultra Sound Scan and Echocardiography. The Data Management System is a specialised computer that manages the entire network. It aids in obtaining the images from the acquisition devices, storage of images, managing these images and patients' information

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and enables to retrieve these images at multiple display stations (Choplin, *et al.*, 1992). The Transmission network comprises interconnecting cables that connect the acquisition devices, Data Management System, and the Display Stations. Image display stations are the physicians' interface of the PACS system (Choplin, *et al.*, 1992). Digital Imaging and Communication in Medicine (DICOM) is the universal format for storing, transferring and viewing PACS images (NEMA, n.d.). All image inputs are in this format or converted to this format prior to uploading to the system. Currently, standard formats such as the PDF, MPEG, and JPEG could be incorporated into PACS once encapsulated in DICOM (Micheal, 2010).

A fully fledged PACS was not available in any Sri Lankan public healthcare institution till 2014 (Sylva, *et al.*, 2010). Only a few hospitals had a Radiological Information System used within closed units. So the big question was what encouraged District General Hospital (DGH) Trincomalee to implement PACS and becoming the pioneer in Sri Lanka. There were a number of reasons for the management of DGH Trincomalee to decide on introducing PACS. There is a well-functioning Hospital Health Information Management System (HHIMS) since 2007, a CR system in place since 2004 and most of the radiological diagnostic equipment were DICOM enabled. Hence, the introduction of PACS solution was convenient and economical compared to other public hospitals which did not possess these requirements.

DGH Trincomalee was the main tertiary care hospital for the entire district of Trincomalee, covering a vast population. This meant the institution was providing to the needs to a large number, both in-patient and out-patient services on a daily basis. Operational issues such as misplacement or loss of films, delay in obtaining hard copies and difficulties in retrieving old ones involved more human resources and also was an obstacle in providing quality healthcare services in a timely manner (Bansal, 2006). PACS provided the ideal solutions to overcome these issues (Arenson, 2000). One of the important features of PACS was, it facilitated manipulation of images using software tools. This enabled the clinicians to make efficient and effective clinical decisions, thus providing optimal quality of care (Huang, *et al.*, 1990). One of the main reasons for initiation of this project was the enthusiasm and willingness shown by the Hospital clinicians to establish a PACS at DGH Trincomalee. Moreover, the support provided not only by the clinical staff but the non-clinical staff was remarkable, even at the incipient stage. The objective of this study was to identify the issues and challenges when implementing PACS at DGH Trincomalee.

METHODOLOGY

This was an institutionally based study at DGH Trincomalee. The focus was on identifying the issues, challenges, and barriers that were faced during the introduction of PACS. Data were collected in three phases; Preparation, Introduction and Post Implementation. All issues, challenges, and barriers that surfaced were documented in detail. These were discussed with the supplier organisation at a number of meetings and the possible strategies and solutions to overcome them were identified, recorded and implemented. The Data were collected from July 2014 to September 2015. The Preparation phase (July 2014 to December 2014) includes the inception of the

idea, writing the project proposal, securing funds, procurement and, installation and commissioning of PACS. The second stage which was the Introduction phase (December 2014 to March 2015) enclosed the education and training of hospital staff and the transition to a film to film free period. Post Implementation phase (March 2015 to September 2015) covered all aspects for six months since the time PACS was fully operational.

FINDINGS

Establishment of PACS was a productive idea. However, there were a number of hurdles that had to be surpassed during its implementation. The findings are presented below in three phases; Preparation, Introduction and Post Implementation.

Preparation Phase (Planning Stage)

Lack of knowledge - Although some sort of partial RIS were available in few Public Hospitals, this was the first attempt in a Sri Lankan Public Hospital to introduce a comprehensive PACS covering the entire hospital. The first obstacle was the lack of readily available information to implement a fully established PACS in a Sri Lankan health institution. The Hospital management setup a Project Coordinating team to establish PACS. The team collected information from several healthcare institutions in South East Asia and had numerous discussions with PACS solution providers. Further, the team also conducted a feasibility study on the project. Subsequently, the project proposal was developed and formulated. This was overcome due to the conscientious project team.

Approval and funds - The next challenge were in securing funds for this project from the Ministry of Health, Sri Lanka. Although a well-written proposal was submitted, obtaining approval from the hierarchy was a challenging task. However, Deputy Director General Medical Services I's visit from the Ministry of Health to the hospital in June 2014 helped in receiving approval and the required funding. During her visit, the project team managed to convince her on the advantages and usefulness of implementing PACS. The team also elucidated the low capital requirement in implementing the system due to the already functioning HHIMS. **Technical requirements** - Another hurdle was in developing the technical requirements for the bid. This was due to the unavailability of expertise knowledge on PACS as there were no previously completed projects in Sri Lanka. The project team identified members including a Radiologist, Surgeon and a Bio Medical Engineer who had decent knowledge and experience on PACS in a foreign land. With further research and meetings with PACS providers, the team was able to develop a specific technical requirement for DGH Trincomalee. These three members were also part of evaluating the tender proposals to ascertain the precise requirements for DGH Trincomalee.

Introduction Phase

Linking with HHIMS - During this phase, the PACS had to be linked to the existing HHIMS. In the preliminary discussions with PACS and HHIMS providers, it was implicit the linkage would be straightforward. Yet, it was later identified that HHIMS was a couple of generations older to the current PACS, making it impossible for both the systems to operate smoothly once linked.

The management had to incur additional costs and time in upgrading the HHMIS to ensure PACS could be interfaced without any hiccups. Patient Identification Number - The Patients had to be provided with a unique identification number to link their personal and medical data, which could be retrieved at subsequent visits. This number must be simple and easy to remember to in case if the identification card was not presented at the registration desk. The HHMIS used the National Identity Card (NIC) number as the Patient Identification Number for patient identification. A new ten digit number, similar to the NIC number was generated for those who did not have the NIC. This patient identification system was adopted for PACS to store and retrieve information as well. Information confidentiality - Maintaining confidentiality of patient information was crucial. Hence, the hospital Management provided user names and passwords to doctors and other end users to gain access to the System. This also enabled the hospital management to monitor the end users of the system and prevented unauthorised personnel accessing it. The pen drives and CD drives at the Clinical Consoles around the hospital were disabled, preventing copying of information. The policy was formulated that information could only be copied and emailed to other clinicians at the Radiologist's workstation with prior approval from the Unit Consultants and the patient concerned. Continued film production - Though the hospital was turning filmless, films still had to be generated for two crucial reasons. First one was mainly for patients who were transferred out or back referred to another hospital for further follow up. This issue was tackled by providing these patients with a copy of the captured radiological images in "JPEG" format onto a Compact Disk (CD). A significant amount of cost savings was achieved as the CD cost around Rs.15 whereas obtaining an X-ray image cost Rs.400 – Rs.500. Further to this, the images were also directly emailed to the physicians to whom the patients were referred to.

Ongoing end user training - Another reason for continuing to print films was, some of the doctors found it difficult to read the films and adapt to the system. A number of workshops were conducted by the solution provider with the Radiologist to educate and train the clinicians in using the system. In addition to this, an agreement was made for the solution provider to organise similar training on a frequent basis to refresh the knowledge of existing end user and to train the new comers. 24/7 Continuous service - An uninterrupted service was necessary to maintain a high quality of care. This meant all system issues had to be sorted out immediately as and when they arose. The ICT assistant maintaining the HHMIS underwent six months training at the University of Moratuwa. He was further trained by the PACS provider company to resolve system issues. He was the first line of management of the system providing solutions when required. To assist him, the provider company placed a software engineer in Colombo to maintain the system online. Also, the provider company has an online contactable expert round the clock for system modification, repair solutions, and monitoring and upgrading the system on a regular basis. This arrangement ensures that the system functions without disruption.

Post Implementation phase

Suitable clinical consoles -The project team identified and implemented desktop computers as the clinical consoles of PACS.

During this stage the management found, Clinicians had to walk to and from the computer to view the images during ward rounds. This was found to be time-consuming and a hassle for them. This also an obstacle in providing effective patient care. Hence, the management decided to provide wireless intranet connection with tablets to in-patient units so that the clinicians can use them during ward rounds. Initially, this set up was planned for the Medical and Surgical units to be in force from January 2016 and thereafter to be extended to the rest of the hospital. The desktop consoles will be used at the outpatient department, clinics and theatres. DICOM – Some of the radiological equipment were not DICOM enabled. The management discussed and made arrangements with suppliers to enable DICOM on that equipment. The hospital management also made a policy decision to ensure all future purchases related to radiological imaging equipment should be DICOM supported.

Tele radiography - PACS solution was upgraded to include Tele Radiography. Currently only the consultants at the DGH, Trincomalee have access to this. The system could be accessed through a computer or a smart phone by clinicians from anywhere in the world giving a quick diagnosis. An inbuilt internal communication system within the PACS was created for the purpose of enabling effective communication and emailing images among clinicians to get a further opinion. To ensure integrity, the PACS has also been further modified to incorporate the e-signature of the clinicians. User acceptance – User acceptance is essential for the successful implementation and functioning of a new information technology project. To increase the acceptance, the management ensured to conduct regular training and discussed with the end users on any modification required on a timely interval.

Conclusion and Recommendation

- Availability of information on prior PACS implementation projects would have been an advantage, however having the correct mix of experts in the project team leads to successful implementation.
- Identifying specific technical needs of each institution is essential before calling for tenders from suppliers. Formulating the correct composition of experts for the technical evaluation team is also crucial.
- Having fully operational HIS will enable a successful implementation of the PACS, yet, the compatibility of the two systems should be analyzed before implementation.
- It is convenient to use the National Identity Card number to use as the Patient Identification Number for sorting and retrieval of information. Generation of a similar ten digit number for those who do not have a National Identity Card number ensured that everyone had a unique PIN.
- Hospitals should formulate policies in regards to maintaining the confidentiality of patient information prior to PACS implementation.
- Suitable solutions should be identified so the hospitals can be film free after implementing PACS, such as burning images on compact disc for transferred out patients or emailing the images to Clinicians at other hospitals.
- An identified person or a team should be trained specifically to deal with software and hardware issues

associated with the PACS to ensure uninterrupted functioning with remote access to it.

- Ongoing training for the end users of the system is essential for effective patient care.
- Ensure all radiological modalities are DICOM enabled.
- Viewing stations: Tablets or detachable laptop screens will be ideal for ward setups and desktop at OPD and Clinics.
- A system that has teleradiography and e-reporting will make the clinicians' work efficient and effective.
- A success story of the PACS depends on the prior acceptance and approval by the clinicians.

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