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Remote Patient Monitoring System Implementation

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ABSTRACT

Remote Patients' Monitoring System is an essential feature of remote healthcare efficiency and durability. It assures adequate clinical supervision and care to admitted patients in a timely and effortlessly manner. The objective of this case study is to show the impact of a health informatics solution application through the implementation of a remote physiological monitoring system in a cardiac care center. It also discusses the following questions: how health informatics was employed in this case study? how did this case study help healthcare providers to a better performance? how can we decide if we need to implement such a system in other organizations? In addition, an overview of the Philips, IntelliVue Patients' Monitoring System (PMS) will be demonstrated and justified. The problem statement will be introduced, then, the organizational contextual settings, summary of key facts, problem implications, and the actual solution tailored and achieved by KACC management is verified in an advance detail.

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Introduction

Physiological monitoring of admitted and discharged patients is an essential aspect of the remote healthcare system [1]. Once a clinician decides that a patient needs to be monitored in a periodic or continuous basis, it becomes an obligation of the healthcare organization to provide this service with courtesy and excellency. As the number of patients are increasing per day, the responsibility on the healthcare provider becomes a burden. Usually, healthcare organizations follow a special clinical protocol when monitoring patients' vital signs [2]. The treating physician should review patients' vital signs in scheduled basis in order to administrate medication prescriptions and medical treatments.

In this case study report, a real example of patient's monitoring issue is documented, which was resolved and implemented in King Abdulaziz Cardiac Center (KACC), King Abdulaziz Medical City-Riyadh (KAMC-Riyadh). At KACC, there are 200 beds in the adult and pediatric intensive care units (ICU), high dependency units, intermediate care units and cardiac wards that are equipped with bedside physiological monitors that displays patients' vital signs. Cardiologists and cardiac surgeons have to view each patient vital signs in order to provide qualitative consultation, pre/post-surgical assessment and medical treatment.

The objective of this case study is to show the impact of implementing a remote physiological monitoring system in a cardiac care center. An overview of the Philips, IntelliVue Patient Monitoring System (PMS) implemented will be explained and clarified [3]. First, the problem statement will be introduced, then, the context/organizational setting, summary key facts, problem implications, and the actual solution that has been tailored and achieved by KACC management.

Background

Problem Statement and Motivation

Due to the clinical staff shortage at KACC, the challenge was that limited number of cardiac consultants have to physically visit patient's physiological monitors on site during scheduled rounds or emergency on-calls to review patient's vital signs. With 200 beds in the cardiac center (CC), time consumption and service quality became a valuable theme that needed to be reevaluated. Hence, came the idea to find a solution that would centralize patient monitoring in an electronic approach while keeping patients health information secured and confidential.

Clinical Engineering Department (CED) was given the task by the organization senior management to study the clinical requirements and investigate the available resources capabilities in order to provide an effective solution that fits the clinical needs and complies with the organizational policies and procedures. Due to obvious circumstances, applying health informatics techniques in this project was quite appealing to the patients and clinical staff benefits. Patients would feel safe and protected during their admission in the hospital in case of any abnormal conditions reported by the PMS.

In addition, clinical staff would have an easy access to patient's data at any time throughout the day. They would be remotely reviewing patient's vital signs and assessing stated conditions in order to instruct the nursing staff with the proper medical treatment that needed for each patient [4]. Moreover, physicians will be able to examine the abnormal incidents in patient's behaviors, and notified by the PMS about the occurrence time and location

of any alarming situation (e.g. if a patient is roaming within the facility) [5].

The benefits of the remote PMS extend to make the clinical engineering task easier and quicker in regard to maintenance, operation and system updating. However, system faults due to human errors or system malfunctioning are logged in a specific folder of the system server in order to aid the technical staff in identifying, troubleshooting and fixing system glitches easily. Advanced technical problems are normally reported to the system manufacturer requesting either additional information, technical support or remote services in some complicated situations [6, 7].

Organizational Contextual Settings

National Guard Health Affairs (NGHA) has five medical cities (Riyadh, Jeddah, Dammam, Al Ahsa, and Al Madinah) and some satellite clinics distributed around the kingdom. The solution represented in this case study has been implemented and operated in KACC, KAMC-Riyadh. KACC is a specialized cardiac care center that focuses on cardiac-pathologies and cardiac-imaging fields.

There are seven major divisions in this center: Cardiac Catheterization Lab (Cath Lab), Cardiac Operating Rooms (COR), Cardiac Intensive Care Units (CICU), Cardiac intermediate care Units (CIMCU), Cardiac Telemetry Wards (CTW), Cardiac Outpatient Clinics (COC) and Advanced Cardiac Imaging Center (ACIC). Among these departments, patients get admission for certain period of times vary from one day to several weeks depending on the reported health condition and the applied procedure. During the admission period, patients' vital signs are monitored and logged in a continuous basis to an electronic PMS.

Each patient is connected to a bedside monitor (Figure 1) that sends patients' demographics, and physiological data and trends to the Monitoring Central Station (MCS) in order to have a continuous observation of each patient's status (Figure 2). A trained nurse is assigned to the MCS to look after number of patients (2 to 32 patients) at the same time to control warning signals and report monitored critical events to the clinical team for further assistance or action required.

Figure 1: Philips, IntelliVue Patient Monitors

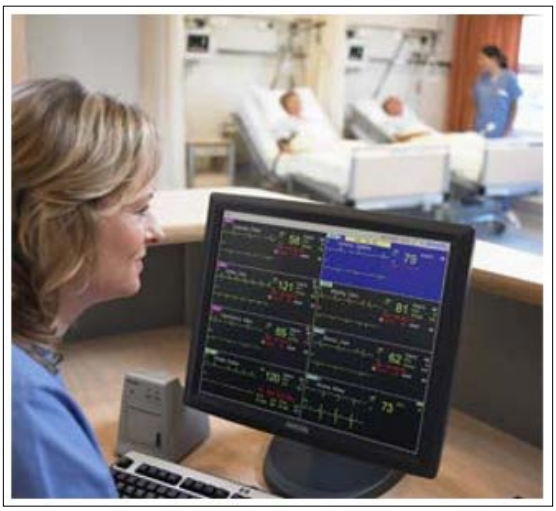

Figure 2: Philips, IntelliVue Clinical Network of Patient Monitoring System

However, the file server centralizes and interconnects all central stations that are distributed among the CC divisions (Figure 3) and sends each patient's information to the server [6, 8]. Due to this cohesive configuration, physicians and clinicians are viewing patients' statuses either on-site or remotely (from office PC) through centralized file server application. Hence, allowing authorized clinical staff to access each patient's bedside monitor (through given username and password) electronically in a secure, private, and fast manner [9]. Usernames accessing the server and viewing patients' data are logged and audited by the system itself through an organizational security policy.

Implications of the problem

Fortunately, KACC clinical staff have noticed that workflow performance key indicators (KPIs) are falling down. They attended this issue to the senior management. Through proper communication channels within the organization. It has been decided to form a committee to study and resolve all issues that would compromise patients' safety. Otherwise, KACC data and patients' health information would be either misplaced, misused or permanently lost.

With the difficulty of limited number of consultants and staff, healthcare services quality could drop to a level that will jeopardize patients' privacy. Physicians would still be encountering a huge accountability in managing clinical time, administrative duties and quality assurance. For instance, consultants would still be making rounds and visiting each bedside monitor to assess and evaluate patients' health conditions which is time consuming and considered to be a slow service. In addition, the risk of misdiagnosed patients, cases of medical blunders and healthcare delays would increase dramatically [10].

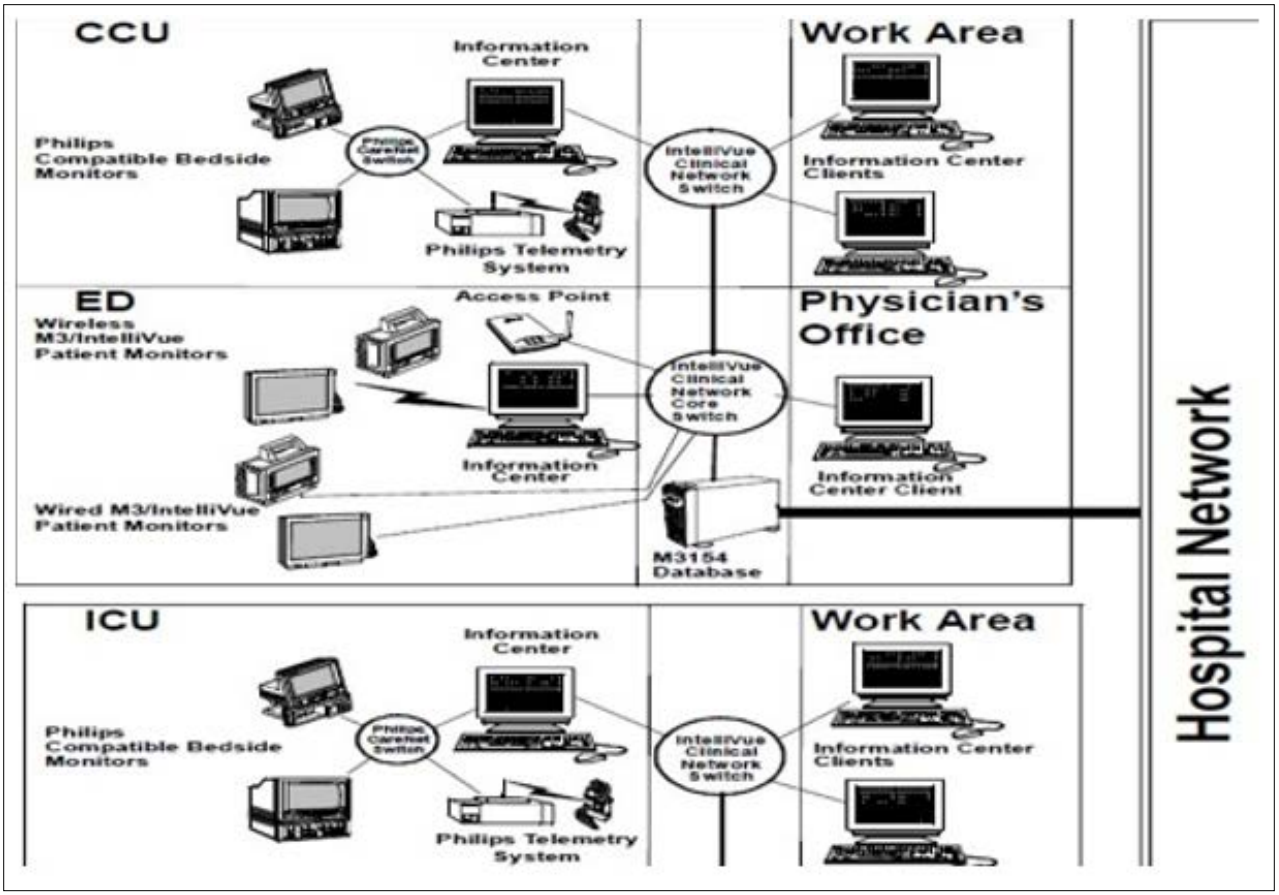

Figure 3: Philips, IntelliVue Information Center – Central Station

Moreover, patients would still be suffering discharge delays waiting for medical decisions to be taken on their health statuses. Also, patients' admission periods would be prolonged waiting for medical team arrival in order to assess the health condition and provide medical consultation. As a consequence, admission departments are usually facing difficulties admitting new patients from the waiting-list patients. KACC patients waiting for a physician discharge order places additional challenge to the admission department tasks and duties.

On the other hand, with such healthcare quality, KACC would lose its medical reputation and international ranking to an irreversible level, which would have a negative impact on the organization in future enrollments to any health accreditation system. Patients would stop trusting healthcare services provided by the CC center which will make them seek other organizations. Moreover, KACC expertise and qualified staff would leave the center looking for better job offers and opportunities on other better organizations.

Implementation and Methodology

Summary of Key Facts

Visiting each patient on-site is an issue that needs considerable attention due to the fact that:

- Clinicians cannot spend sufficient time with each inpatient and outpatient simultaneously.
- Physicians cannot delegate clinical obligations to other medical residents.
- Short staffing versus continuous project expansions.
- Working on a mixture of paper-based protocols and electronic-based systems.
- Difficulty of having easy access and quick review to patients' historical data (especially chronic patients).

Solution Implementation

The daily clinical workflow difficulties problem was first addressed by the KACC clinical staff and then extended to the CC administration. The CC was concerned about patients' records integrity, continuity and historical health data availability. They asked the senior management to create a sufficient clinical workflow that would enhance patients' care and assure growing service quality. Management have realized the necessity of implementing an informatics solution to automate some of the clinical workflow. CED department were consulted to advice about the most suitable solution that would fit KACC needs.

CED Department scheduled a meeting with all potential stakeholders (CC clinical staff and Information technology (IT) team) involved in this project to discuss and define the workflow requirements in order to facilitate the CC daily activities. With the assistance of the IT department, CED department started gathering information on KACC infrastructure potentials and abilities to come up with a proper plan. The initial plan was to equip the CC with an automated patients' monitoring solution that is capable to be interfaced with the current available systems in the hospital. The result of this meeting was the stakeholders' collective agreement to acquire a remote PMS that will be integrated to the hospital's infrastructure in accordance with NGHA policies and procedures.

Technical specifications were generated and a tendering package was prepared in order to submit it to the Logistics and Contract Management Department (LCMD) for further procurement processes. LCMD collected potential offers from interested manufacturing companies and submitted them back to the technical committee for review and evaluation. Philips IntelliVue PMS was

evaluated and selected to be the monitoring backbone of KACC infrastructure.

NGHA engineering representative was assigned to supervise the installation and the "go-live" processes of this project. Philips Company were required to survey the installation site and assure the wired and wireless coverage over all hospital's premises. They have connected each CC care unit (between 8–22 beds) to a Central Station monitor. However, each Central Station is connected to the server (16 central stations in the CC) that stores patients data and vital signs for the entire admission time [11]. Special display layouts and configurations (colors, numeric values and waves) were designed to fit each clinical unit preference.

The server was connected to the hospital's IT infrastructure with compliance to the NGHA networking security policies and procedures (e.g., internet access, antiviruses, activated options, etc.). The remote access feature was activated and a trial username was generated to test the remote access functionality. After several successful trials, usernames and passwords were distributed to patients care providers after their numerous training sessions conducted by Clinical Engineering staff (System Administrators). Users were able to access and view any bedside monitor screen from any terminal within the organization.

Results and Discussion

There are three main experiment findings extracted from this project implementation as follows:

Involve project stakeholders at early planning stages

Appropriate planning and communication when designing the project implementation stages led to successful installation and operation of the remote PMS. The proper team work between the clinical staff, clinical engineering and IT departments, project tasks were distributed evenly among the team with no complications surfaced during the implementation process. Overall, the project implementation went smoothly at each stage of this application with no barriers or drawbacks mentioned yet.

Inspect your resources and plan accordingly

Knowing your institute infrastructure capabilities, and listing all the details of the facility's resources is vital and cost effective. Studying the available resources supports senior management future decisions and help them guide the project completion to a higher level of standards and quality. In addition, precise planning and pre-implementation testing environment is necessary before launching any system on the hospital network.

Test the system and Train end-users before "go-Live" date

Functional testing of the system should take place by the technical staff to ensure system integrity, compatibility, and operability with all other sub-systems within the organization. Also, assuring clinical staff acceptance to the new system is important to avoid any possible interruption of healthcare services provided to patients. Continuous training, education and progress evaluation are key elements that help hospital staff digest new workflows, and confront any challenges that could paralyze technical advancements in the organization.

Conclusion

The Philips IntelliVue PMS was a solution that offered a remote access ability to patients' bedside monitors saving staff travelling time and optimizing organizational workflow. This implementation demonstrated a new revolution of patients' care service which is provided with high efficiency, security and quality. Moreover, it has promoted clinical workflow and made patients' information manageable, accessible and secured. Although the implementation of the project was a positive modification in the clinical and technical workflows, there are few points should've been considered, such as setting up specific criteria for selecting System Administrators, and giving consultants the privilege to access the system from outside the organization.

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