

DIGITAL HOSPITAL ; AN EXAMPLE OF BEST PRACTICE

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Digital Hospital is a concept contributing to enhancing personnel productivity, facilitating hospital operations, improving the process quality and ensuring patient safety by integrating cutting-edge technologies such as medical devices, smart information systems, facility control and automatic conveyor systems, location-based services, sensors and digital communication tools into health processes. The primary aim of this study is to address the theoretical and practical aspects of “Digital (paperless) hospital” concept, which is addressed in a limited number of studies, and investigate the digital hospital practices of Izmir Tire Public Hospital and Giresun Tirebolu Public Hospital, which entered into the list of top digital hospitals in Europe as examples of best practices. The study was prepared based on the interviews with the managers of Tire Public Hospital and Tirebolu Public Hospital awarded with digital hospital certificates by HIMMS (International Accrediting Agency) in 2016.

18 hospitals received “Stage 6” and one hospital (Tire Public Hospital) received the top-level “Stage 7” digital hospital certificate, which was awarded to four hospitals in Europe by 2016 in Turkey. In the hospital transforming into a top level digital hospital and offering services with this concept; speed and efficiency of business processes increase, paper and document expenses are cut to zero, human-made errors are minimized. Diagnosis and treatment processes are provided not only within the hospital walls but also to long distances. By the help of digital hospitals health data are immediately and retrospectively retrieved at any time by the authorized body, other health institutions and patients and can be forwarded via sensors, cameras and early warning systems without requiring follow-up by humans, fast and right decisions can be given thanks to decision support systems, and the right medicine is administered to the right patient, at right doses and at the right time by the Closed Loop Drug Delivery System. With the widespread access to digital hospitals, it will be possible to benefit from all these advantages and offer the most effective and efficient healthcare services to the patients within the shortest time. Hospital personnel will have less workload and be less likely to make mistakes.

Keywords: Digital Hospital, e-Health, Smart Hospital, HIMMS

1. INTRODUCTION

In the early years of their foundation, hospitals dating back to Seljuk period were named darush-shifa and shifahane, (Kayseri Gevher Nesibe Shifahane, Edirne Sultan Bayezid II Darush-shifa etc.) and located inside the complexes consisting of structures like madrasa, mosque and bathhouse [1]. Hospitals achieved their traditional structures in early 1900s with independent service premises.

Hospitals undergoing transformation in accordance with the needs of the current time, differently from their early examples, now aim to integrate the state-of-art technology (telemedicine, mobile health, digital hospitals etc.) into the service processes and carry their services to remote regions with the concept of “*digital hospital*” without time and space limit as opposed to traditional structures providing physical location-dependent services.

Digital hospital concept is a practice coming to the forefront and invested in by developed countries in recent years. United States have moved one step further by making a first in the world and founding a hospital without beds in Missouri named Mercy Virtual Care Center that offers distant diagnosis and treatment methods [2]. Turkey follows the developments in the world closely and makes reforms in healthcare services accordingly, therefore “digital hospital” works were started in 2013 and one of the four top-level digital hospitals in Europe (Tire Public Hospital) was founded in 2016. The outcomes of digital hospitals demonstrate that hospitals practicing this system gain an efficiency of 35% [3].

In this context, the aim of this study is to address the criteria of digital hospital concept and the advantages of this system compared to traditional hospitals.

2. DIGITAL HOSPITAL

New scientific and technological innovations made it possible the acquisition, archiving, handling and visualization of an amount of various data and phenomenon everywhere in hospitals, which are involved in biomedicine, medical engineering, clinical diagnosis, sanitary economics, hospital administration and culture [4]. *Digital Hospital* is a concept contributing to enhancing personnel productivity, facilitating hospital operations, improving the process quality and ensuring patient safety by integrating cutting-edge technologies such as medical devices, smart information systems, facility control and automatic conveyor systems, location-based services, sensors and digital communication tools into health processes [5,6,7]. Common sharing of medical information resources and adaptation to local circumstances enables the information processing and communication function to be achieved on a complete platform, which offers completeness to present hospital management and future medical environment [8].

According to the Ministry of Health, *Digital Hospital* can be defined in a broad sense from a hospital where maximum level of information technologies is used in administrative, financial and medical processes, to a hospital where all kinds of communication tools and medical devices are integrated with each other and with other information systems, and healthcare staff and patients can exchange data inside or outside the hospital by using telemedicine and mobile medicine practices [9]. Digital hospital is an important goal of the hospital construction, which is significant for promoting medical development and improving healthcare quality [10].

The use of information and communication systems for the prevention, diagnosis, treatment and monitoring of diseases and provision of health counseling in healthcare services is described with the term “*e-Health*” [11]. In this context, “Digital hospital, mobile health, telemedicine and robotic health” are defined as the *sub-components of e-Health*.

Digital Hospital carries the hospital services to individuals outside the hospital walls (to houses, emergency stations etc.) by integrating information and communication technologies into clinical and administrative workflow processes in order to offer high-quality healthcare services, as well as connecting healthcare staff and units working at distant locations from each other.

Digital hospital concept is recently one of the practices in the forefront in healthcare sector. Therefore, many hospitals in Europe and Turkey underwent transformation processes and initiated accreditation activities to receive a “*digital hospital*” certificate. In 2016, the hospitals in Turkey were checked by HIMSS (accrediting agency) and 18 hospitals received “Stage 6” and one hospital received the top-level “Stage 7” digital hospital certificate. HIMSS is a non-profit organization founded in 1961 incorporating 52,000 healthcare provider institutions, 600 firms and 250 associations/foundations around the world, with structures in the USA, Europe and Asia (EMRAM). The EMR Adoption Model (EMRAM) is an eight-stage model that allows you to track your progress against other healthcare organizations around Europe and across the world [2]. The purpose of its foundation is to ensure the optimum use of information technologies in the provision and development of healthcare services. Digitalization levels of hospitals are rated with EMRAM at an international level. In this process, the level of use of information systems in the operation of healthcare organizations is inspected and accredited. HIMSS uses the universally accepted accreditation and standard model EMRAM to assess the digital processes and determine the stages of applicant hospitals. In this model, hospitals are rated from 1 to 7 and the ones completing their digitalization process up to 6th and 7th stages are awarded with certificates. With EMRAM staging, HIMSS facilitates the adaptation of hospitals to ever-growing health information technologies at international standards.

For a hospital to be a digital hospital, it must be assessed and awarded with a certificate by the accrediting agency HIMSS. The relevant assessment criteria and stages are tabulated below. When criteria in the table are met, hospitals apply to the HIMSS agency. Experts assigned by HIMSS inspect the relevant hospital on-site and rate it pursuant to its compliance with the published criteria, and award it with a certificate accordingly [13].

Table 1. - HIMSS EMRAM Digital Hospital Stages and Criteria

Stage 7	A hospital at this stage never uses <i>paper documents</i> while providing services. All data, documents and medical images are processed electronically. Data stored in a digital environment are analyzed and used to increase the quality of healthcare, ensure patient safety and offer efficient services. The relevant data are standardized electronically ready for use and information exchange by authorized persons and institutions (management, other hospitals etc.). The hospital ensures the data continuity of all service processes and publishes such data. At this stage, healthcare materials such as blood products are also made available via <i>Closed Loop Medication Administration System</i> .
Stage 6	A full-fledged and marketable physician documentation system is in practice for at least <i>one in-patient clinic</i> . Third stage clinical support system provides guidance in all clinical processes. Closed loop medication management system and coded drugs system are fully in practice. To maximize the patient safety, other automated identification technologies and automated delivery systems such as electronic medication management record and computerized physician order entry/e-Prescription and Barcoding or RFID (radio frequency identification) integrated with the pharmacy are in practice. Thus, in accordance with “5 rights (right patient, right drug, right dose, right route and right time)” principle developed in order to prevent Erroneous Drug Use, patient credentials and medicine barcode are verified at the patient bedside.
Stage 5	Medical images in the full-fledged Radiology Image Archive and Communication System (PACS) are open to the access of all physicians and sent to other locations via intranet. At this stage, if image documents of cardiology department (ECG etc.) are entered into the PACS system, the hospital is given extra points.
Stage 4	At this stage, the second stage of clinical decision support systems for evidence-based medical protocols is available. In this system, any licensed Clinician can write an order and add a nurse for his/her access to data in the Computerized Physician Order Entry (CPOE) system. If the Computerized Physician Order Entry system is used in an in-patient service area and previous stages are completed, then this stage is deemed to be completed as well.
Stage 3	Clinical documents regarding nursing care (vital signs, flow sheets, nursing notes, eMAR) and/or electronic medication management record and order entry and tracking systems must be integrated with electronic patient records and clinical data store in at least one service process. The first stage of clinical decision support may be practiced to check the errors in order entry. Drug/drug, drug/food, drug/laboratory interaction data are usually available in the pharmacy. Medical pictures in the picture archive must be accessible from the system via intranet to the physicians outside the radiology department.
Stage 2	Information systems of the clinical data repository (CDR) send all kinds of medical information and results of the patients to a system viewable by the physicians. This system sends data to the Electronic Patient Record or Clinical Data Archive receives feedback and forward them to the sub-systems. The system can receive and send medical picture documents and enable information exchange between hospitals.
Stage 1	It describes that digital systems are set up in main clinical support units (pharmacy, laboratory and radiology).
Stage 0	It describes the hospitals where even main clinical support units (pharmacy, laboratory and radiology) and processes are not included in digital environment.

3. METHOD

In the present study, the results concluded by considering the interviews with the managers of Tire Public Hospital and Tirebolu Public Hospital awarded with digital hospital certificates by HIMMS (International accrediting agency) in 2016 are presented below.

4. FINDINGS

4.1. An Example of a Digital Hospital - Tire Public Hospital

After interviews with the managers of hospitals it was seen that in the course of awarding Tire Public Hospital with “Digital Hospital, Stage 7” certificate, following arrangements were determined to be made:

- ✓ Patient admission, hospitalization and other clinical processes, consultation and referrals are moved onto paperless digital platform.
- ✓ Practices such as e-prescription and e-signature are initiated in the hospital.
- ✓ Orders for MR, X-Ray, ECG, blood and other tests (hearing test etc.) are concluded without papers in a computer environment. Results of these orders are submitted in the digital environment. These results can be accessed anywhere both by healthcare staff and patients via phones and tablets.
- ✓ All generated data (records, results, invoices etc.) are archived in the digital environment, and information safety is ensured.
- ✓ Treatment orders of physicians are completely processed in an online environment immediately and by remote access.
- ✓ With the computer terminals placed in patient rooms, nurses enter the treatment information into the system without using any paper or document, thus pharmacy, stock tracking and invoicing system can record the entries and exits immediately.
- ✓ Thanks to the *Closed Loop Medication Administration System* the right drug is administered to the right patient, at right doses, via the right route and at the right time.
- ✓ All administrative documents and correspondences in the hospital (excluding purchasing documents as required by laws) are followed up in the electronic system and e-signature is used in the documents.
- ✓ Programs such as budget and stock alert systems are used to view the resources all the time.
- ✓ Infrastructure components such as fire system, security, electricity, water and natural gas are followed up by a central system. In emergency cases, these technologies can be activated.
- ✓ None of the data generated in the hospital get lost and all data can be accessed from anywhere and anytime.
- ✓ As paper is not used, stationary costs are saved.
- ✓ Hospital services can be provided fast and efficiently thanks to the smart software.

Practices listed above are the requirements for Stage 7 in “Digital-Paperless Hospital” classification. Moreover, Giresun Tirebolu Public Hospital in Turkey awarded with “Stage 6” certificate was checked and informed that all processes (drug tracking, patient admission etc.) had to be performed in the digital environment in at least one clinic of the hospital in order to be awarded with the Stage 6 certificate. Therefore, Pediatric Clinic of the hospital was equipped with a digital system and strictly checked by HIMSS.

5. CONCLUSION

As seen in our study, *Digital hospitals* increase the speed and efficiency in business processes and cut the paper and document costs to zero. From the viewpoint of working personnel, human-made mistakes are eliminated and data can be retrieved by authorized units, other healthcare institutions and patients immediately and retrospectively at any time [14].

Diagnosis and treatment processes can be managed not only within the hospital walls, but also from long distances. Some processes can be managed with sensors, cameras and early warning systems without the need for follow-up by humans (for example, software that warns of too high blood test results).

With the *Closed Loop Medication Administration System* between the pharmacy and the patient's room, which is one of the services provided by Digital Hospitals, after the drugs are e-prescribed by the physician, they are brought to the patient via a channel with smart software and taken to be administered by the relevant personnel. Thanks to the closed loop drug delivery system, patients can benefit from healthcare services better and waste of drugs can be prevented.

In digital hospitals, fast and right decisions can be given thanks to the decision support systems. A structure is formed in compliance with the lean management philosophy, which is a much discussed and increasingly more practiced approach in recent years, and transition to lean hospital practices is accelerated.

With the widespread access to digital hospitals, it will be possible to benefit from all these advantages and offer the most effective and efficient healthcare services to the patients within the shortest time. Hospital personnel will have less workload and be less likely to make mistakes.

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