Healthcare information system: The levels of computerization

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ABSTRACT: Health information systems refer to any system that captures, stores, manages or transmits information related to the health of individuals or the activities of organizations that work within the health sector. This definition incorporates things such as district level routine information systems, disease surveillance systems, and also includes laboratory information systems, hospital patient administration systems (PAS) and human resource management information systems (HRMIS). Health information systems serve multiple users and a wide array of purposes that can be summarized as the generation of information to enable decision-makers at all levels of the health system to identify problems and needs, make evidence-based decisions on health policy and allocate scarce resources optimally. Data from different sources are used for multiple purposes at different levels of the health care system. Hospitals are becoming more reliant on the ability of hospital information system (HIS) to assist in the diagnosis, management and education for better and improved services and practices. In health organization such as hospitals, implementation of HIS inevitable due to many mediating and dominating factors such as organization, people and technology. This paper discusses the levels of computerization and related factors.

Keywords: Hospital Information Systems, Medical Records Systems, Electronic Health Records, Public Health, Computerized

INTRODUCTION

The information technology extension is among the inseparable parts of any economical, social, and cultural policies(Hosseini & Asefzadeh, 2009). Health care throughout the world is becoming increasingly complex (Lorenzi, Ash, Einbinde, & McPhee, 2010) and nowadays, it is hard to imagine health care without Information and Communication Technology(Ammenwerth et al., 2004). The technology has a capacity to generate unrealistic expectations, persuading even serious observers that it is "revolutionizing every sphere of human interaction and communication" (Lucas, 2008). Health information involve any medical or related administrative information, whether oral or recorded in any form or medium, that is created or received by a health care provider, health care plan, public health authority, employer, life insurer, school or university, or health care clearinghouse; or relates to the physical or mental health or condition of an individual, the provision of health care to an individual, or payment for the provision of health care to an individual (Wager, Wickham Lee, & Glaser, 2005). An information system (IS) is an arrangement of information (data), processes, people, and information technology that interact to collect, process, store, and provide an output the information needed to support the organization (Whitten, Bentley, & Dittman, 2004). Note that information technology is a component of every information system. Information technology is a contemporary term that describes the combination of computer technology (hardware and software) with data and telecommunications technology (data, image, and voice networks). Often in current management literature the terms information system and information technology are used interchangeably. Data are raw facts about people, places, events, and things that are of importance in an organization (Wager et al., 2005).

Hospital Information System (HIS) is a mechanized document and information management system in hospitals (Tabibi, Nasiripour, Baradaran Kazemzade, Farhangi, & Ebrahimi, 2011). HIS provides the required information to each level of the management at the right time, in the right form, and in the right place, so that the
decisions to be made effectively and efficiently. HIS plays a vital role in planning, initiating, organizing and controlling the operations of the subsystems of the hospital and thus provides a synergistic organization in the process, and improves patient care by assessing data and making recommendations for care and enables a hospital to move from retrospective to a concurrent review quality and appropriateness of care (Ismail et al., 2010). For a variety of reasons, health care has traditionally been a “dabbler” in the information technology area. Many healthcare organizations are still functioning with information systems that by contemporary business standards are ludicrous for organizations of their size (i.e. as measured by “sales,” capital investment, or number of employees). These healthcare organizations are realizing that information technology is transforming health care (Lorenzi et al., 2010). The aim of HIS was and is as simple as relevant: to contribute to a high-quality, efficient patient care. This aim is primarily centered towards the patient, so it is a patient centered approach and towards medical and nursing care, and the administrative and management tasks needed to support such care (Wager et al., 2005). Health data serve three broad purposes to define the problem, to understand the problem and the identification of effective interventions, preventative and curative (Hovenga, Kidd, & Garde, 2010). The Information is data that has been processed or reorganized into a more meaningful form for the user; information can lead to knowledge and facilitate decision making.

**Definition of health information system**

There are two primary classes of health care information systems, administrative and clinical. An administrative information system (or an administrative application) contains primarily administrative or financial data and is generally used to support the management functions and general operations of the health care organization. For example, an administrative information system might contain information used to manage personnel, finances, materials, supplies, or equipment. It might be a system for human resource management, materials management, patient accounting or billing, or staff scheduling (Wager et al., 2005). In contrast a clinical information system (or clinical application) contains clinical or health related information used by providers in diagnosing and treating a patient and monitoring that patient's care. Clinical information systems may be departmental systems such as radiology, pharmacy, or laboratory systems or clinical decision-support, medication administration, computerized provider order entry, or electronic medical record systems (Ministry of Health and Medical Education, 2011). They may be limited in their scope to a single area of clinical information (for example, radiology, pharmacy, or laboratory), or they may be 92 Managing Health Care Information Systems comprehensive and cover virtually all aspects of patient care (as an electronic medical record system does, for example). The Health Insurance Portability and Accountability Act (HIPAA), the recent, sweeping federal legislation that includes provisions to protect patients’ health information from unauthorized disclosure, defines health information as “verbal or written information created or received by a health care provider, health plan, public health authority, employer, life insurer, school or university or health care clearinghouse that relates to the physical or mental health of an individual, or payment for provision of health-care”. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) divides health care information into four categories: Patient-specific data and information, Aggregate data and information, Knowledge-based information, and Comparative data and information. There are several key purposes for maintaining medical records such as patient care, communication, legal documentation, billing and reimbursement, and research and quality management. The American Health Information Management Association sponsors lists the following components as being common to most patient records, regardless of the type of facility or whether the medical record system is electronic or paper based: Identification sheet, Problem list, Medication record, History and physical, Progress notes, Consultation, Physician’s orders, imaging and X-ray reports, Laboratory reports, Consent and authorization forms, Operative report, Pathology report and Discharge summary (Wager et al., 2005).

**Health information system history**

Articles can be found dating back to the end of the 1950s pertaining to the potential applications of medical electronics. It was really patient billing that drove the corporate development of medical software. Billing systems were implemented on mainframe computers in programming languages designed for the management of patient "records”(Hanson, 2006). As far back as, in 17th century, Wilhelm Fon Liebnitz was advocating the idea that it might be possible to represent the entire nature of human behavior in some codified form. This principle still forms the bases on which many software developer, especially medicine view coding, HIS started the developing way by created the computer and punch card system (Hovenga et al., 2010). Following are descriptions of the Medical Records Institute’s five levels of computerization.

Level 1: Automated Medical Record, the health care organization still depends on paper-based medical record systems, although nearly half of the patient information may be computer generated and stored as computer printouts within the medical record. At this level the paper-based medical record system remains the primary source for entering and retrieving the patient’s clinical information, and the problems inherent in using paper records (availability, legibility, completeness) still exist.
Level 2: Computerized Medical Record involves digitizing the patient's medical record through the use of a document imaging system. Much of the patient's clinical information is scanned into the medical record and stored electronically as optical images. Document imaging systems may be used by organizations to address accessibility and retrieval concerns and space and storage issues associated with paper medical records. However, a document imaging system typically does not allow the user to analyze or aggregate data for decision-making purposes. Many health care organizations opt not to use document imaging systems. They see them as a costly storage medium and as an unnecessary step in getting to the next level, the electronic medical record (Wager et al., 2005).

Level 3: Electronic Medical Record, up until this point the medical record has served as a passive storage device. It is at Level 3, the electronic medical record (EMR), where we begin to see the patient record as an active tool (Dick & Steen, 1991) that can provide the clinician with decision-support capabilities (Ganesh & Al-Mujaini, 2009) and access to knowledge resources, reminders, and alerts (Wager et al., 2005) and it has ability to access-transmit and copy large volumes of the data easily (Donaldson & Lohr, 1994). Although still used and maintained at the organizational level, the EMR provides the clinician with access to decision-support capabilities and other aids. For example, the EMR may alert the clinician to the fact that the patient is allergic to certain medications or that two medications should not be taken in combination with each other (Wager et al., 2005).

Level 4: Electronic Patient Record, whereas the electronic medical record contains only the patient information (Wager et al., 2005) and demographic factors (Dick & Steen, 1991; Wager et al., 2005) that is maintained by a single organization, the electronic patient record (Level 4) includes all health care-related information concerning the patient—gathered across two or more organizations. An electronic patient record brings together in a central database all clinical information available on a patient (Wager et al., 2005). The benefits of EPRs include the arability of much more powerful databases, elimination of need for repeated request to reed subjects for same information, and assurance that information is available when needed (Donaldson & Lohr, 1994). For example, if a primary care physician saw a patient in the physician's office, admitted the patient to a hospital, and then discharged the patient to a rehabilitation facility, all relevant information concerning the patient would be available to clinicians involved in the patient's care across these three settings. This level of computerization requires (1) a system of identifying all patient information available, (2) a way to combine information from multiple facilities, (3) a common terminology and structure, and (4) a consensus on security.

Level 5: Electronic Health Record (EHR) is broader in scope than the electronic patient record and includes wellness information and other information not routinely maintained by health care organizations. Wellness information might include data on the individual's smoking habits, nutrition, and level of exercise, dental health, and alcohol use (Wager et al., 2005), and information on life style, family history, health status, have become of greater interest relevance as genetic data for assessing an in The patient is at the center and all information related to the individual's health and wellness is brought together as needed in managing the patient's care and treatment more effectively. The EHR is a longitudinal record and ultimately would encompass a person's relevant health information from before birth to death (Waegemann, 1995).

The paper record is familiar and portable, but it can only be read by a single user at a single time, is formatted sequentially, and does not lend itself to the inclusion of alternative, non-paper-based content (Hanson, 2006). The types of tasks traditionally assumed by medical record professionals are highly quantitative and departmentally focused. A good source for identification of these tasks is the Professional Practice Standards (1984, 1990) published by the American Health Information Management Association (AHIMA) formerly the American Medical Record Association. A review of these standards and their accompanying evaluation mechanisms reveals that tasks of medical record practitioners involve planning, developing, and implementing systems designed to control, monitor, or track the quantity of record content, flow, storage, and retrieval or quantitative data collection on departmental personnel productivity. These traditional activities principally center on the paper medical record or clinical reports as opposed to ensuring the appropriateness, quality, timeliness, or completeness of the information itself. For example, such tasks include forms control, record tracking, incomplete record control, quantitative analysis of record content, control over release of information, and monitoring utilization of resources (Johns, 2002). In addition, traditional tasks have usually been confined to a single department (i.e., medical records department). In very few instances have tasks crossed departmental lines.

It is evident that the use of modern information technology offers tremendous opportunities to reduce clinical errors (e.g., medication errors, diagnostic errors), to support health care professionals (e.g., availability of timely, up-to-date patient information), to increase the efficiency of care (e.g., less waiting times for patients), or even to improve the quality of patient care. However, there are also hazards associated with information technology in health care: modern information systems are costly (according to about 4.6% of the budget of health care enterprises is spend on information and communication technology), and their failures may cause negative effects on patients and staff (Ammenwerth et al., 2004). Despite the need for administrative and clinical information to facilitate the delivery of high-quality, cost-effective services, most organizations still function are using paper-based or otherwise insufficient information systems. There are many reasons why this situation exists, not the least of which is that the health care industry is complex, both overall and in many of its...
functions. This complexity poses challenges for both the purchasers and vendors of health care information systems and the related IT products and services (Wager et al., 2005). Almost every major economy in the world experiences the effects of the high cost of health care, and many, if not most, national and regional governments are in some stage of healthcare reform (Lorenzi et al., 2010).

**Barriers and facilitators**

Powerful societal and economic forces are moving us towards an integrated, patient-centered health care information system that will allow providers to exchange up-to-date patient health information quickly and easily (Mäenpää, Suominen, Asikainen, Maass, & Rostila, 2009). Many communities are now building a local or regional health information infrastructure or strategy to provide secure, ubiquitous access to complete healthcare information and to improve health care through the quality, completeness, and timeliness of public health data reporting from clinical care settings. These will improve the ability to monitor better-quality information through timely disease reporting, improve case management and care coordination, communicable disease patient management. These strategies have improved the analysis of patterns of care, and gaps in delivery of preventive services, and have improved the ability to plan, and resource allocation for preventive services. These regional health information infrastructure or strategies provide the capability to move from a traditional paper-based retrospective data collection and review mode of operation, to real-time, interactive electronic data exchange and action response practice. They also reduce health care cost, prevent medical errors, improve administrative efficiency, reduce paperwork, and increase access to affordable health care (Follen et al., 2007; Kass-Hout et al., 2007). These forces include patient safety, potential health care cost savings, and empowerment of consumers, new policies and growing regional health care initiatives (Mäenpää et al., 2009). Every time a patient contacts a health care professional, the information handled includes patient data, scientific knowledge, and professional communication (Berg & Timpca, 1998).

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Information systems (IS) constitute the source of many of the problems in the health care industry. Health care is one of the most transaction-intensive industries (estimated at thirty billion transactions annually), given all the encounters between patients and providers, providers and other providers, providers and insurers, suppliers and providers, and so on (Wager et al., 2005). Financial barriers, lack of standards, cultural barriers are the health information system problems. The fundamental difficulty in modern medical care is execution. Providing reliable, efficient, individualized care requires a degree of mastery of data and coordination that will be achievable only with the increased use of information technology. New approaches that improve customization and gather and sift through reams of data to identify key changes in status and then notify key persons should prove to be especially important (Bates & Gawande, 2003). In general, threats to health care information systems will fall into one of these three categories: Human threats, which can result from intentional or unintentional human tampering

Natural and environmental threats, such as floods, fires, and power outages

Technology malfunctions, such as a drive that fails and has no backup (Wager et al., 2005)

The lines of development in health information systems from the past until today were towards computer-based information processing tools, from local to global information system architectures, from health care professionals to patients and consumers, from using data only for patient care to research, from technical to strategic information management priorities, inclusion of new types of data, inclusion of new technologies, and summarizing the HIS development. The need for institutional and (inter-) national HIS-strategies, to explore new architectural HIS styles, education in health and biomedical informatics, and for research in health and biomedical informatics are consequences for health information systems in the future (Haux, 2006).
CONCLUSION

Currently, the term electronic health record (EHR) is widely used. It describes the concept of a comprehensive, cross-institutional, and longitudinal collection of a patient’s health and healthcare data. Therefore, it includes data that is not only particularly relevant to a subject’s medical treatment but also to a subject’s health in general. The patient is regarded as an active partner in his/her treatment by accessing, adding, and managing health-related data, thereby supporting care (Ball, Smith, & Bakalar, 2006).

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