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Information Technology in Health-Care Systems and Primary Health Care

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Abstract

BACKGROUND: Health information technology (HIT) is being increasingly necessary to manage the ever-increasing amount of data generate by the health system in general, including primary health care (PHC).

AIM: This study aimed to provide an overview of HIT being currently use in the health systems and PHC as well as to highlight the advantages and disadvantages of HIT options.

METHODS: This is a narrative literature review of papers, documents, and websites that address and discuss HIT for the health systems. The analysis of the retrieved materials provided an overview of the importance of HIT for the health system, the various options of health technology currently available, as well as the future trends. Strengths and weaknesses have been highlighted as well.

RESULTS: HIT is being increasingly used in the health sector, as an indispensable tool to handle the extraordinary amount of data being generated by the health system but also as an instrument to improve the quality of health care through the reduction of medical errors and health care-associated costs, improvement of patient follow-up and monitoring, and also as a tool that informs and guides clinical decision-making. A large variety of HIT options is available, including telehealth, telemedicine, mobile health, electronic medical records, electronic health records, personal health records, electronic prescriptions (e-prescriptions), wearables, metadata, and even artificial intelligence. Each HIT option has its own advantages and disadvantages. PHC could benefit from the implementation of various HIT options.

CONCLUSIONS: The decision which HIT option(s) to employ will depend on many factors, but the process needs to employ small steps, strong political will, cooperation, and coordination between all stakeholders.

Introduction

Over at least the last five decades several trends are evident in health systems virtually all over the world. These trends include the aging of the population and the increase in the proportion of the elderly (individuals aged 65 and over), the changing position of hospitals as centers of health care provision around which the other actors of the system operate and a health education market that tends to train more doctors than is necessary (market oversaturation). Additional mainstream developments include the ever-increasing role of government in the financial support of health care, the issue of universal coverage and other problems to be solved with the uninsured individuals of society, coupled with the unstoppable increase in the amount of information that is necessary to make evidence-based decisions (which then lead to cost-effective solutions) in the health care sector are. All these tendencies have highlighted an indisputable truth: to properly solve all these issues and to ensure coordination, connectivity, continuity and accountability, radical changes are needed in the health care system. If we carefully examine the above factors, it is clear that each of them is, in essence, driven by the need to improve the quality, limit the costs of health care, and improve the access of individuals in need to the health care system [1], [2]. All these factors increase the need for information for all actors involved, such as health-care staff at every level of the health-care system (tertiary, secondary, and primary), as well as for managers of health organizations and the health system in general, societies of health insurance, but also for patients or users of the health-care system. This is because, to improve the quality of health care, to identify interventions or cost-effective measures and to make decisions of a strategic nature, it is necessary to have available data related to clinical activity and results, as well as related to procedures and administrative aspects of health care; the need for such data is only increasing due to the increasing pressure on the health system to provide high-quality health care at a reasonable cost [1], [2].

One of the fundamental problems facing any health-care system in the world is precisely the modality of providing health care so that it reaches individuals in need, when they need it, but still staying within the framework of available resources, and always bearing in mind the fact that everywhere and

whenever, resources are limited [3], [4], [5]. It is clear that high-quality health care must be effective, efficient, accessible, acceptable, patient-centered, equitable and safe, timely, and integrated, which can be regrouped into three main dimensions: Effectiveness, safety, and patient-centered care [6].

In addition, high-quality health care is important for achieving Sustainable Development Goal 3 (SDG3): "Ensuring healthy lives and promoting well-being for all at all ages," where target 3.8 puts emphasis on the importance of high-quality basic health-care services [6]. Only a health system based on integrated and people-centered health services can achieve the goal of universal health coverage (UHC) [6].

All the above aspects and attributes are also important for primary health care (PHC), in the context where PHC is the gateway through which patients or users get the initial contact with the health-care system [7]. For the PHC system to fulfill its role of helping the population to solve general health problems that can be well managed at this level while limiting costs, it must be patient or user centered, it must be comprehensive, coordinated, accessible, and continuous [7]. Therefore, the PHC system must be based on three main pillars: Continuous efforts to empower users and involve the community in the decision-making process related to health care, strengthening interactions between different sectors to improve health, and the provision of high-quality health care including basic public health services [7].

To have quality health care, it is necessary to collect and analyze information related to every aspect of care and individual patients, but also of the health system in general. In the age of the internet and the tremendous increase in the amount and nature of information that needs to be collected from the various levels of health care, it is simply impossible for the health information system to continue to function in the traditional way, that is, with a pencil and paper. For this reason, information technology is something not only necessary for health systems but also something inevitable if we want to respond in time to the needs of health-care users and if we aim to provide high-quality health care. In this context, our aim was to provide an overview of the HIT that is being used in PHC systems as well as to highlight the related benefits and drawbacks.

Methods

This is a narrative review of the literature. We tried to find relevant papers describing health information technology (HIT) being used in the health systems and PHC system around the world, as well as the advantages and disadvantages of implementing and using various HIT options.

We searched PubMed, Google Scholar, and simply Google to find the relevant papers or documents. The keywords used for our search included: HIT, *types of* HIT*, health systems*, *HIT in health systems*, and *HIT in* PHC.

The relevant information was retrieved, analyzed, and described to obtain an overview of HIT in health systems and PHC, focusing on the strengths and weaknesses of each HIT option.

Results

Information technology components in the health sector include a relatively wide range of electronic systems that can be used by health-care staff but also by patients to improve the quality and cost-effectiveness of health care. Thus, e-health encompasses a large number of interventions and modalities, including telehealth, telemedicine, mobile health, electronic medical records (EMRs), electronic health records (EHRs), personal health records (PHRs), electronic prescriptions (e-prescriptions), wearables, metadata, and even artificial intelligence (AI) [8].

EMR

EMR can be considered as a digital version of a patient record, including a particular patient's medical and treatment history, records of diagnoses, medications, allergies, vaccines, and treatment plans [9].

In another perspective, EMR is defined as the electronic records of all patients of a health center, institution, or health organization, including all patient interactions with health-care staff such as data about health problems and patient complaints, diagnoses, medical investigations and tests performed, results of these tests, treatments, suggested medications, and other data deemed appropriate and necessary [10].

The benefits of using EMRs include improving the effectiveness of health care, promoting patient safety, better adherence to clinical guidelines, reducing medication errors, reducing drug reactions, improving the quality of health care, improving health-care productivity and effectiveness, and reducing health-care costs, thus leading to better health outcomes [11]. Disadvantages include hacking problems, the need to update software and problems with managing electronic devices, and the need for a team of professionals to support the operation of the platform at all times.

EHRs

EHRs include patient health data, including data recorded in the patient's medical record, but

also other additional data. In this way, EHRs are more comprehensive than EMRs. Or another way to differentiate EMRs from EHRs is that EMRs represent the digital version of patient records and other patient data, while EHRs represent the ability to easily share digital health information (hence, EMRs) between stakeholders or various interested parties [12].

According to the National Cancer Institute, EMRs and EHRs can be considered synonymous with each other [9]. However, it should be noted that the difference between them remains: EMRs mean a complete electronic version of a patient's medical record, whereas EHRs use EMR data, supplement it with additional information, and make those available for use among health institutions or health-care providers who are authorized to access them. Another difference concerns their use: While EMRs are used by specific physicians for the treatment, care, and diagnosis of individual patients, EHRs enable a particular patient's data to be shared with multiple care providers for the purpose of diagnosis and making clinical decisions [13].

EHR's data can be accessed at any time by the authorized health staff, allowing the latter to better follow the patient's health information and detect a possible problem even in the absence of a physical meeting with the patient. Furthermore, EHRs enable patient data to be shared with medical specialists so that they have that patient's information in case it is needed [14]. EHRs can strengthen the relationship between patients and doctors as they, essentially, through the availability of real-time data, enable better clinical decisions, and improve the quality of health care [14], [15]. Improving the quality of health care through the use of EHRs is due to the reduction of medical errors (this is one of the main functions of the information technology system in the health system), the availability of health information, the reduction of delays in treatment, improvement of informing patients, etc. [14], [15].

Major advantages of EHRs range from providing a complete, accurate, and up-to-date health information to patients at the point of care to improved quality of care and using electronic health data for scientific research, experiments, etc. [14], [15].

According to the Office of the National Coordinator for HIT, EHRs comprise the first step toward transforming of health care, as EHRs enable the improving of health care, improving of health of patients/users of the health system, improving of clinical decision-making process, and improving the effectiveness and reducing the health-care costs [16].

However, the introduction and implementation of EHRs is a complex process that may encounter resistance, and therefore, it needs a strong and comprehensive regulation of health information and policies related to the storage of health data (some of which may be sensitive) [17].

PHR

Personal health records (PHRs) contain the same information as EHRs but are designed to be operated, accessed and managed by patients themselves; patients can use these devices or programs to maintain and manage their health data in a secure and private environment; PHRs can contain many data of different natures including data from doctors, health monitoring devices, and data about patients themselves [18].

There are two types of PHRs: Stand-alone PHRs and linked PHRs. Stand-alone PHRs mean that patients enter the appropriate information from the platform and this information is stored on the patient's computer or on the internet; here, patients can add data about diet or physical activity and they can decide whether to share this information with others (family members, doctors, etc.) [19]. Meanwhile, linked PHRs mean that they are linked to a particular health facility EHR system; in this case, patients can access their personal data through a secure portal and can see the results of their past tests, vaccination history, dates of medical checks or future screenings, etc. [19].

Electronic prescriptions (e-prescriptions)

Electronic prescription is a digital version of traditional (paper) prescriptions. According to the Academy of Managed Care Pharmacy, e-prescribing means "*the use of technology to improve accuracy, patient safety, reduce costs, and enable real-time, two-way, electronic communication between physicians and pharmacies* [20]."

The main purpose of using e-prescriptions is to reduce medical errors and risks associated with the handwriting used in traditional prescriptions; thus, essentially improving patient safety. The Institute of Medicine has recognized that e-prescribing is one of the most promising tools to reduce these errors, recommending that all prescriptions be electronic [21].

Another reason for the use of e-prescriptions is to increase the penetration of the use of technology in the health system and to increase the skills of health-care staff in the use of computers and technology in general; in fact, today, such devices are used by all groups of the population, thus facilitating the use of e-prescriptions [20].

A system that enables e-prescriptions should ensure that some essential functions are fulfilled [22]. The benefits of e-prescribing include: Reducing errors in the prescription of medications, increasing the speed of taking prescribed medications, reducing the time to execute a prescription, avoiding drug reactions, reliable substitution of less expensive alternatives of

reimbursed medicaments, improving compliance with the treatment regimen by reducing the phenomenon of lost prescriptions or unfilled prescriptions and thus reducing costs, and reducing drug abuse by notifying doctors and pharmacists about duplicate prescriptions of controlled drugs [22], [23].

However, even the e-prescription system has its limitations and disadvantages, which include the costs of setting up and maintaining the system, coping with the challenges that occur at the time of transition from the traditional handwritten prescription system to the electronic prescription system, issues related to the selection of infrastructure and related programs (software), issues related to the integrity of data entry, issues of data security and privacy, issues related to situations when the system may shut down (lack of power electrical, internet problems, hardware/software crashes, etc.), and situations where patients cannot access the system [22].

Telemedicine

Telemedicine essentially means using technology to provide health care without the need for physical contact between doctor and patient. Of course, such an approach requires the use of the Internet and the corresponding devices that enable it [25].

Telemedicine has several options, such as using a telephone for audio or video calls with a doctor or other health-care staff, exchanging electronic messages or through email between patients and health-care staff, monitoring devices that patients wear at home to follow certain health indicators and parameters, etc. The range of services that can be provided in this way is quite wide, including: Screening and sending laboratory tests, prescribing mental health treatment (therapy, counseling, and treatment management), solving problems such as migraines or infections of the urinary tract, skin diseases, management and counseling for urgent issues such as cold, cough, abdominal pain, follow-up of patients after surgery, physical and occupational therapy, and remote monitoring of various health parameters that help in the management of diabetes, hypertension, and high cholesterol level [24].

There are also dedicated telemedicine centers, which can be located in hospitals, for example, and which are used to consult specific complex patient cases and to obtain a professional opinion regarding the diagnosis and further management of these cases, without the need to transport the patient to a tertiary hospital center if the case can be managed at a lower level of the health-care system. In the telemedicine centers, the cases of different patients are examined, the complex cases that cannot be solved by the staff in other health centers, and the best experts in the relevant fields give their opinions based on the patient data, examination of graphs, or results of other examinations (e.g., scanner, resonance images, etc.), all of which are accessed through video links with the respective hospitals or health centers where the patient is located. This is an optimal solution to avoid the costs associated with unnecessary transport (as the case can be resolved at the relevant health institution) and to provide expert opinion even in remote areas with suboptimal access to health professionals [24].

In this way, the main advantages of telemedicine include: Physical doctor-patient contact is limited, and this is important in times of pandemics such as COVID-19, health care reaches the patient wherever he/she is: At home, in work, in the car, at the beach, etc.; costs related to transportation are reduced, time lost at work is reduced; waiting times for appointments with health-care staff are reduced, and increasing the population's access to experienced and highly trained health-care specialists who are not available in certain localities of a country [24].

Wearables

Devices worn by patients (wearables) represent smart devices, such as cardiac activity monitors, electronic skin patches, blood pressure monitors, and temperature monitors, which are equipped with other sensors and software; these devices are connected to the cloud and enable the collection, analysis, and transmission of health data in real time, for example, to the health-care staff following these patients/individuals. According to the Healthcare Information and Management Systems Society, such technologies in health care have virtually endless application possibilities because they are present at moments in individuals' lives where no other technology or health-care staff can be present; they focus on lifestyle habits or behaviors that increase the risk for certain diseases, so monitoring these behaviors can help to change them and reduce the risk for the respective diseases; they can provide real-time guidance on changing risky behaviors; and they are becoming less and less expensive, so they can be used by everyone [25]. At present, there is a tremendous increase in the production and use of such devices all over the world.

AI

AI is gaining more and more ground in the context of information technology in health-care systems. This is driven by the increasing complexity and extraordinary amount of medical and health data or other natures, on which health staffs are increasingly relying to make decisions related to the management of patients or health-care users. The main uses of AI in health care include applications for diagnosis and treatment, applications that encourage greater patient involvement and increased adherence to treatment

regimens, and applications of an administrative nature [26]. It is thought that the role of AI in these aspects but also in other dimensions of health care will increase in the future.

Use of HIT in PHC

The use of information technology in PHC (for example, the use of electronic medical data – EMR) can include some of the advantages that we mentioned earlier in this scientific paper, such as increasing patient satisfaction, reducing the time spent on paperwork or other documents that must be completed by health-care staff and/or patients, increasing and improving the quality of health care, increasing the effectiveness of health care, and reducing health-care costs [27], [28], [29], [30].

Some strengths of using EMRs in PHC include: Maintaining the confidentiality and privacy of patient data [31], reducing the risk of incomplete data [32], [33], improving health-care services [34], improving the access to health information [10], and reducing of medical errors [35] between 8% and 18% [36]; in addition, EMRs can reduce errors related to the prescription of antibiotics, the duration of treatment and their dosage [36], and improve communication between health-care providers [37], [38]. In addition, it has been reported that EMRs improve the communication between patients and their family members and health-care staff [39], reduce the health-care costs [36], [40], reduce the spaces for data storage, increase the satisfaction of doctors [36], etc.

However, EMRs may also have disadvantages related to the high costs of setting up and operating these systems (purchase of equipment and software, conversion of physical records to digital records, training of EMR/EHR users, etc.), cost for continuous maintenance of the system (replacement of equipment, need for continuous training, etc.), loss of income due to temporary loss of productivity (the time it takes users to get used to the new system), decrease in income, risk of compromising patient data privacy, etc. [36]. In addition to these, EMRs can also trigger some other unwanted consequences such as an increase in medical errors (due to poor design, errors in the design or conception of EMRs/EHRs, lack of training, etc.), fostering negative emotions (especially older and technology-inexperienced health-care staff who may become stressed while trying to adapt to new technology), changes in power structures between doctors and patients (because, for example, the EMR can prevent the doctor from prescribing a certain drug, and this can be perceived as a loss of the doctor's autonomy and power), creating a great dependence on the technology (and interrupting work in case of electronic system failures as users are used to this system and find it difficult to work manually; therefore, the PHC institutions implementing EMRs should ensure that work and health care will continue to be offered even in the event of a temporary malfunction of the electronic system), etc. [36].

A systematic literature review that aimed to identify interventions that improve the use of EHRs in PHC settings reported that these interventions include: Integration of patient referral functions, electronic communication, use of "reminders," the use of clinical decision support systems, and workflow management support functions were 5 times more likely to improve the use of EMRs compared to controls, whereas interventions focusing on data quality were over 5 times more likely to improve their use of EMRs [41].

In conclusion, we can state that despite the disadvantages of EMRs and EHRs, their benefits outweigh the disadvantages, especially from a societal and public health perspective, because: EMRs increase the quality of PHC (but also at the secondary and tertiary levels) by improving patient safety through reducing medical errors and reducing health-care costs (thus improving health-care effectiveness), as well as improving patient adherence to treatment regimens (such as increasing vaccination rates) [36]. In this way, all of society benefits as EMRs help keep patients healthy and reduce their risk of contracting various diseases [36]. Another societal benefit of using EMRs is the opportunity they create to use their data for scientific research purposes in an effort to identify evidence or scientific facts related to best practices.

Discussion

HIT is indispensable to be able to respond in time to the needs of health-care users and to provide high-quality health care.

HIT means the equipment, software, and systems that include data collection, transmission, processing, and analysis of information in the health-care system [42]. The use of information technology in the health system has a critical role in improving health care based on scientific progress and technological advancement, ensuring that health information is confidential and available whenever and wherever it is needed; in this way, HIT can substantially improve the quality of health care, the safety of care, the coordination of care, and the cost-effectiveness of health care [42].

In fact, the use of technology in health care has undergone a real evolution based on developments in technology, information, and communication in general, leading to the development of the concept of e-health (electronic health); drivers for this evolution include increased knowledge about different overlapping disciplines, scientific research data related to the promotion of evidence-based medicine, e-medicine, and e-health services for remote or difficult areas to be reached; all

these are leading to a comprehensive change of traditional health-care systems but also of the environment where these systems operate; on the other hand, the introduction of concepts such as e-commerce, e-business, or online in health care has created the possibility of using low cost and online technologies to optimize health care also from a business point of view [43].

According to the World Health Organization: "e-*health means the cost-effective and secure use of information and communication technologies in support of health and health-related fields* [8]." Nowadays, electronic health or e-health has an essential role in achieving health priorities that are interconnected with many other areas, such as UHC and the SDGs [8].

The goals of health-care information technology include: Increasing accountability, improving the health of patients and the community, increasing the effectiveness of health-care delivery, and reducing health-care costs [42], [44].

Undoubtedly, information technology has an essential role in increasing the effectiveness of the health-care system and in improving the quality of health care. However, the costs of implementing information technology should also be taken into account, which in many cases can be significant. Given that current trends increasingly favor the use of HIT in the health-care system, this implies that the application of information technology is an inevitable element in any health system that aims to be effective and that aims to provide quality high-quality health care. Hence, this is a matter of time, and the duration of this process depends on many complex factors. In this context, we think that the journey on this one-way road (only toward the increasing implementation of information technology system in the health system) for developing countries with limited resources, such as Albania, can be realized gradually, with small steps but well-thought-out, local interventions with high potential to integrate with other parts so that, in the end, they can generate a complete information technology system that works as a whole.

However, it should be emphasized that technology is one of the instruments to achieve the goals of the health-care system and the detailed analysis of information requirements in the context of a given health system should always take priority over the temptation or rush to digitize the system in an unreasonable way. This is because HIT by itself does not solve system management problems; rather, HIT should be considered as part of a broader health system reform, including a review of the business aspects of the health system.

In this sense, an essential element is to have a match between the chosen information technology strategy and the goals for managing the health system. Indeed, scientific evidence suggests that if HIT is carefully designed, implemented step-by-step and with high accountability, and properly managed, success can be tangible [45], [46].

At the end, to successfully implement any information system in health care, teamwork and coordination among several key actors are essential, including clinicians or other health staff, managers of health institutions or organizations, and information systems professionals; this collaboration between health-care staff and information technology specialists is critical since neither side possesses the full knowledge necessary for such an intervention: IT specialists have the technological knowledge to build information systems but are not inside the reality and requirements of a health-care system or health institution in real daily life activities and, on the other hand, health-care staff naturally does not have the necessary knowledge to build, operate, and maintain a digital information technology system. In this way, the interaction consists of IT specialists listening to the ideas and thoughts of health professionals and clinicians and trying to implement those ideas into the information technology system being built, and virtually, this is a cycle of interactions that never ends (a vicious cycle).

Conclusions

The use of HIT in the health system and PHC system is an inevitable process that is gaining increasing importance and attention. Despite the many advantages of HIT, the related disadvantages and operating costs need to be taken into account. Furthermore, a strong political support, teamwork, and coordination are essential for the successful implementation of HIT in every country.

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