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Role of Medical Information Systems in Reducing Financial Costs of Health Institutions: United States Model

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Abstract:

This study aims to examine the role of the medical information system in reducing the costs of medical institutions, and the study concluded that there is potential for (HIS). This is evidenced by the investments that are currently being injected into the development and adoption of HIT. Nonetheless, for HIS to deliver on its promise, there are significant obstacles that must be overcome arising from the interaction of users of the HIT system, HIT itself and the policies that govern the use of health information systems.

key words: Role, development, Information Systems, Healthcare, Financial costs.

Introduction:

It is usually assumed that the introduction of medical information technologies, like any other information technologies, is extremely costly, and their returns are expressed not by cost, but by quality indicators. such as: improving the quality of medical care, facilitating the work of medical

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personnel, improving the health of patients, etc. In essence, this opinion did not arise because of the real lack of economic efficiency. years provided by information technology, and because of the lack of development of methods for measuring economic effect.

Evaluation of the economic efficiency of investing in any investment projects, which is the creation of an information system for a medical institution, is obtained by comparing the value of these funds with the expected results, In the case of medical information systems, we can estimate the costs associated with their implementation and support, but the task of estimating the economic benefits that a medical institution will receive through this information system is much more difficult.

Evaluations can be used to determine the cost-effectiveness of medical information systems, since some countries have many years of experience in computerizing health care.

SECTION I: MAJOR DEVELOPMENTS FROM INFORMATION SYSTEMS TO HEALTH INFORMATION SYSTEMS

Healthcare information systems refers to such systems that are used to process data, information and knowledge in healthcare environments while healthcare information systems and health information systems are often used today to refer to the same concept, a series of terms have been used in the evolution of this phenomenon from its early foundations in the 1960s. Though there is no clear consensus in literature until lately, the term health information systems analogous to various primitive forms of this concept such as hospital information systems. Similarly, terms such as computerized patient records, electronic medical records, and the more current electronic health records have come to be commonly used almost interchangeably. Though the exact meanings may differ, all represent a progression in the development of healthcare information technology. discusses major evolutionary developments from the primitive hospital information systems to the health information systems as we know them to date. In the following paragraphs important trends are discussed in a bid to provide a perspective to this chapter.

Paragraph 1: Trend 1: From Paper-Based Systems to Computer-Based Systems: Meanwhile health data and information in the past have been created and stored mainly on paper, there has been a clear migration from paper to computer-based systems (Haux, 2006). This ability means that more data can be processed and stored through the use of modern information technologies to yield better knowledge. The future of healthcare information systems looks towards a near “paperless” era (Haux, 2006, p. 75)

Paragraph 2: Trend 2: From Local to Global Information Systems: While earlier healthcare information systems were limited to departmental units (e.g., radiology, or laboratory) or just within a healthcare practice system (e.g., hospital or clinic) (Linberg, 1998), modern healthcare systems target regional, national and even a global reach (Linberg, 1998, p. 48).

Paragraph 3: Trend 3: From Healthcare Professionals to Patients and Consumers: Originally, health- care information systems were designed to be used by mainly physicians and administrative staff (Ball, and others, 1994), but it was later passed on to be used by nurses. Since then, the trend has shifted to involve more patient input.

Paragraph 4: Trend 4: From Using Data for Patient Care to Research: Over the years, patient data has been used beyond patient care management to a more general use involving research in health- care and even education (Leiner, Gaus, Haux, & Knaup, 2002).

Paragraph 5: Trend 5: From Technical to Strategic Information Management Orientation: Haux (2006) has noted that while computer-supported information systems from the 1960s to the 1990s focused on problems resulting from the technical aspects of the systems, concerns about the organizational problems, social issues and change management aspects became more relevant at the turn of the millennium (Kuhn & Guise, 2001, p. 40).

Paragraph 6: Trend 6: From Numeric Data to More Complex Forms of Data: Not only has the technology that support health information systems advanced in technological complexity, the data that is being received and processed has also become complex. From numeric data through alphanumeric data to imaging and even molecular data (Maojo & Martin-Sanchez, 2004, p. 43).

SECTION II: HEALTH INFORMATION SYSTEMS INFRASTRUCTURE AND INFORMATION FLOWS

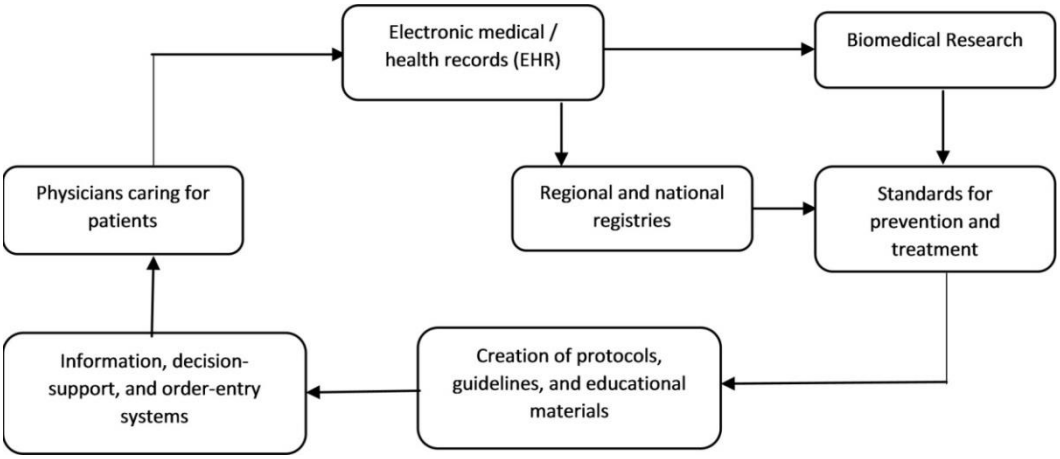
Health information technology consists of a wide range of networking technologies, clinical databases, electronic medical/health records, and other specific biomedical, administrative and financial technologies that generate, transmit and store healthcare information. In the diagram below, a generic model of information flows that typify health information systems infrastructure is presented, and a brief discussion of the application of this model is highlighted in Figure 1.

In the model above, all information from healthcare providers (hospitals, clinics, emergency rooms, small offices, multispecialty groups, etc.) are entered into an electronic health record. This information is then networked to regional and national databases through electronic exchange. Data flows

from EHRs and regional registries are then channeled into standards for prevention and treatment, which can be further pro- cessed to yield information for decision-making and decision-support. At each of these levels, appropriate information technologies are used to undergird data flow. The implications of this type of technological architecture are many-fold. First, it raises issues of the encryption of data. The United States Health Insurance Portability Accountability Act (HIPAA) has set in place the privacy and security policies to provide guidance. Second, the standards for data transmission and sharing over networks requires that all EHR developers all use the same standard—the HL7 standard. Third, given data transmission standards, data definition standards are equally important. They ensure that data communicated is read and understood by others. Fourth, with data coming from diverse healthcare sources, data quality control then becomes critical. Lastly, this model infrastructure means that regional and national databases with ability to hold, manipulate and produce useful information for decision-making (Shortliffe & Sondik, 2006, p. 863).

Figure 1. Information flows in a health information systems

Source: (Adapted from Shortliffe & Sondik, 2006)



Summarily, the healthcare information systems arena has changed and is changing. These changes offer unique opportunities as well as challenges never before seen. Whether opportunities or challenges, both of these phenomena cut through technological, organizational and human factors. In fact, the interaction between these factors is responsible for providing a more informative and richer lens for understanding the current and future landscape of health information systems. Like Shortliffe and Sondik (2006) have stated, the potential barriers in healthcare information technology are rather logistical, political and financial than technical. Hence, in the pages below,

an effort is made to discuss these factors in the light of the both the opportunities and challenges that be. The rest of this paper is dedicated to discussing the opportunities and challenges that lie in HIS arising from the triad interaction of technology, the internal and external environments of the healthcare sector, and the human agent.

SECTION III: OPPORTUNITIES

Healthcare information systems have been critically acclaimed for their ability to increase legibility, reduce medical errors, shrink costs and boost the quality of healthcare.

In the following subsections, the potential opportunities that lie in HIS are examined (Jha, et al., 2010)

Paragraph 1: Cost Savings Healthcare information systems is expected to save money in the long run and generate organizational profitability through efficiencies, cost-effectiveness and safety of medical deliveries.

Practically-speaking, it is expected that HIS will reduce expenses associated with record-keeping while meeting privacy regulation standards and improving workflows, practice management and billing. HIS is also expected to permit automated sharing of information among providers, reduce office visits (to receive tests results) and hospital admissions (due to missing information), and even reduce risks of malpractice law suits (Goldschmidt, 2005, p. 70).

The United States healthcare industry was prob- ably the most inefficient information enterprise in the world. They further contended that more than $81 billion could be saved annually if electronic medical record (EMR) systems were effectively and sufficiently implemented. With the adoption and implementation on interoperable EMR systems they were even more optimistic, estimating a cumulative net savings totaling another $142-$371 billion over a 15-year period. There seems to be no question that long-term savings is a potential economic strength of health IT systems (Devaraj & Kohli, 2006).

Paragraph 2: Reduction in Medical Errors the Institute of Medicine (IOM) (1999) study reported that up to 98,000 people die in U.S. hospitals each year as a result of preventable medical errors alone. It further predicted that 50% of errors could be eliminated over a five-year period if existing technological know-how was implemented.

A more recent report noted yearly increases in medical errors claiming a disturbing 1.5 million adverse drug events due to preventable medical errors.

In its list of solutions to this problem, the IOMunequivocallymentioned the use of health information technologies such as e-prescription-as a key solution element. Evidently, health information systems' role in increasing

legibility and medical error reduction in healthcare services has been shown to be a potential benefit (Psaty & Burke, 2006).

Paragraph 3: Overall Quality of Healthcare

While reduction in errors certainly contributes to the quality of healthcare, there are more general oppor- tunities that HIS offer provide insights as to how HIS in improving patient outcomes in a society. These include (Van de Castle, et al., 2004):

- More complete, accurate and structured clini- cal data documentation.
- Automatic sorting and summarization of data for information generation.
- Direct access to instant updates to records as well as remote access to patient records.
- Reduced medical mistakes from legibility and order entry errors;
- Increased decision support from structured data and predictive modeling and disease man- agement tools.
- Data mining capabilities provided by the vast amounts of structured medical record data con- tributing to disease research and preventive in- terventions in clinical care.
- Continuous improvement in clinical decision making through decision support (enabled by health information exchange), rapid dissemina- tion of information and quicker monitoring of care.

SECTION IV: ASSESSMENT OF BENEFITS BASED

The most significant and significant among the currently implemented medical information technologies are electronic medical record systems (EMS). Based on literature data, in European countries, electronic medical cards have already replaced regular paper cards by 90%, in the USA - by 70% (Wang, 2003)

ince the return from the introduction of medical information technologies as a whole is made up of savings in individual areas of their spending, estimates of the economic effect achieved can be obtained by identifying the fullest possible range of benefits provided by information systems. The most tangible benefits of introducing medical information technologies are the following:

- the benefits of reducing the number of actions with medical records, the possibility of copying records;
- savings in drug costs;
- savings on laboratory and radiological studies;
- benefits of reduced hospitalization;
- administration benefits obtained when working with payment documents

It should be noted that to the listed benefits obtained through the introduction of an electronic medical record system, provided they are widely distributed, the economic effect of other factors is surely added, for example, from the exchange of clinical information about patients between medical institutions. But in this aspect, the economic effect is poorly studied.

SECTION V: CLASSIFICATION OF BENEFITS FROM MEDICAL INFORMATION TECHNOLOGIES

Quantitative determination of the amount of savings for each, was carried out by means of timekeeping of the working time of medical personnel, expert polls, cost comparisons before and after the introduction of information systems, direct calculations of the cost of drugs, 5 for the out-patient sector and 5 for the stationary sector (Girosi, Meili, & Scoville, 2005, p. 16):

Paragraph 1: Outpatient sector:

- the benefits of electronic medical records;
- cost savings on card statements;
- savings on laboratory research;
- cost savings on drugs;
- savings in radiological research

Paragraph 2: Stationary sector:

- the benefits of improving the work of nurses with documents;
- the benefits of electronic medical records;
- savings on laboratory research;
- cost savings on drugs;
- the benefits of reduced hospitalization

SECTION VI: BENEFITS OF REDUCING THE NUMBER OF ACTIONS WITH PAPER MEDICAL RECORDS

Paragraph 1: Benefits of the Foundation

a) Outpatient sector:

SEMC reduces or eliminates the need to maintain paper outpatient patient records. Here, savings are achieved due to the fact that the need for medical personnel who are engaged in the search and issuance of paper cards disappears; Once you have entered the data on the patient, the doctor can then quickly find them and familiarize yourself with all the resources of the card; the data does not occupy a physical space that can be used more productively. Of course, institutions equipped with an SEMC still continue to receive paper documents in the form of laboratory reports, referrals to a specialist doctor, and so on. It is also possible to save money by scanning paper documents in the EMS and using them by any doctor without additional searches for the necessary information in paper documents. Since the translation of a document into an electronic form is carried out once, in the future staff costs

for working with documents can be reduced, there are various data on savings due to the introduction of electronic medical records. Such savings in the costs of medical personnel recording a record are estimated at 63.4% (Lambertville & Miller, 2014, p. 33)

b) Stationary sector:

The electronic medical record system, which allows nurses to access patient care documents, saves money by reducing the amount of nursing time they spend on documentation and over-collecting data; by reducing the costs associated with paper forms, preventing accidental omission of procedures. Decision support mechanisms in such systems can coordinate treatment, automatically recalling the need to involve support services.

For evaluation, the reduction of working time with documentation is mainly considered. It was determined that the EMS can reduce the number of operations with medical records by 60–70% and reduce the number of personnel working with medical records by 50%. Saving time spent on working with documentation can be used in at least4 ways:

- to reduce the number of nurses hired.
- to take better care of the same number of patients.
- to treat additional patients without compromising the quality of services.
- Savings on drug costs

Drug costs are reduced due to the introduction of modules for the computerized input of medical prescriptions and support for clinical decisions. Doctors are given the opportunity to use electronic databases of drugs, their combination, contraindications, etc. With their help, the choice of treatment is carried out in accordance with medical standards, taking into account the cost of medicines, as well as their rational combination and the optimal period of use. Different expert estimates, cited in a number of literary sources, agree that the electronic system of supplying alternative medicines can reduce the total cost of drugs by 15% (Tierney & Miller, 1998, p. 381)

Paragraph 2: Savings on laboratory and radiological research

Savings on laboratory research in medicine, equipped devices, as well as support for clinical decisions, by reducing the number of unnecessary, often duplicating each other tests. This is explained by the fact that the EMSK not only provides medical care, but also builds an optimal scheme for their implementation in connection with, for example, products for treatment, with a transition from one stage of treatment to another, etc. Also, SEMC helps to create a structured set of assignments for analysis, eliminating the redundancy of the tests. Estimates stand at 22.4% of the total cost of laboratory tests in the outpatient sector and 11.8% in the inpatient sector, the costs of

radiological examinations in the outpatient sector are reduced by 14% (Lambertville & Miller, 2014, p. 39)

Paragraph 3: Benefits of reduced hospitalization

Patients' stay in hospitals accompanies many different types of time losses delays in prescribing treatment, searching for documents, in the actions of appointments of various specialists, etc. The system of electronic medical records allows you to carry out such time losses to a minimum and, therefore, resource of urgent hospital stay. According to various studies obtained by sampling, it takes from 10 to 30% of the actual length of hospital stay (Johnston, 2013, p. 14).

Paragraph 4: Administration benefits from working with payment documents

Up to now, one type of information systems introduced into medical organs has been considered - the electronic medical card system (SEMC). At the same time, the introduction of information technologies into the administrative services of medical institutions ensures savings in the cost of registering payment documents in the amount of 63% of the average costs, note that the scope of implementation (Wong, 2006). Integrated information management systems based on Interin technology, in addition to medical departments of medical institutions, also cover their administrative divisions. A more complete fixation of all the medical actions and procedures performed in the SEMC reduces costs by 2%. Errors in billing are reduced by 78%.

SECTION VII: COMPARISON OF COSTS AND RESULTS OF IMPLEMENTATION OF MEDICAL INFORMATION TECHNOLOGIES

a cost model for EMS in American hospitals was constructed on the basis of data from literature and predetermined goals by hospitals, for a total of 27 hospitals. The model makes it possible to predict the cost of an SEMC, taking into account the main characteristics of hospitals, such as their size and operating costs. The model does not affect the technical specifications of the SEMC; most likely we are talking about the general functionality of SEMC, which includes elements of computerized input of medical appointments and reports on patient management.

The cost of an SEMC consists of two parts: capital expenditures for implementation and annual, current maintenance costs. At the same time, the cost of maintenance is estimated as a percentage of capital costs (Tierney & Miller, 1998, p. 383).

It is assumed that in most cases the capital costs of the EMSs will be separated by a period of three to five years, they include the cost of the EMSS software, local infrastructure costs (such as networking and computer

services), as well as the labor costs of inpatient staff in installing and upgrading work based on information technology.

for the clinic, which makes five years of expenses in information technologies in the allocation of $ 42,900, the Discounted value of the savings obtained for the same period is $ 129300, which is an order of magnitude higher than the efficiency of the most profitable sectors of the economy.

In general, for the entire US healthcare system, financial benefits are calculated that can be obtained through the introduction of medical information technologies (Table 1). The potential (maximum) value of benefits is almost twice their average value.

As we see, in the outpatient sector the most significant benefits are: savings in drug costs, savings in radiological studies, savings in laboratory tests. In the inpatient sector, the benefits of a reduction in the length of hospitalization and the improvement in the work of nurses with documents.

The greatest benefits from the introduction of electronic medical records are obtained by saving on medicines (33%), saving on radiological studies (17%) and by reducing errors in bills (15%). Such a result makes it possible to concentrate on these types of benefits when conducting such studies, if the full coverage of all the advantages of the electronic medical records system is fraught with difficulties in obtaining cost information (Lambertville & Miller, 2014, p. 43).

The data table. 1 allows us to estimate the economic efficiency of introducing medical technologies into the US healthcare system. Considering that annual expenditures for these purposes in the inpatient sector amount to $ 6.7 billion and the average financial benefits 31.3 billion dollars (tab. 1), the profitability of expenses for medical information technologies is 367%.

No matter how sceptical about this fabulous economic efficiency, it is with such a margin exceeds the efficiency of the economy, which remains evidence even with the very pessimistic assumption of repeated overestimation in the analysed works medical information technology (Wang, 2003).

. **Table 1. Cumulative benefits from the introduction of information technologies in US medical institutions**

Types of benefits Potential	annual savings, billion dollars.	Average annual savings, billion dollars.
The outpatient sector		
the benefits of electronic medical records	1,9	0,9
cost savings on list of cards	1,7	0,8
saving on laboratory research	2,2	1,1
cost savings on carnal drugs	12,9	6,2
savings on radiological ces studies	3,6	1,7
Total:	22,3	10,7
Stationary sector		
the benefits of improving the work of nurses with documents	12,7	7,1
benefits of electronic medical records	2,5	1,3
savings on laboratory research	3,0	1,6
cost savings on drugs	3,7	2,0
benefits of shorter hospital stays	36,7	19,3
Total:	58,6	31,3
Total:	80,9	42,0

Conclusion:

The presented problem of evaluating the effectiveness of medical information systems was investigated by us autonomously from solving the common problems of creating these systems. We encountered information difficulties in conducting an economic analysis of the implementation of information technologies in hospitals.

In this connection, the task of expanding medical information systems with a special block of economic analysis clearly arises, especially since the evaluation of the effectiveness of information systems is necessary not only at the stage of preparing and selecting projects for funding, but, equally important, for constant performance monitoring at the operation stage. The control task should be solved on timely updated, real information, which it is advisable to form within the information system itself.

In the studied foreign literature on the assessment of the economic benefits of the introduction of electronic medical records, we have not met a single job that would talk about the creation of such blocks. All estimates were obtained virtually by hand, partly on the basis of expert, approximate estimates.

Thus, the next stage of the research should be the implementation of methods for assessing the economic efficiency of medical information systems in the form of a software package embedded in the structure of these systems.

Healthcare information systems promises to increase legibility, reduce medical errors, shrink costs and boost the overall quality of healthcare. Government investments in healthcare technology are both significant and purposeful in achieving desired outcomes. Nevertheless, there are many challenges resulting from the technology, end-users and environment that continue to undermine these efforts. This article explored the opportunities and challenges that lie in health information systems and lessons learned were also highlighted. Future implementation will do well to focus on the integration of all stakeholders and technology while remaining mindful of the sociocultural organizational environment while exploiting recent advances in cloud technologies and information exchange.

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