Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

THE IMPORTANCE OF IMPLEMENTING INTEGRATED INFORMATION SYSTEMS IN HOSPITALS

Yasmin A MOBASHER
Bucharest University of Economic Studies, Romania
yasmin_mobasher93@yahoo.com

Abstract
Integrated information systems are a fundamental component of companies' activity. The existence of such a system allows a much more correct management of the company's resources, streamlining operations and thus bringing a substantial competitive advantage to those who use it. Health is a vast and complex field in which computerization is useful and necessary in both the public and private areas. In the field of health, hospitals that use such integrated information systems can cover the management of the entire activity, from supply, to the management of patients, staff, tests and procedures or the reporting of diagnoses to insurance companies. The desired end result of the introduction of electronic services in health consists in increasing the quality of services and decreasing the costs of these services, for all those involved: patients, healthcare professionals, medical institutions or insurance companies. This paper aims to analyze the importance of implementing an integrated information system in hospitals from theoretical point of view. It presents the particularities of integrated computer systems for hospitals and it details the components of a hospital integrated system as a useful tool for improving the patient care process and reducing costs in these uncertain times.
Keywords: health care services, hospital, Hospital Information System, HIS, integrated information systems.
DOI: https://doi.org/10.24818/beman/2022.S.I.3-01

1. INTRODUCTION

Integrated IT systems describe the wide range of activities that support the company in managing important aspects of the business. The main purpose of integrated information systems is to collect and process information in the form of data (Chapman & Kihn, 2009). The information processed through integrated information systems serves as a basis for managerial decision making within companies (He, Zhang & Li, 2021). In this sense, an integrated information system is designed to meet three basic criteria: information quality, information security, information uniqueness (Gomes & Romão, 2018).

The managerial decisions made based on the information depend on the quality and correctness of the information (Ferraris et al., 2018). Quality can be represented by the fact that an integrated information system allows or even requires the collection of all information relevant to the decision-making process, while fairness is the fact that the information is in line with reality (Karademir, 2019).

The information gathered in the integrated IT systems is basic to the operation of the company and can create a potential advantage if they reach the competition (Veile et al., 2019). Also, some information is personal patient data and it is very important that this information does not become public. To this end, an integrated computer system must ensure the security of the information collected by restricting staff access to areas of the integrated computer system which it does not need to view or modify (Yaacoub et al., 2020).

Operating the same information several times is a waste of resources, in terms of gathering information (multiple input) and maintaining that information. One of the main reasons for the emergence of an integrated computer system is the integration of different systems to allow the propagation of information collected in one system to other systems (Alber et al., 2019).

Integrated information systems can be used in product life cycle planning, supply planning, inventory management, order tracking, service, etc (Pundir et al., 2019). Such a system can include both modules for financial and general accounting, for human resources management, etc., as well as specialized operational modules. ERP systems allow the optimization of the use of resources available to the company, helps to increase the quality of internal processes (Appelbaum et al., 2017), ultimately leading to increased operational efficiency and analysis of real-time activity indicators. An informed and efficient company is a competitive company, which is essential in the context of globalization.

Electronic health care services are the result of the application of information and communication technology in the full range of functions related to the health sector (Aceto, Persico & Pescapé, 2018). These services are intended to meet the requirements of citizens, patients, healthcare professionals and healthcare organizations, public and private, as well as the authorities and policy makers involved in the field. The introduction of electronic services in the field of health care is a process that can be complex and time consuming (Shahid, Rappon & Berta, 2019), but the benefits (better services at lower costs) justify the efforts, whether they are submitted by the government with reference to the public sector or by the private health care sector.

The human side of the impact of introducing an integrated health information system is particularly important, and improving patient safety throughout the care process is a key priority (Smith et al., 2008). Reducing the number of preventable deaths due to incorrect or late medical interventions, adverse effects of medication, and other preventable adverse effects of the medical act is an emergency. The introduction of electronic means (computers, applications, telecommunications) can significantly reduce the incidence of unintended and avoidable adverse effects of the medical act (Starmer et al., 2013). At the same time, there is a significant increase in the quality of life of citizens and the medical services provided to patients, medical staff have a wider range of support tools, and all organizations involved in

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

the medical act can achieve cost reductions. One of the main electronic ways to achieve the desired goal - better services and lower costs - is to transfer all on paper patient information, into databases that can be connected to each other so that any doctor to be able to access all the information he needs for the care of any patient, at any time and in any place (Ford et al., 2006; Zahabi, Kaber & Swangnetr, 2015).

Cloud computing is the storage of files, databases, and the running of programs and interfaces over the Internet from one or more data centres configured to balance the load on requests. Since 2010, the concept of cloud has become very popular in the IT field. The term cloud has been used and reused in an attempt by companies to become pioneers and innovators, but not all the meanings given to this term are real. Studies conducted by the European Commission in 2011 show that the adoption by 80% of organizations of cloud technologies would reduce operating costs by 20%, increase productivity by up to 41% and standardization by up to 35% (Zota & Fratila, 2013).

Below are a number of advantages generated by using on-premises or cloud-based systems from both the user's and the developer's perspective. The disadvantages can be easily deduced, as the elements that recommend the location option are also those that can be disadvantages in the case of the cloud version and vice versa.

From the user's point of view, the advantages of using on-site ERP systems are:

- the possibility to customize the system,
- low dependence on the supplier,
- enhanced security through increased control over data access,
- high working speed, within the same physical network,
- ownership of use licenses once purchased.

From the developer's point of view, the advantages of on-site ERP systems are:

- collection of licenses at the beginning of implementation,
- the possibility to market a wider range of services,
- most on-premises ERPs are more developed than the more recent cloud-based ones.

From the user's perspective, the advantages of using cloud integrated systems are:

- it does not require a high investment in infrastructure,
- low cost, monthly in the form of a subscription,
- high accessibility, from anywhere in the world and from almost any mobile device,
- higher working speed in the case of several locations globally.

From the developer's perspective, cloud integrated systems have the following advantages:

- state-of-the-art technology, in continuous development,

- high speed of implementation in case of legislative updates,
- standardization of the source code - it no longer has to have a variant for each client,
- global access.

2. RESEARCH METHODOLOGY AND OBJECTIVES

The aim of this empirical research is to unveil the importance of implementing an integrated information system in hospitals, especially in these times of uncertainty of Covid-19 pandemic that affected the functionality of many health care units. The paper uses a theoretical approach to this topic and it tries to achieve the following objectives:

- presenting the particularities of integrated computer systems for hospitals,
- analysing the components of a hospital integrated system as a useful tool for improving the patient care process and reducing costs,
- highlighting the advantages of using Hospital Information Systems.

The paper is structured according to the set objectives and it is an ongoing study, that will further analyse cases of effective implementation of integrated information systems in hospitals.

3. PARTICULARITIES OF INTEGRATED COMPUTER SYSTEMS FOR THE HOSPITAL

Integrated IT systems, due to their dual nature: licenses and services, do not require the completion of the contract at the time of sale. A contract for the sale of an IT system usually involves the collection of the value of the licenses at the beginning of the contract and the higher value of the services will be collected during and after the completion of the implementation. This, together with studies that show that post-implementation services can reach value, the initial acquisition value in just 2-3 years makes the success of implementations become an object of study and analysis for the team responsible for integrated IT services for hospitals.

Research conducted in 2001 studied the most important factors of implementation success, by analysing over 110 implementations of information systems and their ranking by 52 managers (Somers & Nelson, 2001). The main factors considered to be successful, depending on the degree of importance were: supporting the top management, the competence of the project team, inter-departmental cooperation, well-defined purpose and objectives, project management.

In addition to the success factors of implementing an information system, there are also failure factors, of which one of the most important are the users and more precisely their resistance to change.

User resistance to change is defined as a subjective, psychological process at the individual level (Siegel, 2008). Users can manifest resistance in an active (easy to identify) or passive (more difficult to detect and manage) way. Coetsee (1999) presents four types of resistance:

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

• *Apathy*, corresponding to the attitude of disinterest and inactivity about a situation. It represents a state of transition between resistance and acceptance.

• *Passive resistance*, when people adopt attitudes in order to slow down certain processes, changes and to maintain the previous state of affairs.

• *Active resistance*, considered a constructive form of resistance, which aims to improve the project (expressing different points of view, negotiations, etc.).

• *Aggressive resistance*, users can resort to threats, blackmail, boycotts and other actions in order to block the implementation of systems.

An important role in the management of the hospital activity has an integrated computer system. Internationally called the Hospital Information System (HIS), it allows at any time an overview or detail of the activity carried out in a hospital.

Although there are similarities of HIS-type integrated systems with other integrated systems, a number of peculiarities can be identified (Auerbach et al., 2013). For example, the main objectives of a HIS-type computer system, as they were identified by Herbst et al. (1999) are:

• Improving the quality of patient care,

• Standardization of the medical act,

• Improving the efficiency of the management of the health unit.

Rahmani et al. (2018), define a HIS as an integrated computer system that includes all computer systems in the hospital that deal with data collection, storage and processing and contains at least one hospital management system, one billing or settlement system, and several specialized components.

Researchers present eight basic functionalities of a HIS (Cubo et al., 2014; Catarinucci et al., 2015; Li et al., 2020):

1. *Clinical information and data* - an integrated computer system must contain data about a patient so that a doctor can make the right decisions. On the other hand, it is important that the user interface is intuitive and does not provide unnecessary information that could mislead the user;
2. *Management of results* - to keep track of all historical and current results from all doctors involved in treating the patient, including laboratory results, microbiology, pathology, radiology, with multimedia support for images, sounds and scanned documents;
3. *Introduction and application management* - known in the literature as Computerized Provider Order Entry (CPOE). CPOE assists in carrying out clinical activities such as: electronic prescription sheets for medicines, laboratory applications, consultation requests, etc. from the section;

4. *Decision support* - helps in making clinical decisions such as determining diagnoses, requests for drugs from the ward (through CPOE), etc. and provides clinical alerts;
5. *Communication and electronic connectivity* - the exchange of medical information possible due to the integrated systems within the units and between the units is critical for the quality of the medical act. Communication can be within a multidisciplinary team or between several teams;
6. *Patient care* - the system can contain functionalities through which a patient can access and consult his own information (e.g.: a web portal), functionalities for patient education, follow-up and monitoring at home (tele-medicine);
7. *Administrative processes* - the system provides access to planning and booking features to support administrative services for patients;
8. *Reporting and monitoring the health of the population* - internal and external management reports and reports to monitor the health of the population and also the monitoring of epidemics or widespread diseases.

4. COMPONENTS OF AN INTEGRATED COMPUTER SYSTEM FOR THE HOSPITAL

The integrated computer system for the hospital generally consists of components designed to be marketed separately or integrated, depending on customer needs. Integration between components is done either using the same database, more common when the components are produced by the same provider or by data transfer or web services when the components are produced by different companies. The components of a HIS are the following:

- Hospitalization management,
- Clinic management,
- Laboratory management,
- Hospital pharmacy,
- Radiology,
- Resource management,
- Electronic Patient File,
- Calculation of hospitalization costs,
- Reporting.

1. Hospitalization management

One of the most important components of an integrated computer system, the component for hospitalization management allows tracking of hospitalizations and discharges, along with the

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

necessary medical information related to patients: diet, medical diagnoses at admission and discharge, passport data, information on recommended drug treatment etc. (Figure 1.).

Upon hospitalization of the patient, the user collects his passport data and saves it in the system. Medical data regarding antecedents, hereditary collateral diseases, allergies, etc. The information will then be used to establish diagnoses and treatments by doctors.

The administration of the patient's diet can be monitored with the help of the computer system. From the establishment of the regimen by the doctor and its registration in the system, to the recording of the type of regimen administered each day, physicians can have access to this information later, if necessary.

Constituting very important information about the patient, diagnoses can be of several types: inpatient and outpatient diagnoses, primary and secondary diagnoses. They are also recorded in the system, together with any changes during hospitalization. In addition to the value of medical information, diagnoses are also used to calculate certain performance indicators, depending on which the level of financing of the unit from public funds is established.

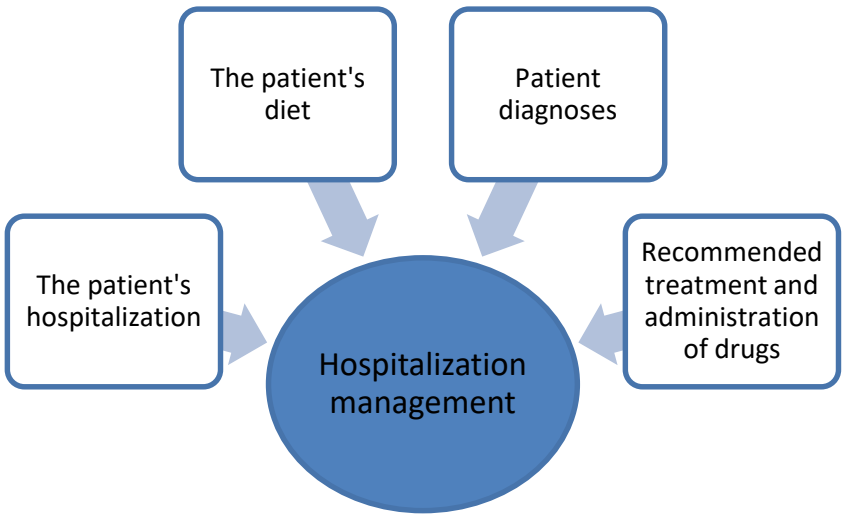

FIGURE 1. HOSPITALIZATION MANAGEMENT COMPONENTS

Source: Author

Drug treatment is a very important component of the treatment received by the patient during hospitalization. It is very useful for the doctor to have in determining this treatment, in addition to medical information, gained through experience and education, and information strictly related to the patient in question, information he can take from the computer system, if they were introduced in previous or at admission episodes.

In addition to the establishment, the process of administering this treatment is very important, for this the computer system has specialized functionalities, which can create an administration schedule for a

patient or for an entire ward, throughout the hospitalization period, right from beginning. This also helps in determining the need for medication for the next period.

2. Clinic management

In a hospital, the outpatient clinic is a big part of the activity. Outpatient consultations and procedures are performed in the outpatient clinic, both for inpatients and outpatients. Simple, medium or complex procedures are performed in the outpatient department, as well as simple therapeutic procedures or surgical treatments. (Figure 2).

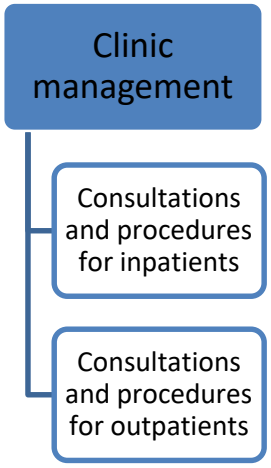

FIGURE 2. CLINIC MANAGEMENT COMPONENTS

Source: Author

Within the specialized outpatient clinic, the computer system helps by registering requests for consultations or procedures in the department. The operation of consultations results in the system makes those results available to the wards and other structures within the hospitals, helping to establish the diagnoses and treatments.

The outpatient clinic also offers its services to patients who are not hospitalized, or are hospitalized in the form of day hospitalization. In their case, the system can help to make appointments in the available schedule of doctors, for a better fluidization of the outpatient activity.

3. Laboratory Management

Within the hospital and during the hospitalization episodes, in order to establish the exact diagnoses, it is necessary to perform laboratory analyses, the results of these analyses representing a primary medical information. The component for laboratory management is complex, allowing the tracking of

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

analysis samples from their collection to introduction into laboratory devices and recording the results received from the devices. For this, the component has a number of distinct functionalities (Figure 3).

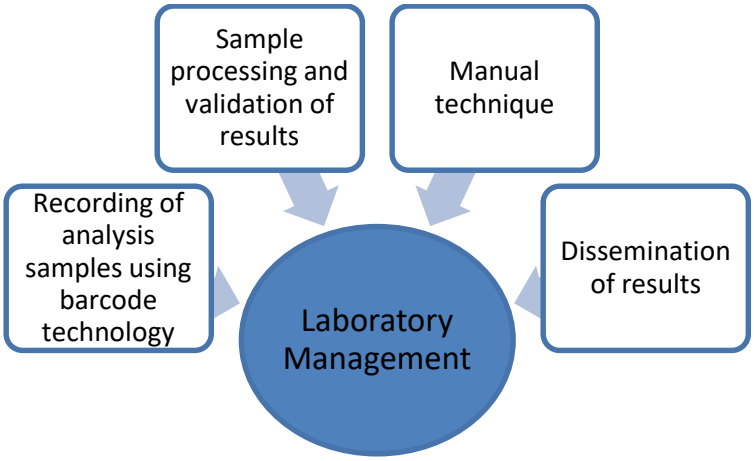

FIGURE 3. LABORATORY MANAGEMENT COMPONENTS

Source: Author

The registration of the analysis samples is done at the level of a patient (possibly using an analysis request generated directly from the ward), printing barcodes for each container with samples taken. These barcodes physically accompany (usually by gluing) the containers and at the same time have a representation in the computer system. Thus, a flow automation is performed, especially using modern analysers, because the samples are introduced in the analysis devices, and they, after reading the barcodes, perform a query of the system after which they will know which analyses must be performed. Also, the sending of the results back to the computer system will be done also based on the respective bar code.

Although the procedure for processing samples and validating the results is largely automated, the final validation of the results is still done by the laboratory doctors and the chief physician. They have access through the system to worklists, which can be generated per department, per device or per day, worklists containing the analyses to be performed. Upon receipt of the results from the devices, the medical staff checks these results and validates or returns them to the device for re-performance if the values are much different from the normal values.

Some analyses cannot be performed automatically but are performed using classical instruments, such as the microscope (manual technique). The results of these analyses are entered manually into the system, then following the same flow as the automatic ones in terms of validation.

The results of the analyses are then visible through the system in the sections from which they were requested and in which the patient is hospitalized, in the patient's electronic file and in some systems

are available directly to the patient via the Internet using a patient code and a sample code or a username and password.

4. Hospital pharmacy

A hospital pharmacy is called a closed-loop pharmacy and follows different rules than regular pharmacies (open-circuit pharmacies), the most important of which is that closed-circuit pharmacy cannot sell products, they are only sent to departments or outpatient clinic for the administration of treatments established by doctors. In the closed-circuit hospital pharmacy, the computer system has several important tasks, as shown in Figure 4.

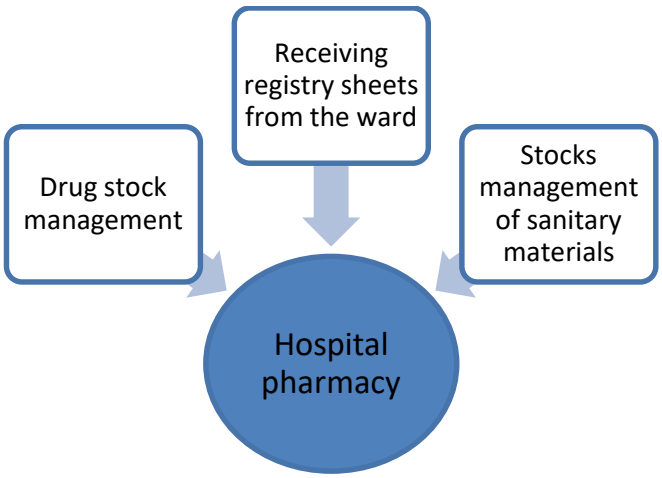

FIGURE 4. HOSPITAL PHARMACY COMPONENTS

Source: Author

A hospital's stock of medicines is based on an average of previous consumption, to which is added a safety margin in case of emergency. However, it is important that these stocks are always above the safety margin, as the lack of medicines can make it impossible to treat patients. At the same time, an oversupply can lead to the non-use of drugs and their expiration. With the help of the computer system, the inflows and outflows of the stock are tracked and forecasts can be made based on which the needs of medicines are calculated over a period of time.

The treatments are prescribed by doctors, within the wards, and based on them sheets are completed. The sheet represents the document by which medicines are requested by the hospital from the pharmacy. Originally a physical document, it is now represented in the computer system as an electronic document. Following requests from all departments and the automatic comparison of what is

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

needed with the stock of medicines, the pharmacy staff knows if they have enough medicines or need to make a supply note to start the supply process.

Within the pharmacy system, the records of sanitary materials can also be kept. The managements are separated from those of medicines, usually each section has its own management, for which it is supplied from the warehouse, by transfer.

5. Radiology

Radiology is the medical specialty that uses imaging both in the diagnosis and in the treatment of the disease visualized in the human body. Radiologists use imaging technologies such as ultrasonography, computed tomography, nuclear medicine, positron emission tomography and nuclear magnetic resonance. These technologies have one thing in common: devices that collect visual information generate visual, video, audio or still images, recordings that must be stored in the system for a long time. The computer system that stores and plays back these records is called the picture archiving and communication system (PACS). This is not a basic component of the HIS information system, but any HIS system must have a strong integration with PACS systems.

Integration is necessary to avoid double data recording. Thus, the HIS system sends the passport data to PACS, and the PACS system sends back to HIS the consultation sheet and a link to the physical representation of the record, through which it can then be viewed on any computer running the HIS system.

6. Resource management

Usually, the resource management component is separate from the HIS type system, when it comes to ERP type information systems, able to operate independently of the HIS system, but also integrated with it. In the few cases where the resource management component is integrated into the HIS, it will need to provide a minimum of functionality:

- Inventory management - in which all the entrances and exits of materials and raw materials, other than sanitary materials and medicines, necessary in the activity of the sanitary unit are operated.
- Financial and management accounting - carrying out accounting in accordance with the legal requirements in force.
- Management of fixed assets, used to keep track of fixed assets and to calculate their depreciation, according to the calculation methods specified in the legislation.

Especially in the private environment, where there is a close competition between players, additional modules can be used, which belong to an ERP but are specialized for the activity of the health unit:

- Partner management, used in the registration of services provided by partners,
- Evidence of referrals, through which the activity of external sending doctors can be evaluated and settlement can be made with them.

7. Electronic Patient File

Within the HIS, a special place is occupied by the Electronic Patient File component. This is the component that collects all the information about a patient, accumulated over time, from all his hospitalization episodes. The Electronic Patient File is very important in supporting the medical act, by making available to doctors, in an easy-to-use interface, the information needed to make medical decisions. In some cases, the information in the file is also displayed in the online environment, where it can be accessed by the patient, based on a username and password, which will allow him to access his own medical information and other health units, globally.

8. Calculation of hospitalization costs

In general, the evaluation of the activity of a health unit is done by calculating indicators and performance indices that relate to the patient, length of hospitalization, diagnoses, etc. The costing component with hospitalization helps in this regard by allocating indirect costs, not directly related to a specific patient, but made for the treatment of patients, at the ward, bed or patient level. This aspect is a very important one, because it allows complex analyses on the activity of the hospital and comparative analyses between departments or with other health units.

The costing component with hospitalization is a complex one, taking into account all the expenses incurred by the hospital, from consumables to current expenses with utilities and allocating these amounts using previously defined allocation keys to the basic level, respectively the patient.

9. Reporting

In general, regardless of the market in which it operates, a healthcare unit is obliged to report, partially or completely, its activity to control bodies, coordination bodies, to certain partners, to audit companies, etc. This is done through the reporting component of the computer system, which deals with aggregating data in the format required by the partner or higher institution and sending this data through modern methods of data transmission - web services, email, etc. Each report has a different format to meet the requirements of that institution and in most cases a different way of transmitting the data. Therefore, the reporting component must be constantly up to date with the reporting requirements and ensure the correct and complete transmission of the data. Moreover, in order to report, the HIS

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

information system must implement a series of restrictions on data collection, so that at the time of reporting all the necessary data are in the information system.

5. ADVANTAGES OF USING HIS

The use of integrated information systems in the health units is beneficial to the entire activity carried out at the unit level, being a basic tool in its development. There is an important number of researches that analyse the relationship between IT investments and business performance and innovation (Popovič et al., 2018, Haseeb et al., 2019, Dima, 2021). Most research demonstrates a complex link between the acquisition of computer systems and the overall performance of a company (Li et al., 2018; Nedelcu, Dima & Dinulescu, 2018), while others (Stoel & Muhanna, 2011) suggest that the company's external environment may play an important role in this relationship. Lee, McCullough & Town (2013) identify the impact of the adoption of information systems on the performance of the health unit as a modest one, in research conducted on 309 hospitals in California, between 1997 and 2007. It can be considered that the use of information systems may have an indirect influence on certain aspects of a company's activity (Figure 5).

FIGURE 5. ADVANTAGES OF USING HIS

Source: Author

Previous research shows that the implementation of IT applications in healthcare facilities can lead to a reduction in clinical errors (e.g., medication errors, diagnostic errors), can form a decision base for qualified staff (e.g., availability of patient information), can improve the efficiency of the medical act (e.g., shortening the waiting time of patients) and can increase the quality of the medical act (Bates et al., 2001; Dash et al., 2019). Quality is considered a determinant factor of business competitiveness (Dobrin et al., 2015). But there is research that highlights the negative effects of the implementation of computer systems, on employees and patients, by reducing communication between nurses and doctors, etc. (Campbell et al., 2006; Shachak & Reis, 2009).

Although most of the resources in a health unit are under the control of staff, doctors and nurses, their activity is difficult to track and evaluate in the absence of a computer system to record this activity. Healthcare facilities can use the IT system to track medical staff by generating periodic activity reports and resource utilization reports to streamline workflows. These reports can be used to support internal initiatives to improve the quality of services provided, the use of resources, etc.

The computer system for the hospital provides through its heart, the patient's electronic file, support in making decisions for the implementation of treatment protocols, to identify and warn about dangerous interactions between drugs, to give medical staff access to medical information about patient and ultimately lead to the elimination of errors and the standardization, as far as possible, of the medical act itself, thus improving both the quality of the medical act and productivity.

By eliminating or reducing paperwork from the operational flow, by eliminating multiple data entries in different systems, the integrated IT system can help increase the productivity of medical and support staff. By digitizing the operations performed within the hospital, implementing a better record of materials and medicines, the computer system can help reduce operational costs, avoiding over-supply, streamlining the use of productive resources, e.g., operating rooms, at their maximum capacity.

One of the most important advantages of using a medical information system is the improvement of billing (Lee, McCullough & Town, 2013), by collecting all expenses incurred with the patient and grouping them to be settled, by billing them directly to the patient or by settling with health insurance companies. Access to historical data from the system, related to services, medicines, diagnostics and other medical information, can help to conduct clinical trials (e.g., analysis of the effectiveness of certain medicines, treatments and procedures).

6. CONCLUSIONS

Integrated information systems improve both access to information and communication, right at the patient's bedside, through the hospital network or the Web. They facilitate the use of information for cost management and analysis of results, as well as for monitoring quality and compliance with required

Business Excellence and Management
Volume 12 Special Issue 3 / October 2022

standards. Patient treatment plans and clinical procedures defined by these systems allow medical care to be performed by applying problem-based protocols, expected outcomes, types of interventions, procedural guidelines, and data variation. HIS must have as basic principles in its elaboration the orientation towards solving the real problems of the hospital, obtaining maximum information from minimum data and compatibility with the whole information system of the health care branch and with other components of the national information system. The advantage of using HIS is both in improving the patient care process and in reducing costs. The performance of these information systems is conditioned by their integrated operation in order to correlate and transform the data provided into useful information for the entire health system. For these reasons, it is necessary and appropriate to achieve an integrated system that allows the collection of the existing volume of data and the performance of complex analyses throughout the health system.

REFERENCES

Aceto, G., Persico, V., & Pescapé, A. (2018). The role of Information and Communication Technologies in healthcare: taxonomies, perspectives, and challenges. *Journal of Network and Computer Applications*, *107*, 125-154.

Alber, M., Buganza Tepole, A., Cannon, W. R., De, S., Dura-Bernal, S., Garikipati, K., ... & Kuhl, E. (2019). Integrating machine learning and multiscale modeling—perspectives, challenges, and opportunities in the biological, biomedical, and behavioral sciences. *NPJ digital medicine*, *2*(1), 1-11.

Appelbaum, D., Kogan, A., Vasarhelyi, M., & Yan, Z. (2017). Impact of business analytics and enterprise systems on managerial accounting. *International Journal of Accounting Information Systems*, *25*, 29-44.

Auerbach, D. I., Liu, H., Hussey, P. S., Lau, C., & Mehrotra, A. (2013). Accountable care organization formation is associated with integrated systems but not high medical spending. *Health affairs*, *32*(10), 1781-1788.

Bates, D. W., Cohen, M., Leape, L. L., Overhage, J. M., Shabot, M. M., & Sheridan, T. (2001). Reducing the frequency of errors in medicine using information technology. *Journal of the American Medical Informatics Association*, *8*(4), 299-308.

Campbell, E. M., Sittig, D. F., Ash, J. S., Guappone, K. P., & Dykstra, R. H. (2006). Types of unintended consequences related to computerized provider order entry. *Journal of the American Medical Informatics Association*, *13*(5), 547-556.

Catarinucci, L., De Donno, D., Mainetti, L., Palano, L., Patrono, L., Stefanizzi, M. L., & Tarricone, L. (2015). An IoT-aware architecture for smart healthcare systems. *IEEE internet of things journal*, *2*(6), 515-526.

Chapman, C. S., & Kihn, L. A. (2009). Information system integration, enabling control and performance. *Accounting, organizations and society*, *34*(2), 151-169.

Coetsee, L. (1999). From resistance to commitment. *Public Administration Quarterly*, 204-222.

Cubo, J., Nieto, A., & Pimentel, E. (2014). A cloud-based Internet of Things platform for ambient assisted living. *Sensors*, *14*(8), 14070-14105.

Dash, S., Shakyawar, S. K., Sharma, M., & Kaushik, S. (2019). Big data in healthcare: management, analysis and future prospects. *Journal of Big Data*, *6*(1), 1-25.

Dima, A. (2021). The Importance of Innovation in Entrepreneurship for Economic Growth and Development. A Bibliometric Analysis. *Revista de Management Comparat Internațional*, *22*(1), 120-131.

Dobrin, C., Gîrneaţă, A., Uda, M. M., & Croitoru, O. (2015). Quality: a determinant factor of competitiveness–the evolution of iso certifications for management systems. In *Proceedings of the International Management Conference* (Vol. 9, No. 1, pp. 1062-1073).

Ferraris, A., Mazzoleni, A., Devalle, A., & Couturier, J. (2018). Big data analytics capabilities and knowledge management: impact on firm performance. *Management Decision*.

Ford, E. W., Menachemi, N., & Phillips, M. T. (2006). Predicting the adoption of electronic health records by physicians: when will health care be paperless?. *Journal of the American Medical Informatics Association*, *13*(1), 106-112.

Gomes, J., & Romão, M. (2018). Information system maturity models in healthcare. *Journal of medical systems*, *42*(12), 1-14.

Haseeb, M., Hussain, H. I., Ślusarczyk, B., & Jermsittiparsert, K. (2019). Industry 4.0: A solution towards technology challenges of sustainable business performance. *Social Sciences*, *8*(5), 154.

He, W., Zhang, Z. J., & Li, W. (2021). Information technology solutions, challenges, and suggestions for tackling the COVID-19 pandemic. *International journal of information management*, *57*, 102287.

Herbst, K., Littlejohns, P., Rawlinson, J., Collinson, M., & Wyatt, J. C. (1999). Evaluating computerized health information systems: hardware, software and human ware: experiences from the Northern Province, South Africa. *Journal of Public Health*, *21*(3), 305-310.

Karademir, B. (2019). Management and Information Systems.

Lee, J., McCullough, J. S., & Town, R. J. (2013). The impact of health information technology on hospital productivity. *The RAND Journal of Economics*, *44*(3), 545-568.

Li, X., Krumholz, H. M., Yip, W., Cheng, K. K., De Maeseneer, J., Meng, Q., ... & Hu, S. (2020). Quality of primary health care in China: challenges and recommendations. *The Lancet*, *395*(10239), 1802-1812.

Li, Z., Wang, W. M., Liu, G., Liu, L., He, J., & Huang, G. Q. (2018). Toward open manufacturing: A cross-enterprises knowledge and services exchange framework based on blockchain and edge computing. *Industrial Management & Data Systems*.

Nedelcu, M., Dima, A., & Dinulescu, R. (2018). Digital factory-a prerequisite for revitalizing the production sector. In *Proceedings of the International Management Conference* (Vol. 12, No. 1, pp. 520-529).

Popovič, A., Hackney, R., Tassabehji, R., & Castelli, M. (2018). The impact of big data analytics on firms' high value business performance. *Information Systems Frontiers*, *20*(2), 209-222.

Pundir, A. K., Jagannath, J. D., Chakraborty, M., & Ganpathy, L. (2019, January). Technology integration for improved performance: A case study in digitization of supply chain with

integration of internet of things and blockchain technology. In *2019 IEEE 9th Annual Computing and Communication Workshop and Conference (CCWC)* (pp. 0170-0176). IEEE.

Rahmani, A. M., Gia, T. N., Negash, B., Anzanpour, A., Azimi, I., Jiang, M., & Liljeberg, P. (2018). Exploiting smart e-Health gateways at the edge of healthcare Internet-of-Things: A fog computing approach. *Future Generation Computer Systems*, *78*, 641-658.

Shachak, A., & Reis, S. (2009). The impact of electronic medical records on patient–doctor communication during consultation: a narrative literature review. *Journal of evaluation in clinical practice*, *15*(4), 641-649.

Shahid, N., Rappon, T., & Berta, W. (2019). Applications of artificial neural networks in health care organizational decision-making: A scoping review. *PloS one*, *14*(2), e0212356.

Siegel, D. M. (2008). *Accepting technology and overcoming resistance to change using the motivation and acceptance model*. University of Central Florida.

Smith, M., Madon, S., Anifalaje, A., Lazarro-Malecela, M., & Michael, E. (2008). Integrated health information systems in Tanzania: experience and challenges. *The Electronic journal of information systems in developing countries*, *33*(1), 1-21.

Somers, T. M., & Nelson, K. (2001, January). The impact of critical success factors across the stages of enterprise resource planning implementations. In *Proceedings of the 34th Annual Hawaii International Conference on System Sciences* (pp. 10-pp). IEEE.

Starmer, A. J., Sectish, T. C., Simon, D. W., Keohane, C., McSweeney, M. E., Chung, E. Y., ... & Landrigan, C. P. (2013). Rates of medical errors and preventable adverse events among hospitalized children following implementation of a resident handoff bundle. *Jama*, *310*(21), 2262-2270.

Stoel, M. D., & Muhanna, W. A. (2011). IT internal control weaknesses and firm performance: An organizational liability lens. *International Journal of Accounting Information Systems*, *12*(4), 280-304.

Veile, J. W., Kiel, D., Müller, J. M., & Voigt, K. I. (2019). Lessons learned from Industry 4.0 implementation in the German manufacturing industry. *Journal of Manufacturing Technology Management*.

Yaacoub, J. P. A., Noura, M., Noura, H. N., Salman, O., Yaacoub, E., Couturier, R., & Chehab, A. (2020). Securing internet of medical things systems: Limitations, issues and recommendations. *Future Generation Computer Systems*, *105*, 581-606.

Zahabi, M., Kaber, D. B., & Swangnetr, M. (2015). Usability and safety in electronic medical records interface design: a review of recent literature and guideline formulation. *Human factors*, *57*(5), 805-834.

Zota, R. D., & Fratila, L. A. (2013). Cloud standardization: Consistent business processes and information. *Informatica Economica*, *17*(3), 137.