Research Article

Improved Healthcare Quality Through Integrated Hospital Management and Digitalization

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Abstract

In order to maximize efficiency and effectiveness of an organization, an integrated management system is designed to integrate multiple functions and processes into a unified system that facilitates the integration of those functions and processes. A particularly relevant application of this approach is in the field of health care, since it integrates a number of different functions into a single system, such as patient management, inventory management, human resources management. By improving communication and collaboration among departments, reducing duplication of activities, and reducing unnecessary expenses, the primary objective is to enhance the efficiency and quality of healthcare services.

By consolidating and managing all functions and processes in one place, an integrated management system, also known as a software platform, facilitates this approach in healthcare facilities. Performance monitoring, data reporting and analysis, planning and scheduling, inventory management, and human resources management are all supported by this system. As a result, medical services will be more efficient and higher quality, costs will be reduced, interdepartmental communications will be improved, and the patient and employee experience will be enhanced. Integrating hospital management involves coordinating departments so services are delivered efficiently, identifying priorities and performance indicators, securing necessary resources, implementing standardized policies and procedures, and developing monitoring and evaluation systems. Quality healthcare services, cost reductions, and patient satisfaction can all be ensured through effective integrated hospital management.

When an organization uses a holistic approach to integrated management in healthcare, it is able to improve both its organizational processes and its activities. We can achieve a higher standard of patient care if we enhance the centralization of data, improve the interoperability, and ensure that patient needs are met by aligning the quality of care with the needs of society.

Keywords: digitalization, integrated management, healthcare quality.

Introduction

Integrated management refers to the management approach that integrates multiple functions and processes of an organization into a coherent and unified system, with the aim of maximizing the efficiency and effectiveness of management activities. Integrated management can be applied in various fields, including the medical field.

In the context of healthcare facilities, integrated management may involve the integration of management activities of all departments and functions, such as patient management, inventory management, human resources management, and others, into a coherent system. The goal of this integrated management is to enhance the efficiency and effectiveness of the healthcare facility by improving communication and collaboration between departments and functions, and by eliminating duplication of activities and unnecessary expenses.

Integrated management can be implemented through the use of an integrated management system, which is a software system that allows the integration and management of all management functions and processes of the healthcare facility in one place. The system can enable performance monitoring, data reporting and analysis, planning and scheduling, inventory management, human resources management, and much more.

The benefits of integrated management in healthcare facilities include increased efficiency and quality of medical services, cost reduction through the elimination of duplication of activities and unnecessary expenses, improved communication and collaboration between departments and functions, increased patient and employee satisfaction, and many others.

Integrated hospital management refers to the integrated management approach within a hospital or a hospital system. It involves the use of management techniques and strategies to improve the efficiency and effectiveness of medical services and enhance patient satisfaction.

Key aspects of integrated hospital management include:

1. Coordination among departments and services within the hospital to ensure the delivery of integrated and efficient services.

2. Development of a strategic plan that identifies priorities, objectives, and performance indicators.

3. Ensuring a solid foundation of human, financial, and technological resources to provide quality services.

4. Implementation of standardized policies and procedures to ensure a consistent and systematic approach to patient management, medication administration, and other aspects of medical services.

5. Development of monitoring and evaluation systems that enable the management to assess performance and make informed decisions regarding the improvement of the quality and efficiency of medical services.

Integrated hospital management can be an efficient approach to ensure the provision of quality medical services, cost reduction, and increased patient satisfaction. For it to be effective, it is important for the management to be actively involved in developing and implementing standardized policies and procedures, as well as monitoring and evaluating the hospital system's performance.

An integrated hospital management system allows the hospital to oversee the functioning of its multiple-location clinics by simply switching between the organization's identities. Whether centralized or distributed data, there are data to be managed.

An integrated computerized management of a medical facility should include a series of components and functionalities to ensure a systematic and integrated management approach. Among the key elements that such a system should include are:

1. Patient management system: It should enable the medical facility to efficiently manage patient information, including medical history, appointments, and communication with patients. The system should allow for the management of all patient medical data in one place and ensure their accessibility to all authorized physicians and medical staff.

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2. Inventory management system: Such a system should allow the medical facility's inventory management to efficiently handle the procurement, storage, and distribution of medications and medical equipment. The system can be connected to medical service providers to facilitate the fast and efficient acquisition of necessary materials.

3. Performance monitoring system: This system should enable the efficient monitoring of the medical facility's performance by tracking key performance indicators such as waiting time, bed occupancy rate, service occupancy rate, patient satisfaction rate, and many others. It can help identify areas where the medical facility could improve and make decisions regarding resource prioritization.

4. Planning and scheduling system: This system should enable the efficient planning and scheduling of medical procedures and patient appointments, thereby avoiding overcrowding or underutilization of schedules and reducing waiting times for patients. (Hema Kumar, 2019)

5. Human resources management system: This system should enable the efficient management of medical staff, including scheduling, performance evaluation, and administration of salaries and benefits. The system should allow for monitoring the number of employees and occupancy levels to make adjustments based on the medical facility's needs.

These are just a few key components of an integrated computerized management system for a medical facility. It is important to identify and implement specific systems to ensure that the medical facility operates efficiently and provides quality services to patients.

History

Digitalization in medicine refers to the use of information and communication technologies to manage, process, and communicate medical information and improve the quality of healthcare. Digitalization in medicine began to gain momentum in recent decades but had its roots as far back as the 1950s and 1960s.

In the 1950s, the first computers were introduced in hospitals to assist in managing medical information and data. These computers were used to process patient data, such as medical history and prescribed medications, but were still limited to a small number of hospitals and medical institutions.

In the 1960s, large hospital systems began acquiring mainframe computers, primarily for business and administrative functions.

In the 1970s, information technology began to rapidly develop, leading to the creation of the first medical information systems. These computerized systems allowed doctors to access patient medical information remotely through computer networks. In the 1980s, the first specialized software for managing medical information and computer-assisted medical diagnosis systems were developed.

In the 1970s, smaller, cost-effective minicomputers allowed for the placement of smaller specialized clinical applications in different departments of hospitals. Early time-sharing applications used display terminals located in medical care stations.

In the 1960s and 1970s, a small number of pioneering institutions, many of them federally funded academic teaching hospitals, developed their own hospital information systems (HIS). Providers then acquired and commercialized some of these successful academic prototypes.

In the 1990s, digitalization in medicine began to rapidly advance with the increasing processing power of computers and the development of the internet. During this period, the first electronic health record (EHR) systems were developed and implemented to manage patient medical information. This system allowed doctors to access patient medical information from a single location and improved communication and collaboration among medical departments.

In recent decades, digitalization in medicine has continued to rapidly evolve with the development of mobile technologies and sensors. Today, there is a variety of mobile medical applications that can be used to monitor patients' health status, assist in disease diagnosis, and improve communication and collaboration between doctors and patients.

In the 1980s, widespread availability of local area networks encouraged the development of large HISs with advanced database management capabilities, typically utilizing a combination of mini- and large microcomputers connected to a large number of clinical workstations and bedside terminals. When federal funding for HIS development declined in the mid-1990s, academic centers receded, and commercial vendors increased their system development efforts. Interoperability became a major design requirement for HIS and electronic patient

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record (EPR) systems and their associated subsystems.

After 2010, open system architectures and interoperability standards hold promise for full information exchange between multi-provider HISs and EPR systems and their related subsystems. (Collen, M.,F.; Miller, R.,A., 2015)

In conclusion, digitalization in medicine has come a long way from the first computers introduced in hospitals in the 1950s to the advanced computerized systems and mobile medical applications developed today. Digitalization has significantly improved the quality of healthcare, efficiency, and access to medical information, and this process continues to evolve and enhance healthcare worldwide.

Applications

There are several computer applications available on the market that can be used for implementing integrated management in hospitals and other medical units. These applications are designed to help integrate and manage all the management functions and processes of the medical unit in one place, which can lead to increased efficiency and quality of medical services.

Among the most common computer applications that apply integrated management in hospitals are:

1. Health Management Information Systems (HMIS) - These are computer applications that integrate and manage all the medical data of patients, such as medical history, test results, medical images, and other relevant information. HMIS can be used to improve communication and collaboration between departments and functions, as well as to reduce medical errors. (Moukénet A, 2021)

2. Patient Management Systems (PMS) - These computer applications are designed to manage all aspects related to patients, such as appointments, medical history, prescribed therapies and medications, billing, and much more. PMS can be integrated with other management systems, such as HMIS or inventory management systems, to enable more efficient management of the medical unit. (van Elten HJ, 2021)

3. Stock Management Systems (SMS) - These computer applications are designed to manage all aspects related to stocks of medications, medical instruments, and other consumables used in the medical unit. SMS can be integrated with other management systems, such as PMS or HMIS, to enable more efficient stock management and cost reduction. (M., 2016)

4. Human Resources Management Systems (HRMS) - These computer applications are designed to manage all aspects related to the employees of the medical unit, such as recruitment, scheduling, performance management, and payment. HRMS can be integrated with other management systems, such as PMS or HMIS, to enable more efficient human resources management and increased employee satisfaction. (Wang T, 2021)

These are just a few examples of computer applications available for implementing integrated management in hospitals. Depending on the specific needs of the medical unit, other applications or customized solutions can be selected to ensure efficient and integrated management of all processes and functions. (Bombard Y, 2022)

In a medical unit, many activities take place daily, and these activities generate a large amount of data shared across departments. These data are essential and need to be stored and centralized in a user-friendly interface system. Integrated management information systems not only store the information but also connect all departments (pharmacy, laboratory, admissions, medical, financial, etc.) under a single interface, facilitating interaction and information sharing. (Sheikh A, 2021)

The Role of Artificial Intelligence in Integrated Hospital Management

In recent years, artificial intelligence (AI) has become an important part of various fields, including integrated hospital management. With the help of state-of-the-art technology, scientists and engineers can develop intelligent solutions that improve the efficiency and quality of medical services.

One of the most important aspects of integrated hospital management is planning and organizing activities. In this regard, AI can be used to identify patterns and trends that help optimize internal hospital processes. Additionally, it can assist in anticipating patient demand for medical services, enabling appropriate allocation of staff and resources.

Another crucial aspect of integrated hospital management is the improvement of the quality of medical services. AI can aid in developing algorithms and models that assist doctors in making better and faster decisions based on specific clinical information and data. For

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example, AI can be used for analyzing medical images, identifying anomalies, and helping doctors make informed decisions in real-time.

Furthermore, AI can be employed to assist in monitoring patient status and improving the treatment process. Through technologies such as Internet of Medical Things (IoMT), including sensors and connected medical devices, AI can collect and analyze data during patient treatment, aiding in identifying trends and potential risks and allowing for treatment adjustments based on them.

In addition to the evident benefits of using artificial intelligence in integrated hospital management, there are also some challenges to consider. One of these is ensuring the security of patient data, as they are sensitive and require protection in accordance with data privacy laws. Moreover, the implementation of AI technologies can be costly and requires appropriate training of medical staff.

Artificial intelligence plays an important role in integrated hospital management, enhancing the efficiency and quality of medical services and assisting in making more informed and faster decisions. However, it is crucial to be aware that technology cannot completely replace the experience and skills of doctors and other hospital staff members. Therefore, we must use AI as a complementary tool and ensure that it is used responsibly and ethically.

Advantages of an Integrated Management System

Interoperability - integrating departments will lead to their communication through a digital channel, resulting in a smoother and easier workflow. (S., 2021)

A study shows that medical units spend 49.2% of their time on necessary paperwork for healthcare units, but this can be automated, reducing the time allocated to them by medical staff.

Activities that can be digitalized include:

- Patient record management,

- Tracking and managing patient appointments,

- Human resources management,

- Patient billing,

- Patient insurance (Awantika, 2023)

Benefits of an Integrated Hospital Management System:

- Improved communication between the hospital and patients

- Restricted access to patient data

- Reduced response time

- Cost efficiency

- Automated report generation

- Centralized management control

- Avoidance of duplicate and fragmented records in the electronic medical record

- Reduction of medical errors

- Decreased patient readmission rates (Melchiorre MG, 2020)

Case study

In the next chapter, we will analyze the ARES Society - Centers of Excellence in Cardiology and Interventional Radiology.

The ARES Group is one of the leading private providers of cardiology and interventional radiology services in Romania, with centers in major cities across the country: Bucharest, Cluj-Napoca, Constanța, Pitești, and Tulcea. In over 10 years of activity, the ARES medical team has been distinguished by treating highly complex cases through minimally invasive interventions performed for the first time. Currently, ARES centers perform all types of modern cardiology and interventional radiology procedures, addressing coronary, structural, and electrical heart pathologies, as well as vascular, gynecological, urological, oncological, and neurological conditions.

The Centers of Excellence in Cardiology and Interventional Radiology ARES were established in 2011 in Bucharest and initially operated with one angiography room in Delta Hospital. Since its inauguration, ARES has become one of the top private clinics in Romania, paving the way for revolutionary interventional cardiology procedures by offering minimally invasive treatments as an alternative to traditional surgical techniques.

In 2012, ARES relocated to Ponderas Hospital, where it brought together a multidisciplinary team of cardiologists and radiologists. It became the first Center of Excellence in Eastern Europe for Uterine Fibroid Therapy, the first Romanian private center to treat arterial hypertension through renal denervation, and the first private clinic in Romania to have a dedicated section for

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minimally invasive treatment of congenital heart malformations.

In October 2016, ARES signed a strategic partnership with Monza Hospital and took over the interventional cardiology department in this hospital. The number of angiography rooms in Bucharest increased to three. As part of the partnership with Monza Hospital, ARES opened the center in Constanța within the Emergency County Hospital of Constanța, the center in Pitești within Muntenia Hospital, and the cardiology hospital in Cluj-Napoca (2019).

In 2019, ARES attracted the attention of the American investment fund Highlander Partners (HQ), which decided to acquire the majority stake and take over the managed centers together with Monza Hospital. Thus, the ARES Group was formed, which owns centers in Monza Hospital and Enayati Medical City, the ARES Cardiology Hospital in Cluj, as well as centers in both public and private hospitals in Constanța, Tulcea, and Pitești. At the end of 2021, the ARES Group also acquired Cardiomed, the network of clinics in Cluj founded by Dr. Carmen Mureșan. ARES Centers:

ARES București - Monza Hospital:

The ARES Bucharest Cardiology Clinic is the most important center for interventional cardiology in Romania. It has three angiography rooms equipped to European standards, a clinical cardiology department, and a specialized outpatient clinic with 6 medical offices. ARES Bucharest is located within Monza Hospital and has surgical support for interventional and hybrid procedures. It is the only center in the country where complex interventional procedures such as MitraClip, Jetstream, Rotablation, or Complex Angioplasty are performed.

ARES MEMORIAL - Bucharest:

ARES MEMORIAL is a center for interventional cardiology and radiology located within MEMORIAL Hospital in Bucharest. In this center, patients have access to modern therapeutic solutions in the field of interventional cardiology and radiology for cardiovascular conditions, uterine fibroids, varicocele, prostate adenoma, spinal conditions, and tumor-related conditions. ARES MEMORIAL houses the Fibroid Center, the first department in Romania exclusively dedicated to minimally invasive treatment of uterine fibroids, and the Tumor Center, where interventional oncological conditions are treated.

ARES Tulcea - Tulcea County Emergency Hospital:

ARES Tulcea is an interventional cardiology center located within Tulcea County Emergency Hospital. It is the only center for minimally invasive treatment of cardiovascular pathologies in Tulcea County. ARES Tulcea treats patients with acute myocardial infarction, ischemic heart disease, peripheral arterial disease, and various cardiac arrhythmias. The center has an angiography room equipped with state-of-the-art equipment, allowing procedures to be performed with high precision and patient safety, with limited exposure to X-rays and a smaller amount of iodine-based contrast substance.

ARES Constanta - Constanta County Emergency Hospital:

ARES Constanta is the only interventional cardiology center in Constanta County, serving the population in the entire Dobrogea region. The center is located within Constanta County Emergency Hospital and is a treatment center for acute myocardial infarction. ARES Constanta benefits from an angiography room equipped to European standards.

ARES Pitesti - Muntenia Hospital:

ARES Pitesti is an interventional cardiology center located within Muntenia Hospital. It treats patients with ischemic heart disease, peripheral arterial disease, and various cardiac arrhythmias. The center has an angiography room equipped with state-of-the-art equipment, allowing procedures to be performed with high precision and patient safety, with limited exposure to X-rays and a smaller amount of iodine-based contrast substance.

ARES-CARDIOMED L.L.C. Cluj:

ARES-CARDIOMED L.L.C. in Cluj-Napoca offers specialized medical assistance, medical imaging, and day hospitalization in the fields of oncology, surgery, ENT, and urology. The activity is carried out at the main headquarters on Republicii Street, No. 17, and the branch on Republicii Street, No. 30, which are located in close proximity to each other and are fully equipped to high medical standards.

ARES Angiocare Cardiology Hospital in Cluj-Napoca:

ARES Angiocare is the largest private interventional cardiology hospital in Transylvania, located on Republicii Street, No. 8. It occupies an area of 2,500 square meters on three levels and has two angiography rooms

where a wide range of cardiology services for coronary diseases, structural heart diseases, as well as neurological or peripheral vascular diseases are provided. The hospital has 17 beds and eight medical offices for clinical consultations.

Source: https://termene.ro/firma/13356876-ARES-GROUP-SRL
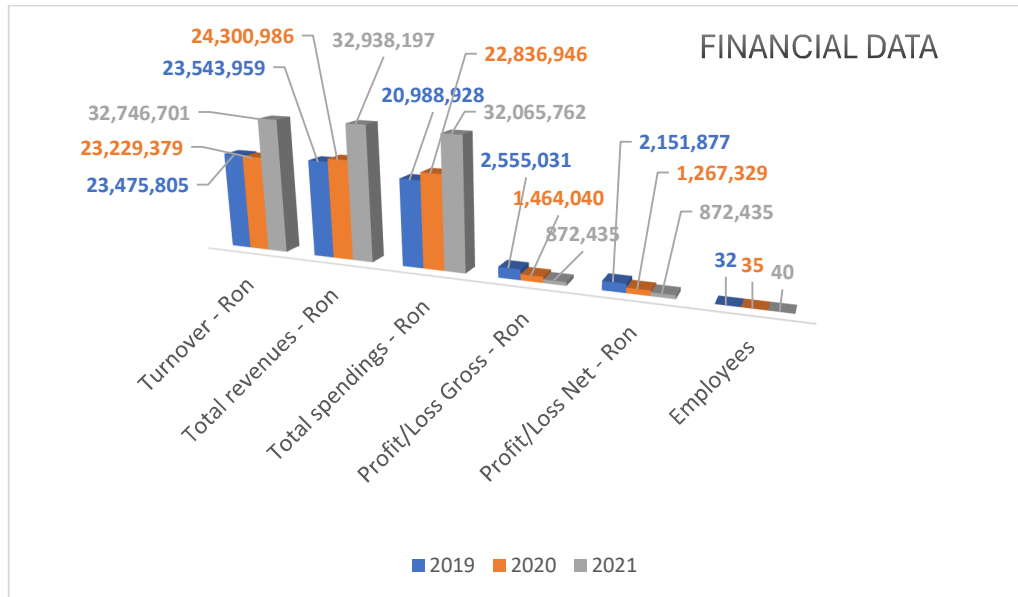
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MedicalCM - An integrated information system for public or private hospitals, which can be implemented in various configurations based on the complexity of the medical center. The modules, options, and applications within it define the functionality of the IT solution. It integrates with the ERP solution and offers the following actions:
  - MCM - Offers/Contracts
  - MCM - Inpatient Appointments
  - MCM - Surgery Appointments
  - MCM - UPU (Emergency Unit) Sheet
  - EWU (Emergency Ward Unit) Dashboard
  - PDP - Personal Data Protection
  - Billing - Automates the billing and collection process
  - MCM - Sections
  - Consumption Sheet - Records the consumption of medication and sanitary materials per patient
  - Electronic Prescription - Issues compensated/free medication prescriptions
  - Medical Leaves - Issues medical leave certificates
  - DocManagement - Stores documents per patient/observation sheets
  - MCM - Care Plan - schedules nursing activities and marks their execution
  - MCM - ICM Calculation - monitors the complexity index of the case

  - MCM - Reporting to SIUI/DRG/CM/DES - reports to institutions and ensures reimbursement with the National Health Insurance House (CNAS)
  - MCM - Patient Reimbursement
  - MCM - Critical Care ICU Sheet - CALCULATES the Omega score
  - MEDIS Integration - integrates the clinic, laboratory, and radiology
  - PAA Sigma - Closed Circuit Pharmacy
  - DEP Sheet - organizes the patient's Electronic Medical Record
  - Medic EMR - online medical record of the patient.

2. MEDIS - Medical Integrated System: An integrated information system for clinics and laboratories, which can be implemented in various configurations based on the complexity of the medical center. The modules, options, and applications within it define the functionality of the IT solution. It integrates with the ERP solution and offers the following actions:
  - FrontDesk - necessary instrument for any clinic's reception
  - CallCenter - support for the call center department
  - PDP - Personal Data Protection
  - Billing - automates the billing and collection process
  - MedPractice - Solution for managing activities within specialty cabinets

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- Telemedicine - Conducts remote medical consultations

- Ambulance - maintains a permanent record of requests, keeps a history of ambulance interventions on a patient level, and prints intervention forms after completing the information resulting from each action

- BFT Executions - manages procedure performance in the Treatment Base

- Occupational Medicine - supports the management of specific activities within occupational medicine departments

- Medis4Reports - reports to institutions and ensures reimbursement with the National Health Insurance House (CNAS)

- Physician Payment Calculation - facilitates reimbursement with collaborating physicians

- Subscription Payment Calculation and Invoicing - facilitates reimbursement with partner clients

- Medical Leaves - prescribes medical leaves

- Electronic Prescription - prescribes compensated/free medication prescriptions

- Consumption Sheet - records the consumption of medication and sanitary materials per patient

- DocManagement - stores documents per patient/consultations

- DEP Sheet - organizes the Electronic Medical Records of patients

- Med SMS - automatically sends contextual SMS messages

- E-mailing - automatically sends contextual emails

- Trace - data processing traceability

- Online Appointments - allows patients to self-schedule appointments online

- Medis EMR - online medical record of the patient

- Self Check-in - Digital reception

3. ERP - The Information System ensures the management and automation of informational flows at the General and Administrative functional level of a company. The modules, options, and applications within it define the functionality of the IT solution. It offers:

- PAA Gestoc Centremed - Primary Accounting and Stock Management

- PAA Sigma - Closed Circuit Pharmacy Management

- PAA Contab - Financial Accounting

- PAA GemFix - Fixed Assets Management

- PAA Billing - Service Invoicing - Clinic, Laboratory, Hospital

- PAA Cost Price - Post-calculation - P&L by Profit Centers

- PAA E.M.M.A - Machinery and Auto Asset Management

- Payment Appointments - Controls Payments to Suppliers

- Bank Statement Import - Integrates Bank Applications

- Supplier Order Suggestion - ERP PAA feature that automates the process of determining the Required Order Stock from Suppliers.

- Multi-Dimensional Accounting - Multi-Cost/Profit Centers

- Section/Cabinet Requirements - Centralizes requirements from Sections/Cabinets

- Revenue and Expense Budgets - Monitors achievement level - Budgeted vs. Actual by Cost/Profit Centers

- PAA WinSal - Human Resources and Salary Calculation

- PAA ReviSal - Reports Revisal.

4. PACS - a PACS solution integrated with hardware and software that uses DICOM standards for storing, archiving, and viewing information related to medical images and studies taken from medical imaging equipment, regardless of the manufacturer, such as CT (computer tomography), MRI (magnetic resonance imaging), X-ray, ultrasound, mammography. Connectivity with a large number of medical devices. Large storage archive with real-time compression. Multi-clinic/hospital, multi-user access. Electronic storage (CD) for patient records. Possibility of integration with patient file applications.

All these applications fail to provide a comprehensive picture for company management regarding the entire process that takes place during activities. Analyzing the management needs to achieve a much more organized company that can monitor goal achievement, meet customer needs, and generate more revenue, they decided to implement a CRM system.

CRM Software - Customer Relationship Management manages and monitors the current activities of the company on a single platform and saves precious time to implement new growth plans.

Sales management is done by:

- Centralizing all quotation requests

- Obtaining personalized and complex profiles of all clients

- Creating and sending offers

- Easily converting offers into proforma or invoices

- Generating contracts in less than a minute

- Managing collections and tracking reports

Supplier management and company costs:

- Centralizing all company suppliers and segmenting them according to the company's needs or specific requirements

- Placing orders with suppliers based on contracted offers or projects

- Planning recurring or one-time costs

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- Adding costs by categories, subcategories, projects/works, and suppliers
  - Monitoring detailed reports that will help make important decisions in the company

Company organization and management:
  - Planning and managing day-to-day activities on the company calendar
  - More efficient communication with the team through task management
  - Managing projects/works based on well-defined and easily trackable workflows
  - Centralizing all issues and requests in a single support module
  - Generating any document using the templates module
  - Obtaining activity reports for each employee and easily tracking attendance

Conclusion

Integrated management represents a management system approach that integrates multiple functions and processes of an organization into a coherent and unified system. In the context of medical units, integrated management can be implemented through the use of an integrated management system, with significant benefits for the efficiency and quality of medical services.

By developing an integrated management system, a holistic approach to organizational processes and activities can be achieved. The main limitation lies in the integration and exchange of information between healthcare organizations and system providers. Data centralization is currently considered a challenge. Each organization typically has its own internal ecosystem and method of storing electronic medical records of patient history. Recent research explores the advantages of an integrated ecosystem through information exchange among different healthcare service providers.

Some examples include reducing medical errors, disease control and monitoring, personalized patient care, and avoiding duplicate and fragmented records in the electronic medical record. Additionally, some studies have shown technologies to efficiently achieve this goal, with the ability to interoperate data, allowing for interpretation and use of health information. In this regard, semantic interoperability aims to share data across all sectors of the organization, clinicians, nurses, laboratories, the entire hospital. Interoperability - the integration of

departments will lead to their communication through a digital channel, resulting in smoother and easier workflow. Avoiding data silos and maintaining data regardless of providers to exchange information at an institutional level and beyond organizational boundaries helps develop integrated management.

The integrated management system allows an overview of activities by collecting data from the entire system to highlight them in well-defined reports that can be accessed at any time for quick, accurate, and efficient managerial decisions. It helps improve management performance by fostering proactive managerial thinking among healthcare system managers in Romania, which means developing the hospital organization in line with societal needs.

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