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Exploring The Utilization Of Management Information Systems In Public Hospitals: Challenges, Limitations And Future Trends Innovations

Ebtsam Ali Ahmed Alghaithy[1], Reem Mohammed Ali Moafa[1], Arej Abdullah Alqubli[2], Manwer Taleb Albalawi[2*], Mohammed Alqaraani[3], Ahmed Rahil Ahmed Aloqbi[3], Fahad Munadi Salem Alanazi[4], Nawaf Munadi Alanazi[4], Ahmed Mansour Shaman Alenezi[5], Mohammed Mansour Shaman Alenezi[5], Bader Ayed Matar Alshammary[6], Hayas Hmood Alshammar[7], Yahya Abdullah Jubran Maashi[8], Moayed Abdullah Alqadi[8], Mohammed Awadh S Alharbi[9]

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Abstract

This review article examines the utilization of Management Information Systems (MIS) in public hospitals, focusing on current implementations, case studies, benefits, limitations, and future trends. It provides an overview of the prevailing MIS platforms in public healthcare institutions, including Electronic Health Records (EHR), Picture Archiving and Communication Systems (PACS), and Peer-to-Peer (P2P) technology, highlighting their roles in enhancing operational efficiency, data management, and patient care delivery. Case studies from various public hospitals illustrate the practical applications and outcomes of MIS implementation, showcasing real-worl[1]d scenarios and challenges faced. Furthermore, the paper discusses the benefits of MIS adoption in public hospitals, such as improved information accessibility, streamlined workflow processes, enhanced decision-making capabilities, and better patient outcomes. However, it also addresses the limitations and barriers associated with MIS integration, such as security concerns, interoperability issues, resistance to change, and financial constraints. Looking ahead, the paper explores future trends and advancements in MIS technology for public hospitals, including the integration of artificial intelligence, machine learning, and big data analytics to further optimize healthcare operations and patient care. Additionally, it discusses the importance of addressing ongoing challenges and gaps in MIS implementation to realize the full potential of information technology in public healthcare settings. Overall, this review provides valuable insights into the current landscape, challenges,

[1]General Directorate of Health Affairs Jazan, Al Rawdah, Jazan-82723, Saudi Arabia
[2]King Khalid Hospital, Tabuk, King Abdul Aziz Road, Tabuk-47915, Saudi Arabia
[3]Duba General Hospital, Mohammed Bin Abdul Wahab, Duba-49314, Saudi Arabia
[4]General Directorate of Health Affairs Tabuk, Al Salihiyyah, Tabuk 47913, Saudi Arabia
[5]King Fahad Specialist Hospital-Tabuk, King Khalid Rd, 8066, Tabuk 47717, Saudi Arabia
[6]Rfhaa Central Hospital, Al Idariyah, Rafha 76321, Saudi Arabia
[7]Turaif Specialized Dental Center, Turaif-75314, Northern Borders, Saudi Arabia
[8]Maternity And Children Hospital, Tabuk 47717, Saudi Arabia
[9]Health Monitoring Center At Prince Nayef Airport In Qassim, Buraydah-52556, Saudi Arabia
*Corresponding author
E-mail: mnor.67@hotmail.com (Manwer Taleb Albalawi)

and opportunities surrounding the use of MIS in public hospitals, offering guidance for future research and implementation strategies.

KEYWORDS: *Management Information Systems (MIS), Healthcare Operations, Decision-making, Data Management, Electronic Health Records (EHR)*

Introduction

Management Information Systems (MIS) represent a cornerstone in modern healthcare management, particularly within the context of public hospitals [1]. With the perpetual advancement of technology and the increasing complexity of healthcare delivery systems, the utilization of MIS has become indispensable for effective decision-making, resource allocation, and overall hospital performance enhancement [2]. In recent decades, the healthcare sector has undergone significant transformation, driven by the imperative need for better patient care, cost containment, and regulatory compliance. Public hospitals, as primary providers of healthcare services to diverse populations, face unique challenges such as limited resources, increasing patient demands, and stringent regulatory requirements. In this dynamic environment, the integration of information technology, particularly MIS, has emerged as a fundamental strategy to address these challenges effectively. MIS in public hospitals encompass a wide array of interconnected systems designed to collect, store, process, analyze, and disseminate information related to various aspects of hospital operations, including patient care, administrative functions, financial management, and strategic planning [3]. These systems leverage sophisticated software applications, databases, communication networks, and hardware infrastructure to facilitate the flow of information across different departments and levels of hospital hierarchy. By providing timely, accurate, and relevant data, MIS empower hospital administrators, clinicians, and staff to make informed decisions, optimize resource utilization, and enhance overall organizational performance.

One of the primary objectives of MIS in public hospitals is to streamline administrative processes and improve operational efficiency [4]. Through automated workflows, electronic documentation, and data-driven decision support tools, MIS help streamline tasks such as patient registration, billing, inventory management, and workforce scheduling, thereby reducing administrative burdens, minimizing errors, and improving workflow efficiency. Additionally, MIS enable real-time monitoring of key performance indicators (KPIs), allowing hospital administrators to identify bottlenecks, track resource utilization, and implement timely interventions to improve process efficiency and patient flow [5]. Beyond administrative functions, MIS play a crucial role in enhancing clinical decision-making and patient care delivery. By integrating electronic health records (EHRs), clinical decision support systems (CDSS), and telemedicine platforms, MIS enable healthcare providers to access comprehensive patient information, medical histories, diagnostic test results, and treatment protocols at the point of care [6, 7].

This integration facilitates interdisciplinary collaboration, improves care coordination, and reduces medical errors, ultimately leading to better patient outcomes and satisfaction. Moreover, MIS support evidence-based practice by providing clinicians with access to clinical guidelines, best practices, and real-time clinical data, empowering them to make informed decisions tailored to individual patient needs. Furthermore, MIS serve as essential tools for strategic planning, performance evaluation, and quality improvement initiatives in public hospitals. By generating comprehensive reports, dashboards, and analytics, MIS enable hospital administrators to monitor financial performance, track patient outcomes, and assess the effectiveness of clinical interventions [8-11]. This data-driven approach facilitates evidence-based decision-making, enables benchmarking against industry standards, and fosters a culture of continuous quality improvement within public hospitals. Additionally, MIS support compliance with regulatory requirements, accreditation standards, and reporting mandates by ensuring accurate documentation, data integrity, and audit trails [12].

Despite their numerous benefits, the implementation and utilization of MIS in public hospitals are not without challenges. Limited financial resources, inadequate infrastructure, and resistance to change among healthcare professionals are common barriers to effective MIS implementation [13]. Moreover, data interoperability issues, security concerns, and privacy risks pose significant challenges to the integration and sharing of patient information across disparate systems. Addressing these challenges requires collaborative efforts from hospital administrators, IT professionals, clinicians, and policymakers to develop robust strategies, allocate sufficient resources, and foster a culture of innovation and technology adoption within public hospital settings [14]. The effective utilization of MIS in public hospitals holds tremendous potential to transform healthcare delivery, improve patient outcomes, and enhance organizational efficiency. By leveraging technology-enabled solutions, public hospitals can overcome existing challenges, optimize resource utilization, and deliver high-quality, patient-centered care to diverse populations. This review paper aims to explore the multifaceted role of MIS in public hospitals, highlighting their benefits, challenges, and future directions in the rapidly evolving landscape of healthcare management.

Evolution of Management Information Systems In Healthcare

The history of Management Information Systems (MIS) in healthcare traces back to the mid-20th century, evolving alongside technological advancements and the growing need for efficient healthcare administration and patient care [15]. In the early stages, healthcare organizations relied on manual paper-based systems for recording patient information, managing appointments, and processing administrative tasks. However, as the volume of healthcare data increased and the complexity of healthcare delivery expanded, there arose a pressing need for more sophisticated information management solutions. The emergence of computers and digital technology in the 1960s provided a platform for the development of early MIS applications in healthcare [16]. During this period, hospitals and healthcare facilities began experimenting with basic computer systems to automate administrative processes, such as patient scheduling, billing, and inventory management. By the 1970s, the healthcare industry witnessed significant advancements in MIS technology, with the introduction of Electronic Health Records (EHR) systems [17]. These early EHR systems allowed healthcare providers to store patient information electronically, streamlining data retrieval and facilitating more comprehensive patient care. However, adoption remained limited due to high costs and technological limitations. It was not until the 1980s and 1990s that EHR systems began to gain widespread acceptance, driven by improvements in computer technology, the development of standardized data formats, and government initiatives to promote electronic health information exchange [18].

The turn of the 21st century marked a pivotal moment in the evolution of MIS in healthcare, characterized by the proliferation of internet-based technologies and the emergence of interconnected healthcare networks. With the advent of the internet, healthcare organizations began leveraging web-based applications and electronic communication tools to enhance information sharing and collaboration among healthcare professionals. Additionally, the implementation of Health Information Exchanges (HIEs) facilitated the seamless exchange of patient data between different healthcare entities, enabling continuity of care and improved care coordination. The early 2000s also saw the widespread adoption of Picture Archiving and Communication Systems (PACS) in radiology departments, revolutionizing the way medical images were captured, stored, and accessed [19]. PACS allowed for the digitization of X-rays, MRI scans, and other diagnostic images, eliminating the need for traditional film-based imaging systems and enabling remote access to medical images for healthcare providers [20].

In recent years, the healthcare industry has witnessed a rapid acceleration in the adoption of advanced MIS technologies, driven by factors such as regulatory requirements, technological innovation, and the need to improve healthcare outcomes. The implementation of electronic prescribing systems, Clinical Decision Support Systems (CDSS), and Telemedicine platforms has transformed the delivery of healthcare services, enabling more efficient diagnosis, treatment, and patient monitoring [21]. Furthermore, the rise of big data analytics and artificial intelligence has opened up new possibilities for leveraging healthcare data to improve clinical decision-making, predict patient outcomes, and optimize healthcare delivery. By analyzing large volumes of patient data, healthcare organizations can identify patterns, trends, and correlations that were previously inaccessible, leading to more personalized and effective patient care.

Components of Management Information Systems

Healthcare Management Information Systems (HMIS) encompass a diverse array of components essential for the efficient operation of healthcare organizations [22, 23]. At its core, HMIS integrates software applications, data management protocols, and interoperability standards to streamline processes and facilitate informed decision-making (Figure 1). Interoperability ensures seamless communication between different systems, allowing for the exchange of vital patient data securely. Standards such as HL7 and FHIR play a pivotal role in ensuring compatibility and consistency across various healthcare IT systems [24]. However, the effectiveness of HMIS relies not only on technology but also on skilled personnel who utilize these tools effectively. Furthermore, robust security measures safeguard patient information from unauthorized access, ensuring compliance with regulatory standards such as HIPAA [25]. Together, these components form a cohesive network that supports the delivery of high-quality healthcare services while maintaining patient confidentiality and data integrity.

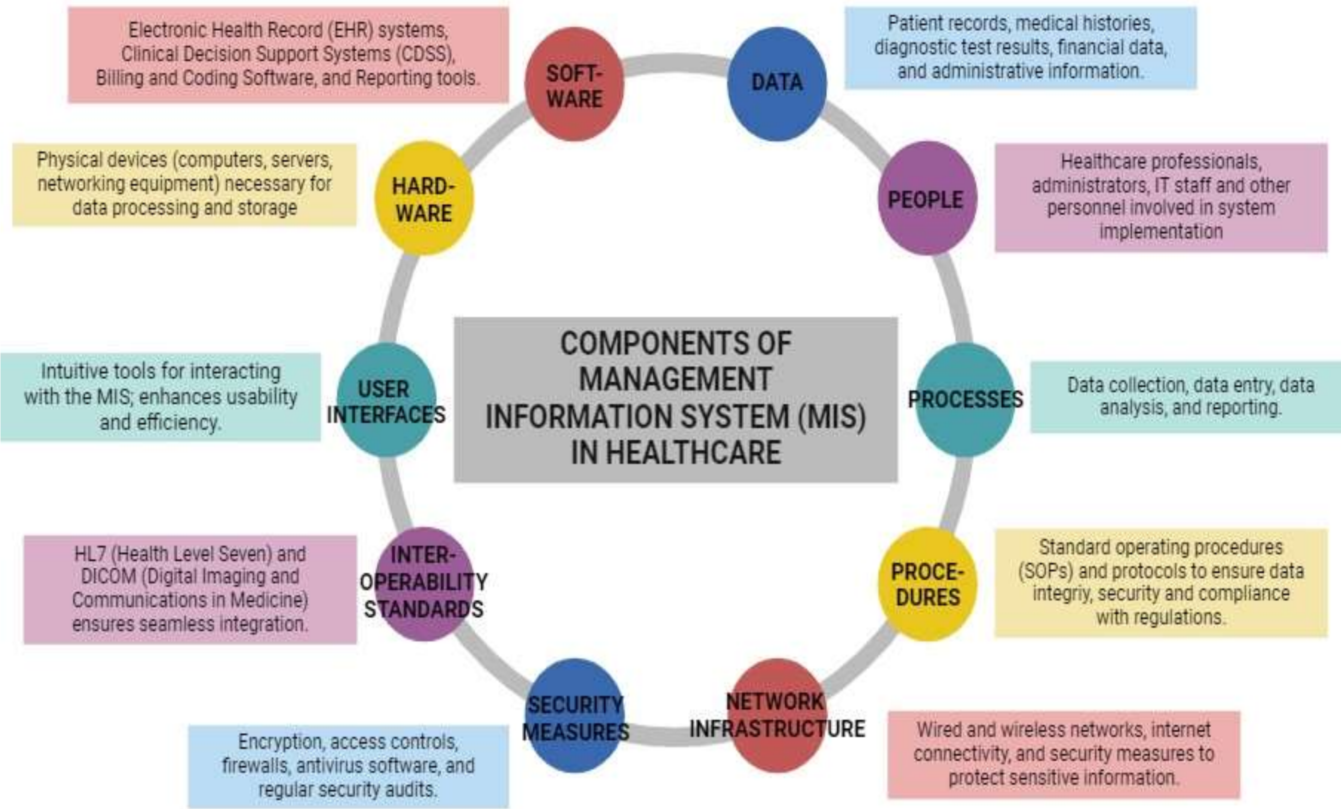

Figure 1: Components of Healthcare Management Information Systems (MIS). This diagram illustrates the essential components of mis in healthcare, including hardware, software, data, people, processes, network infrastructure, security measures, interoperability standards, and user interfaces. Each component plays a crucial role in facilitating data collection, processing, analysis, and dissemination, ultimately contributing to improved decision-making, operational efficiency, and patient care within healthcare organizations.

The software component of MIS encompasses comprehensive processes, from requirements gathering and system selection to design and implementation, aimed at improving efficiency, quality of care, and organizational readiness in healthcare settings [26]. In the requirements phase, an organization typically begins by identifying its generic and clinical functions, categorizing them, and assessing their current level of automation [27]. This involves evaluating interrelationships among different application areas and establishing a technical strategy to address integration challenges, particularly for heterogeneous systems. Criteria for evaluating acquisition options, whether through in-house development or outside sourcing, are also established, considering factors like historical vendor performance and cost constraints. The U.S. Department of Defense (DoD), as an example, has outlined its requirements for healthcare information systems, focusing on goals such as maintaining readiness for joint operations, improving health, and optimizing the medical workforce [28].

The Clinical Business Area, supporting health service delivery, aligns with the vision of a computer-based patient record [29]. Through business process reengineering efforts like those of the Department of Defense Vision Information Services (DVIS), specific functional areas are targeted for improvement, such as Optometry, Ophthalmology, and Optical

Fabrication Laboratory processes [30]. The DVIS workgroup, comprising professionals from various disciplines, collaboratively identified process improvements based on a functional area model-activity (FAM) [31]. Through workshops and groupware tools, they refined and categorized hundreds of improvements into system and non-system business process improvements (BPIs). These BPIs covered diverse areas like patient encounter management, appointment scheduling, equipment/facility management, and preventive measures for eye injuries [32]. During the design phase, understanding the interdependencies among activities and accommodating heterogeneous user groups' competing interests are essential. Designers must navigate organizational complexities, initiate infrastructure developments, and foster integration against potential unit-level disadvantages. In a successful design approach, as exemplified by a small acute care hospital, participation from all departments ensures alignment with organizational development goals. The emphasis on current and future workflow practices acknowledges the dynamic nature of patient care, requiring fluidity in staff behavior and adaptable information processing systems.

The data element of healthcare MIS includes a wide array of aggregated clinical and administrative data, facilitating operational control, management effectiveness, performance evaluation, and quality improvement initiatives within healthcare organizations [33]. In the context of healthcare management information systems (MIS), the data component plays a pivotal role in facilitating operational control, management effectiveness, and performance evaluation. Historically, the focus of hospital information systems in the 1960s and early 1970s centered on operational control, emphasizing the monitoring and optimization of routine tasks through systems like patient accounting and medical records [34]. This operational control was primarily aimed at enhancing the efficiency and effectiveness of structured tasks within healthcare facilities. However, a shift occurred in the late 1970s and early 1980s towards management control, which prioritized functional effectiveness achieved through data aggregation, analysis, interpretation, and presentation. This transition marked a significant evolution in healthcare MIS, wherein the emphasis shifted from mere task optimization to more comprehensive management of clinical and administrative processes. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) underscores the importance of distinguishing between aggregated and comparative data in healthcare settings [35]. Aggregated data involves combining standardized information from various sources, such as electronic medical records, to generate insights into clinical and administrative operations.

For instance, hospitals can query patient databases to obtain aggregated clinical data regarding the number and types of surgeries performed, replacing outdated methods like card catalogues [36]. Additionally, registries serve as repositories of aggregated clinical data, enabling comprehensive tracking of patient information for specific healthcare areas like cancer treatment and research. These registries, whether hospital-based or population-based, play a crucial role in improving patient care, assessing treatment outcomes, and supporting epidemiological research efforts. On the administrative front, aggregate administrative data, including Medicare cost reports and census statistics, offer valuable insights into financial management and patient services planning [37]. Such data help healthcare entities monitor utilization, financial performance, and patient outcomes, facilitating informed decision-making and resource allocation. Moreover, comparative data enables entities to benchmark their performance against industry standards, competitors, or best-in-class entities. Measures like the Health Plan Employer Data and Information Set (HEDIS) and Hospital Quality Measures provide standardized benchmarks for evaluating healthcare quality and performance across different organizations [38]. The integration of performance measurement data into accreditation processes, exemplified by initiatives like the ORYX initiative by JCAHO, further underscores the importance of data-driven quality improvement in healthcare [39, 40]. By aligning measures common to accreditation bodies like JCAHO and CMS, healthcare organizations can streamline data collection and reporting processes, enhancing overall efficiency and accountability.

Information networks serve as catalysts for transforming healthcare delivery by fostering collaboration, streamlining processes, and empowering communities to address public health challenges effectively. Whether through CHINs or HENs, these networks play a crucial role in advancing the quality, accessibility, and affordability of healthcare services. These networks serve as platforms for sharing vital information, facilitating transactions, and improving overall healthcare delivery. Community Health Networks (CHINs) are instrumental in promoting community healthcare services and addressing public health concerns [41, 42]. These networks encompass computer-based systems that link local clinics, government health agencies, hospitals, and other entities involved in community health initiatives. CHINs facilitate information access, data exchange, and linkage, enabling seamless communication and collaboration among diverse stakeholders. By eliminating geographic and bureaucratic barriers, CHINs empower communities to address health challenges effectively [43]. For instance, the Center for Disease Control (CDC) initiated the Information Network for Public Health Officials (INPHO) to provide public health practitioners with access to authoritative information and resources for disease surveillance, prevention, and program evaluation [44]. INPHO leverages platforms like CDC WONDER to streamline access to public health data, fostering research, decision-making, and resource allocation [45, 46]. Similarly, initiatives like the Target Cities Program have established CHINs to enhance substance abuse treatment systems, exemplifying the role of information networks in addressing specific healthcare needs at the community level [47].

Despite technological advancements, the success of CHINs hinges on addressing people-related challenges through extensive training and organizational management efforts. In contrast, Health E-Commerce Networks (HENs) focus on facilitating electronic transactions and standardizing communication among healthcare providers and payers. These networks, such as the Wisconsin Health Information Network (WHIN) and New England Healthcare EDI Network (NEHEN), streamline processes like eligibility verification, claims submission, and access to clinical data [48, 49]. By reducing transaction costs and promoting standardization, HENs enhance operational efficiency and financial management within the healthcare ecosystem. Factors determining the success of HENs include robust sponsorship within the local healthcare community, reliable technology partners, and critical mass participation from payers and providers. For instance, initiatives like HealthBridge of Cincinnati have thrived by leveraging strong partnerships between hospitals, payers, and technology vendors to provide seamless access to clinical and administrative information for physicians [50].

Securing healthcare information systems requires a holistic approach that encompasses organizational policies, technical mechanisms, and workforce training. By prioritizing security and implementing comprehensive measures, healthcare organizations can mitigate risks, protect patient privacy, and uphold the integrity of sensitive health information [51]. Ensuring the security of healthcare information systems is important to safeguarding patient privacy and preventing unauthorized access to sensitive data. One of the primary challenges in healthcare information security is the discrepancy between the increasing reliance on technology and the substandard security infrastructure [52]. The solution lies not in acquiring new technology but in optimizing organizational workflows. A robust security framework emphasizes the importance of human policies driving computer policies, which, in turn, leverage technical mechanisms to enhance security. The extent of inadequate security in healthcare organizations is a pressing concern. While obtaining reliable data on the prevalence of security structures in hospital-based organizations is challenging due to limited public disclosure, experts estimate that the majority of private healthcare organizations lack adequate security measures. Government audits have revealed serious weaknesses in security practices, with reports indicating vulnerabilities in access control and service continuity, putting sensitive patient information at risk [51].

Security in healthcare information systems is intricately linked to workflow management and organizational policies. Despite common misconceptions, security is not solely a technical issue but a multifaceted challenge requiring comprehensive policies and procedures [53]. Effective security policies must align with the organization's goals and regulatory requirements while addressing threats inherent to computer operations, such as viruses and unauthorized access. A robust security framework comprises several interconnected components, starting with the organizational security policy, followed by the computer security policy, model, and mechanisms [54]. These components work in tandem to protect information systems against unauthorized access, modification, and service denial. Cryptography plays a vital role in ensuring data confidentiality, while mechanisms like access control and audit trails support accountability and integrity. Confidentiality, integrity, and availability are fundamental principles guiding computer security policies. While confidentiality receives significant attention, integrity policies, such as separation of duties, and availability policies, focusing on contingency planning and system recovery, are equally crucial. Resource control and accountability complement these principles by regulating access to computing resources and maintaining records of user activities.

Currently Used Mis In Healthcare

Management Information Systems (MISs) have emerged as indispensable tools in hospital settings, facilitating the organization, storage, retrieval, and analysis of vast amounts of clinical and administrative data. These systems serve as the backbone of hospital operations, providing healthcare professionals with timely access to critical information while enabling seamless coordination among various departments and stakeholders. The implementation of MISs in hospitals represents a paradigm shift in healthcare delivery, transitioning from traditional paper-based record-keeping to digital platforms that offer enhanced functionality and accessibility. These systems encompass a wide range of technologies and applications designed to meet the diverse needs of healthcare organizations, ranging from Electronic Health Records (EHRs) and Picture Archiving and Communication Systems (PACS) to workflow management solutions and cloud-based platforms [55, 56]. The importance of MISs in hospitals cannot be overstated, as they play a pivotal role in driving clinical decision-making, improving patient outcomes, and optimizing resource allocation. By centralizing patient data and streamlining administrative processes, MISs enable healthcare providers to deliver personalized and evidence-based care while minimizing errors and redundancies [57]. Moreover, these systems facilitate compliance with regulatory requirements and support quality improvement initiatives by providing robust reporting and analytics capabilities.

Picture Archiving and Communication Systems (PACS) represent a transformative leap in healthcare information management, revolutionizing the way diagnostic images and related documents are stored, accessed, and shared across medical facilities. These digital databases play a pivotal role in modern healthcare systems, facilitating the seamless integration and retrieval of medical records within hospital information systems [58]. By digitizing and centralizing diagnostic images, PACS not only enhance the efficiency of healthcare workflows but also significantly improve the quality of patient care [59]. Despite the immense potential and numerous benefits offered by PACS, widespread implementation faces notable challenges, including cost considerations, infrastructure requirements, workflow adjustments, and user acceptance issues [60]. PACS systems serve as comprehensive repositories of medical images and associated documents, enabling healthcare professionals to access critical diagnostic information promptly and securely. By digitizing and centralizing medical records, PACS streamline workflows and enhance efficiency across various healthcare settings [61].

One of the primary benefits of PACS is the elimination of lost radiographic films, ensuring that vital diagnostic information is readily available when needed [62]. Moreover, the implementation of PACS systems leads to significant improvements in workflow performance, reducing the number of unread, retaken, and lost films in radiology departments [63]. This translates into enhanced quality of emergency patient care, with faster turnaround times for radiology examinations and diagnostic document processing. The meaningful use of PACS brings about transformative changes in healthcare workflows, facilitating seamless access to digital images throughout medical centers. This results in faster turnaround times, reduced redundant tests and examinations, and increased patient throughput, ultimately enhancing the overall quality and efficiency of healthcare delivery.

The implementation of Electronic Health Records (EHRs) represents a significant endeavor in modern healthcare systems, aiming to revolutionize the management and accessibility of patient information. EHR adoption has garnered considerable attention in these regions, driven by governmental initiatives and a growing recognition of the transformative potential of digital health technologies [64]. As hospitals transition from traditional paper-based record-keeping to digital platforms, understanding the multifaceted dynamics of EHR implementation becomes imperative for healthcare organizations seeking to enhance patient care delivery and operational efficiency. EHR systems serve as comprehensive repositories of patient information, encompassing medical records, diagnostic data, and treatment histories. The adoption of EHRs facilitates seamless access to critical information, enabling healthcare professionals to make informed clinical decisions and deliver personalized care [65]. However, successful implementation hinges on various factors, including the selection of suitable software vendors, robust change management strategies, and active engagement of clinical staff. The findings from the reviewed literature underscore the importance of contextual factors, such as hospital demographics, in shaping EHR adoption patterns and organizational readiness [66]. Furthermore, attention to the content of EHR systems, including software flexibility, usability, and data security, emerges as crucial for ensuring user acceptance and system effectiveness.

Additionally, the implementation process itself demands meticulous planning, interdisciplinary collaboration, and effective communication to overcome resistance and promote stakeholder engagement. Notably, physician acceptance emerges as a pivotal factor influencing the success of EHR implementation initiatives, highlighting the need for tailored strategies to address clinical staff concerns and foster collaboration. By synthesizing and categorizing key findings, it offers valuable insights into the critical elements underpinning successful EHR adoption, guiding healthcare organizations in navigating the complexities of digital transformation and optimizing patient care delivery.

Peer-to-peer (P2P) technology has emerged as a promising paradigm for enhancing healthcare Management Information Systems (MISs), offering decentralized and distributed computing capabilities that facilitate seamless information exchange and collaboration among healthcare stakeholders [67]. Unlike traditional client-server architectures, P2P systems enable direct communication and resource sharing between individual nodes or peers, thereby promoting scalability, fault tolerance, and resource efficiency in healthcare information management [68]. P2P technology holds significant potential for addressing the challenges inherent in traditional healthcare MISs, including centralized data repositories, limited scalability, and susceptibility to single points of failure. By decentralizing data storage and processing, P2P systems can mitigate the risks associated with data breaches and system downtime, ensuring continuous access to critical patient information. Moreover, the distributed nature of P2P networks enables efficient utilization of computing resources across multiple nodes, optimizing system performance and resilience to network disruptions [69]. In healthcare management, P2P technology facilitates real-time collaboration and information sharing among healthcare professionals, enabling rapid decision-making and improving patient care outcomes [70].

For instance, P2P-based workflow management systems allow clinicians to coordinate patient treatment plans, share diagnostic data, and collaborate on treatment strategies in a secure and efficient manner. Additionally, P2P networks support telemedicine applications, enabling remote consultations and medical monitoring for patients in underserved or remote areas. Besides, P2P technology offers inherent scalability, allowing healthcare organizations to adapt and expand their information systems in response to evolving patient needs and organizational requirements. As healthcare data volumes continue to grow exponentially, P2P systems provide a scalable framework for managing and processing large datasets, ensuring timely access to critical information for clinical decision support and research purposes.

Case Studies: Successful Implementation of Mis In Public Hospitals

Ethiopia has made significant investments in its routine Health Management Information System (HMIS) to enhance data availability for informed decision-making in the healthcare sector [71]. A study aimed to assess the quality of HMIS data and cross-reference it with other sources like the Demographic and Health Surveys (DHS) study aimed to assess the quality of HMIS data and cross-reference it with other sources like the Demographic and Health Surveys (DHS). Analyzing data spanning from 2012 to 2018 across various health indicators, 38 analysts from the Ministry of Health and two government agencies participated in the Operational Research and Coaching for Analysts (ORCA) project between June 2018 and June 2020. Utilizing the World Health Organization Data Quality Review toolkit, assessments were made on indicator definitions, completeness, internal consistency, and external consistency compared to alternate data sets. Findings revealed instances of reported service coverage exceeding 100%, often due to unreliable population data estimates for denominators. While data on individual vaccinations showed satisfactory internal consistency, discrepancies were observed regarding fully vaccinated children, with HMIS reporting 89% coverage compared to 39% from DHS. Maternal health indicators displayed improvement over time, while consistency was lower for child nutrition, malaria, and tuberculosis indicators. Neonatal mortality data were incomplete, highlighting issues with operationalization. Recommendations include regular triangulation with alternative data sources, addressing denominator issues, simplifying indicator complexity, and aligning indicators with international standards to improve the quality and reliability of routine health data in Ethiopia [72]. Moreno et al. created the Geo Health project that aims to develop a scalable infrastructure enabling real-time analysis of patient data alongside geolocated open Data [73].

The system integrates demographic and environmental data, supporting various analyses from simple correlations to complex regressions. Results showcase data integration through a dashboard, offering heat maps and location-specific insights. The analysis module aids in identifying patient-environment relationships, as demonstrated by clustering analysis in allergology. GeoHealth empowers clinical researchers to understand patient-environment dynamics, enhancing study efficiency and potentially revolutionizing clinical research methodologies. Its innovative approach underscores its potential impact on location-based clinical studies. Another study conducted in Tanzania investigates the utilization of Health Management Information System (HMIS) data and the factors influencing health system performance [74]. Conducted across 11 districts and involving 115 healthcare facilities, data collection utilized semi-structured questionnaires and observational checklists. Findings reveal that while 60% of facility respondents utilize HMIS data, only 38.5% of district officials analyze it routinely. HMIS data primarily aid in service coverage comparison, disease trend monitoring, and community health education. However, challenges such as insufficient training (41.4% received none in the past year), infrequent supervisory visits (42% received in the last 3 months), and limited feedback (69.2% systematically receive it) hinder effective HMIS utilization. Patient load significantly impacts staff performance in data collection and management. Inadequate analysis, poor utilization practices, and resource constraints underscore the challenges facing HMIS performance in Tanzania, emphasizing the need for improved human and financial resources, incentivization, supervision, and standardized data management protocols.

In India, the Comprehensive Rural Health Services Project in Ballabgarh, managed by AIIMS, New Delhi, has implemented a computerized Health Management Information System (HMIS) since 1988. The study conducted by Krishnan and colleagues aimed to evaluate its effectiveness in the rural health system of India. Stakeholders, including program managers and health workers, were interviewed, comparing manual and computerized HMIS at AIIMS and non-AIIMS Primary Health Centers [75]. The computerized HMIS showed minimal hardware issues, with over 95% data accuracy. Health workers appreciated its utility in service delivery, data management, and report generation, while program managers found it beneficial for monitoring and supervision. Initial costs for computerization were estimated at INR 1,674,217 (USD 35,622), with annual savings of INR 894,283 (USD 11,924). Computerization significantly reduced time spent on record-keeping and report generation for health workers. The study concludes that computerization facilitates efficient service delivery, monitoring, and supervision, with initial costs recoverable within two years. Overall, computerized HMIS proves advantageous for rural healthcare systems in India, enhancing operational efficiency and data management.

Benefits

The utilization of Management Information Systems (MIS) significantly enhances clinical decision-making processes within healthcare institutions. The study indicates that MIS facilitates the retrieval of health information, providing detailed data required by various hospital departments and administration levels promptly. The information systems effectively address urgent and emergency circumstances, ensuring the accuracy and usefulness of the provided information for each case. Furthermore, the efficiency of working staff is enhanced through regular training sessions and recruitment of individuals with high experience in information systems. This ensures that employees possess the necessary skills to effectively utilize modern systems, thereby improving overall efficiency. Moreover, MIS supports decision-making by enabling administrations to collect sufficient information, identify problem elements, and analyze alternatives to make efficient decisions. The study identifies statistically significant relationships between the retrieval and acquisition of health information, staff efficiency in information system utilization, and decision-making processes. Based on these findings, recommendations include the development of MIS to provide statistical data upon request, awareness campaigns for staff, strategic planning for long-term e-health applications, and continuous training to enhance staff skills. Additionally, allocating resources for updating and providing accurate health information through MIS is emphasized for improved decision-making efficiency.

Improved interoperability through Management Information Systems (MIS) in hospitals is essential for enhancing communication and data exchange among heterogeneous health information systems and applications. Interoperability ensures that electronic health records (EHRs) and medical systems can effectively share information, leading to more coordinated patient care and reduced healthcare costs (Figure 2). However, achieving interoperability faces challenges due to the diverse suppliers of systems and technologies, as well as the multitude of clinical and administrative applications within organizations. Standardization of messages is crucial for interoperability. Prominent standards like HL7 (Health Level Seven) and DICOM (Digital Imaging and Communication in Medicine) facilitate communication between different health applications. HL7, for instance, facilitates application-to-application messaging through XML-based messages validated against a Reference Information Model (RIM). This allows for structured information encoding and seamless data exchange between disparate systems. Additionally, the Clinical Document Architecture (CDA) standard ensures consistency in document structure, enabling interpretation by both computer systems and end-users.

These standards play a vital role in improving healthcare operations by enabling the automatic transfer of complementary diagnostic procedures results for electronic medical record systems. This accessibility of data across various information systems without the need for translation or additional semantics translation enhances decision-making processes and supports more effective patient treatment. By adopting standardized approaches to interoperability, hospitals can streamline workflows, reduce errors, and improve patient outcomes. Moreover, the development of a universal model for centralized medical records contributes to the overall efficiency of healthcare delivery systems. Overall, improved interoperability through MIS not only enhances communication and data exchange but also lays the foundation for more efficient and effective healthcare operations.

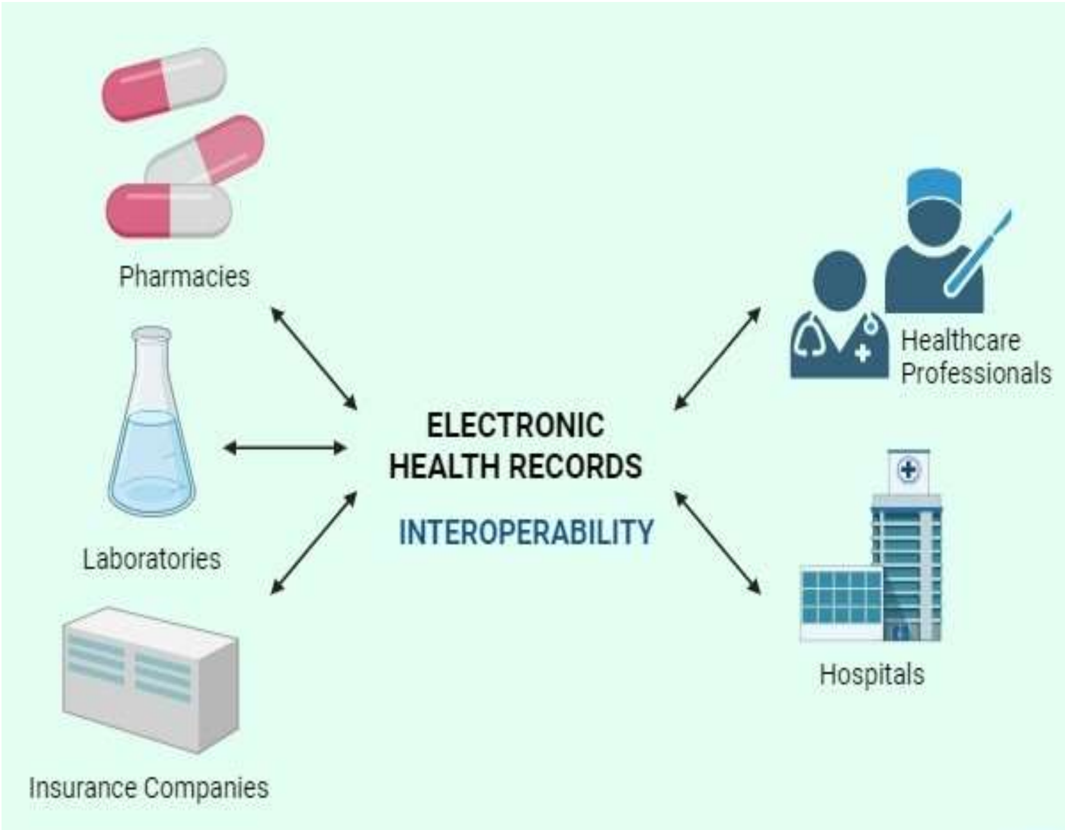

Figure 2: A figure representing how interoperability in healthcare facilitates seamless data exchange among electronic health records (EHR), pharmacies, labs, healthcare providers (HCPs), hospitals, insurance companies, and other stakeholders. This interconnected system enables efficient sharing of patient information, including medical history, test results, prescriptions, and insurance coverage. Through interoperability, healthcare entities can access relevant data from disparate sources in real-time, promoting coordinated care, informed decision-making, and improved patient outcomes.

A study revealed that while Information Quality and Technical Factors do not significantly contribute to the integration of Hospital Management Information Systems (HMIS), Health System Leadership Style emerges as a crucial factor influencing HMIS integration [76]. Specifically, Transformational Leadership style demonstrates a significant positive impact on HMIS integration, suggesting that effective leadership plays a pivotal role in driving the adoption and implementation of MIS in healthcare operations. The regression model, explaining 69.9% of the variance in HMIS integration, highlights the overall statistical significance of the predictors [77]. Although Information Quality and Technical Factors show non-significant coefficients, the significance of Health System Leadership Style underscores its importance in fostering successful HMIS integration. Furthermore, the interaction terms between the independent variables and the moderator variable signify the moderator's significant influence on how the independent variables affect HMIS integration. Overall, these findings emphasize the critical role of leadership in healthcare operations and the importance of fostering a conducive leadership style, such as Transformational Leadership, to effectively leverage MIS for improved healthcare delivery, efficiency, and performance. Effective leadership can drive organizational change, promote collaboration, and facilitate the adoption of innovative technologies like HMIS, ultimately enhancing healthcare operations and patient outcomes.

Challenges and Limitations of Implementing Mis In Public Hospitals

The rising cost of healthcare, exacerbated by the introduction of expensive diagnostic technologies like magnetic resonance imaging devices, presents a significant challenge for Management Information Systems (MIS) in hospitals [78]. This increase in healthcare costs initiates a chain reaction within the healthcare system, as payers, such as insurance programs and employers, strive to contain costs. As a result, hospitals and physicians find their revenue sources constrained, leading them to take actions to cope with these financial pressures [79]. These actions often include increasing preauthorization efforts and sharing cost increases with employees through higher premiums. However, this reactive approach to cost containment creates a circular system where each part of the healthcare system attempts to pass the problem along to another part, hindering cooperative efforts to address the root cause of rising costs. Despite the sophistication of healthcare, characterized by advanced medical care, healthcare expenditures continue to escalate. However, the integration of information technology and effective human practices holds promise for improving care and reducing costs. Standardizing data collection, integrating networks of data, and implementing semi-automated monitoring systems could potentially mitigate the negative impact of rising costs on the healthcare system. However, the primary obstacles to implementing such information systems solutions are not technological but political. Overcoming these obstacles will require collaborative efforts from stakeholders across the healthcare ecosystem to prioritize cost-effective care delivery while maintaining quality standards.

Coordination presents a significant challenge in hospital management information systems (MIS) due to the decentralized nature of the healthcare industry, which consists of various trading partners such as hospitals, providers, group purchasers, pharmacies, and clearinghouses. Unlike other industries with tightly coupled commerce partners, the healthcare industry lacks cohesive data-sharing systems, hindering effective coordination of care. The fragmented nature of the industry makes it imperative to utilize common or cooperating information systems and databases to facilitate data exchange. Inadequate information systems hinder the coordination of care by impeding access to a patient's treatment history, test results, and other pertinent information essential for effective healthcare delivery. Paper-based records further exacerbate the problem, as they are challenging to transfer between organizations. Technical and administrative issues contribute to the difficulty in file sharing, particularly when incompatible hardware and software configurations are involved. Improved information systems are needed to generate population-level data that can assess the health system's performance in caring for specific populations and enable public health officials to monitor disease outbreaks and adverse medication effects effectively. However, most existing MIS are not designed to fulfill these purposes, highlighting the urgent need for system enhancements to address coordination challenges in healthcare delivery.

Medical errors pose significant challenges in hospital management information systems (MIS), leading to adverse outcomes for patients and substantial financial costs. Despite advancements in healthcare technology, estimates suggest that approximately 100,000 people die annually in the United States due to medical errors in hospitals, surpassing the mortality rates of motor vehicle accidents, breast cancer, and AIDS. These errors often stem from systemic issues rather than individual negligence, highlighting the need for improved safety measures within healthcare systems. Existing MIS, primarily designed for billing purposes, frequently fail to accurately record crucial patient information, contributing to diagnostic and medication errors. Common medication errors, including incorrect dosing and administration, are prevalent and potentially harmful to patients.

The implementation of computerized systems like Pyxis, a medication-dispensing computer, has demonstrated significant reductions in medication errors by enforcing double-check procedures and streamlining medication administration processes. However, challenges persist in areas such as prescribing errors, order transcription, allergy management, and medication tracking, underscoring the need for enhanced information systems to mitigate these risks effectively. Improved systems could offer features like Physician Order Entry systems that limit choices to acceptable drug doses, thus reducing the likelihood of errors. Ultimately, addressing medical errors in MIS requires comprehensive strategies that prioritize patient safety, streamline processes, and facilitate effective communication among healthcare providers.

Jalghoum and colleagues investigated the challenges faced by healthcare providers in Jordan regarding the development of e-health initiatives, based on a classification derived from existing literature [80]. Through twenty-six semi-structured interviews with various stakeholders in the e-health system, challenges such as the lack of regulations and policies, financial constraints, privacy concerns, and the unique nature of the healthcare sector were identified. The study concludes that human and cultural factors significantly impact e-health development in Jordan. To facilitate the smooth transition of healthcare services, the paper emphasizes the importance of addressing these challenges by implementing proper laws and policies, securing adequate funding, addressing privacy issues, and standardizing e-health development. By highlighting these findings, the paper aims to provide valuable insights to managers and decision-makers in the healthcare sector, contributing to the advancement of e-health initiatives in Jordan.

This study fills a gap in existing literature by offering empirical evidence and a fresh perspective on the challenges of e-health development in Jordan, thus serving as a significant contribution to the field. Hospitals in Kenya are increasingly adopting Information and Communication Technology (ICT) to enhance transparency, efficiency, and effectiveness in service delivery, primarily through the implementation of Hospital Management Systems (HMIS). A study conducted in Nairobi aimed to assess the extent of HMIS utilization in hospitals and identify challenges faced during implementation. Using a survey design methodology, data was collected on HMIS usage, computerization levels, and implementation hurdles. Questionnaires were administered to IT officers in hospitals using a drop and pick approach, with a high response rate of 85%. Analysis of the data, conducted using SPSS, revealed challenges such as inadequate support from employees, limited financial resources, communication gaps, insufficient training, prolonged procurement processes, and changeover issues. Recommendations to enhance HMIS implementation success include improved planning and coordination, user training and involvement, transparent procurement processes, managerial involvement, software and hardware evaluation, and the use of change agents. Additionally, the study suggests the appointment of qualified managers to lead HMIS implementation and the establishment of dedicated IT departments within hospitals. In Burkina Faso, the health information system (HIS) encounters several challenges hindering its effectiveness [81].

Firstly, while reporting forms are standardized across health facilities, they are not consistently understood at the community level and within health centers, leading to potential discrepancies and errors in data collection. Additionally, there are delays in reporting as reports prepared by community-based health workers (CBHWs) are often held up by head nurses at primary health care services [82]. Furthermore, there is a lack of comprehensive understanding of epidemic disease case definitions among CBHWs and frontline health workers, which may impede timely and accurate reporting of outbreaks [83]. To address these challenges, there is a pressing need for regular training and refresher sessions for surveillance agents, along with the development of simplified case definitions for emerging and public health diseases suitable for community use. Additionally, there is a call for the revitalization of existing epidemic management committees to enhance coordination and response efforts. These strategies are essential to improve the functionality and efficiency of the health information system in Burkina Faso. **Table 1** summarizes the benefits and limitations of the use of management information systems in hospitals.

Table 1: Benefits and limitations/challenges of management information systems (MIS) in healthcare and hospitals.

BENEFITS	**LIMITATIONS**
Enhanced Data Management: Efficiently store, organize, and retrieve vast amounts of patient data, facilitating better decision-making and patient care.	Interoperability Issues: Incompatibility between different systems and standards hinders seamless data exchange and interoperability, leading to fragmented information and workflow disruptions.
Improved Clinical Decision Making: Access to comprehensive patient records and real-time data analysis enables healthcare professionals to make informed treatment decisions.	Data Security and Privacy Concerns: Protecting sensitive patient information from unauthorized access, breaches, and cyber threats poses significant challenges, requiring robust security measures and compliance with regulatory standards.
Enhanced Coordination of Care: Seamless communication and data sharing between healthcare providers streamline care delivery and ensure continuity across different departments and specialties.	Implementation Costs and Complexity: Initial investment costs, ongoing maintenance expenses, and the complexity of implementing new systems can strain healthcare budgets and resources, hindering adoption and scalability.
Increased Efficiency and Productivity: Automation of administrative tasks, streamlined workflows, and reduced paperwork allow healthcare professionals to focus more on patient care, leading to higher productivity.	Resistance to Change: Resistance from healthcare professionals to adapt to new technologies and workflows can impede the successful implementation and utilization of MIS, affecting efficiency and outcomes.
Better Patient Outcomes: Timely access to accurate patient information and evidence-based practices result in improved diagnoses, treatments, and overall health outcomes.	Training and User Adoption: Insufficient training and support for staff to effectively use new systems and technologies can lead to low user adoption rates, workflow disruptions, and suboptimal utilization of MIS.

Future Trends and Innovations In Mis For Public Hospitals

As hospitals continue to navigate the complex landscape of healthcare delivery, Management Information Systems (MIS) play an increasingly pivotal role in driving efficiency, enhancing patient care, and optimizing organizational performance [84]. Looking ahead, several key trends are poised to shape the future of MIS in hospitals. Firstly, the integration of advanced technologies such as artificial intelligence (AI), machine learning, and data analytics will revolutionize how hospitals manage and leverage data [85]. These technologies have the potential to automate routine tasks, identify patterns in patient outcomes, and provide actionable insights for clinical decision-making. Secondly, interoperability and data exchange will become paramount as hospitals seek to integrate disparate systems and share information seamlessly across healthcare networks. Interoperable MIS will enable healthcare providers to access comprehensive patient records, facilitate care coordination, and improve communication among care teams [86]. Additionally, the rise of telemedicine and remote patient monitoring will drive the adoption of cloud-based MIS solutions, enabling secure access to patient data from anywhere at any time [87]. Cloud technology offers scalability, accessibility, and cost-efficiency, empowering hospitals to deliver virtual care services efficiently. Overall, the future of MIS in hospitals is characterized by innovation, integration, and collaboration, with technology serving as a catalyst for transforming healthcare delivery and improving patient outcomes.

In the ever-evolving landscape of hospital Management Information Systems (MIS), the integration of Artificial Intelligence (AI), Machine Learning (ML), and Data Analytics is poised to usher in a new era of healthcare delivery [88]. These emerging technologies hold the promise of transforming how hospitals operate, from patient care to administrative tasks, by harnessing the power of data to drive informed decision-making and optimize processes. One of the most significant future trends in hospital MIS is the widespread adoption of predictive analytics [89]. By leveraging vast amounts of patient data, including electronic health records (EHRs), medical imaging, and genomic information, predictive analytics algorithms can forecast individual health outcomes and tailor treatment plans accordingly. This personalized approach to healthcare has the potential to significantly improve clinical outcomes and patient satisfaction by preemptively addressing health issues and optimizing treatment strategies. Additionally, Clinical Decision Support Systems (CDSS) empowered by AI and ML algorithms are expected to play a crucial role in enhancing diagnostic accuracy and treatment decisions [90]. These systems can analyze patient data in real-time, offering healthcare providers valuable insights and recommendations at the point of care. By integrating CDSS into existing workflows, hospitals can improve patient safety, reduce medical errors, and ensure adherence to clinical guidelines.

Natural Language Processing (NLP) is another key technology that will revolutionize hospital MIS by unlocking valuable insights from unstructured clinical data [91]. NLP algorithms can extract meaningful information from clinical notes, physician documentation, and medical literature, facilitating more accurate coding, comprehensive patient profiles, and epidemiological research [92]. By automating tasks such as clinical documentation and coding, NLP streamlines workflows, reduces administrative burden, and enhances data accuracy. Furthermore, the future of hospital MIS will see a greater emphasis on remote patient monitoring and telehealth services, facilitated by AI and ML technologies. These tools enable continuous monitoring of patient vitals, medication adherence, and disease progression outside of traditional healthcare settings [93]. By leveraging remote monitoring devices and predictive analytics, healthcare providers can detect early warning signs, intervene proactively, and prevent hospital readmissions. Telehealth platforms powered by AI algorithms also enable virtual consultations, remote diagnosis, and patient education, expanding access to medical services and improving healthcare delivery in underserved areas [94].

In financial terms, AI-driven solutions for fraud detection and revenue cycle management will become indispensable tools for hospitals. By analyzing vast amounts of financial data, AI algorithms can detect patterns indicative of fraudulent activities, billing errors, or non-compliance with regulatory requirements. Additionally, AI-powered revenue cycle management systems streamline billing processes, optimize reimbursement, and ensure timely payment collection, ultimately improving financial performance and operational efficiency [95]. Finally, population health management and public health surveillance will benefit significantly from advanced data analytics capabilities. By aggregating and analyzing population-level health data, hospitals can identify trends, patterns, and risk factors for various diseases, enabling proactive interventions and preventive care initiatives. Moreover, AI algorithms can analyze social determinants of health, environmental factors, and community health indicators to inform public health policies and interventions, ultimately improving population health outcomes [96]. As these future trends in AIML and data analytics continue to unfold, hospitals will increasingly rely on these technologies to drive innovation, improve clinical outcomes, optimize resource utilization, and enhance the overall quality of healthcare delivery [97]. By harnessing the power of data and advanced analytics, hospital MIS will play a pivotal role in shaping the future of healthcare.

Cloud-based information systems are revolutionizing the landscape of healthcare Management Information Systems (HMIS), offering numerous benefits and paving the way for future advancements in the field. Currently, cloud-based solutions are being widely adopted across the healthcare industry, with a growing emphasis on scalability, accessibility, and cost-efficiency [98]. Due to scalability, one of the main advantages of cloud based information systems, healthcare organizations can easily scale their infrastructure up or down based on their needs, without the need for significant upfront investments in hardware or software [99]. This flexibility allows hospitals, clinics, and other healthcare providers to adapt to changing patient volumes, regulatory requirements, and technological advancements seamlessly. Additionally, cloud-based systems enable healthcare facilities to quickly deploy new services and applications, facilitating innovation and improving operational efficiency. Accessibility is another key benefit of cloud-based HMIS [100]. By moving data and applications to the cloud, healthcare providers can access critical information anytime, anywhere, and from any device with an internet connection.

This accessibility is especially valuable for remote patient monitoring, telemedicine consultations, and collaborative care initiatives. Healthcare professionals can securely access patient records, medical imaging, and other essential data from their smartphones, tablets, or laptops, enabling more informed decision-making and better patient outcomes. Cost-efficiency is a significant driving factor behind the adoption of cloud-based HMIS [101]. By leveraging cloud services, healthcare organizations can reduce their capital expenditures on hardware, maintenance, and upgrades. Instead, they pay for cloud resources on a subscription or usage-based model, allowing for better cost predictability and budget management. Moreover, cloud-based solutions eliminate the need for on-premises data centers, reducing energy consumption, space requirements, and environmental impact. Cloud-based HMIS holds tremendous potential for advancing interoperability within the healthcare ecosystem [102]. As healthcare providers increasingly adopt electronic health records (EHRs) and other digital systems, interoperability becomes essential for exchanging patient information seamlessly across different platforms and organizations. Cloud-based solutions can serve as a centralized platform for integrating disparate data sources, standardizing data formats, and facilitating secure data exchange between healthcare providers, payers, and other stakeholders. Real-time data analytics is another area where cloud-based HMIS is poised to make significant advancements [103]. By harnessing the power of cloud computing and big data analytics, healthcare organizations can derive actionable insights from vast amounts of patient data in real-time. Predictive analytics, machine learning algorithms, and artificial intelligence (AI) tools can help identify trends, detect anomalies, and personalize treatment plans based on individual patient characteristics and outcomes [104].

Additionally, cloud-based analytics platforms enable healthcare providers to monitor population health, track disease outbreaks, and optimize resource allocation more effectively. Personalized patient care is a key focus of future developments in cloud-based HMIS. By leveraging cloud-based technologies, healthcare providers can deliver more personalized and patient-centric care experiences [105]. Electronic health records stored in the cloud enable comprehensive patient profiles, including medical history, treatment plans, and preferences, to be accessible to authorized caregivers across different care settings. This holistic view of the patient allows for more coordinated care delivery, reduced medical errors, and improved patient satisfaction. Cloud-based information systems are transforming healthcare management information systems by offering scalability, accessibility, and cost-efficiency [106]. Looking ahead, the future of cloud-based HMIS holds promise for advancing interoperability, real-time data analytics, and personalized patient care [107]. By embracing cloud technology, healthcare organizations can unlock new opportunities for innovation, collaboration, and improved patient outcomes in the digital age.

Conclusion

In conclusion, the review of Management Information Systems (MIS) in public hospitals underscores their significance in modern healthcare delivery and administration. The examination of current trends reveals a widespread adoption of MIS across public hospital settings, driven by the increasing digitization of healthcare processes and the growing recognition of technology's potential to improve patient care outcomes and operational efficiency. One of the primary benefits of MIS in public hospitals lies in their ability to streamline administrative tasks, optimize resource allocation, and enhance decision-making processes. By centralizing patient data and automating routine workflows, MIS enable healthcare providers to access timely and accurate information, leading to more efficient clinical operations and improved patient care delivery. Furthermore, the integration of advanced analytics and reporting capabilities empowers hospital administrators to identify trends, monitor performance metrics, and make data-driven decisions to support organizational goals and objectives. However, the implementation of MIS in public hospitals also presents certain limitations and challenges. These may include initial investment costs, interoperability issues with existing systems, data security concerns, and resistance to change among healthcare professionals. Additionally, the reliance on technology for critical healthcare functions raises concerns about system reliability, uptime, and data integrity, necessitating robust backup and contingency plans to mitigate potential risks and ensure continuity of care.

Looking towards the future, several emerging trends are poised to shape the evolution of MIS in public hospitals. These include the adoption of cloud-based technologies, artificial intelligence, and machine learning algorithms to enhance data management, predictive analytics, and personalized patient care. Moreover, the proliferation of telehealth and remote monitoring solutions presents new opportunities for leveraging MIS to extend healthcare services beyond traditional hospital settings, improve patient access to care, and reduce healthcare disparities. While Management Information Systems offer numerous benefits to public hospitals, their successful implementation and utilization require careful consideration of both opportunities and challenges. By addressing issues related to technology infrastructure, data governance, user training, and organizational culture, public hospitals can maximize the potential of MIS to transform healthcare delivery, improve patient outcomes, and drive continuous innovation in the years to come. Thus, embracing a strategic and collaborative approach to MIS implementation will be essential for public hospitals to navigate the complexities of the digital healthcare landscape and realize the full benefits of technology-enabled healthcare delivery.

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References

1. Carvalho JV, Rocha Á, van de Wetering R, Abreu A. A Maturity model for hospital information systems. Journal of Business Research. 2019;94:388-99.
2. Naranjo-Gil D, Hartmann F. How CEOs use management information systems for strategy implementation in hospitals. Health Policy. 2007;81(1):29-41.
3. Ogundaini OO. Adoption and use of electronic healthcare information systems to support clinical care in public hospitals of the Western Cape, South Africa. 2016.
4. Wager KA, Lee FW, Glaser JP. Health care information systems: a practical approach for health care management: John Wiley & Sons; 2021.
5. Burlea-Schiopoiu A, Ferhati K. The Managerial Implications of the Key Performance Indicators in Healthcare Sector: A Cluster Analysis. Healthcare [Internet]. 2021; 9(1).
6. Jardim SVB. The Electronic Health Record and its Contribution to Healthcare Information Systems Interoperability. Procedia Technology. 2013;9:940-8.
7. Esmaeilzadeh P, Sambasivan M, Kumar N, Nezakati H. Adoption of clinical decision support systems in a developing country: Antecedents and outcomes of physician's threat to perceived professional autonomy. International journal of medical informatics. 2015 Aug 1;84(8):548-60.
8. Das SR, Zahra SA, Warkentin ME. Integrating the Content and Process of Strategic MIS Planning with Competitive Strategy. Decision Sciences. 1991;22(5):953-84.
9. Cristancho SM, Hodgson AJ, Pachev G, Nagy A, Panton N, Qayumi K. Assessing cognitive & motor performance in minimally invasive surgery (MIS) for training & tool design. Studies in health technology and informatics. 2006;119:108-13.
10. Hughes RG. Tools and strategies for quality improvement and patient safety. Patient safety and quality: An evidence-based handbook for nurses. 2008.
11. David M, Bayobuya P, Wuletaw C, Samson M, Greatjoy M, Evans S, et al. Implementing an Integrated Pharmaceutical Management Information System for Antiretrovirals and Other Medicines: Lessons From Namibia. Global Health: Science and Practice. 2018;6(4):723.
12. Smith S, Winchester D, Bunker D, Jamieson R. Circuits of Power: A Study of Mandated Compliance to an Information Systems Security "De Jure" Standard in a Government Organization. MIS Quarterly. 2010;34(3):463-86.
13. Akhlaq A, McKinstry B, Muhammad KB, Sheikh A. Barriers and facilitators to health information exchange in low- and middle-income country settings: a systematic review. Health Policy and Planning. 2016;31(9):1310-25.
14. Detmer DE. Building the national health information infrastructure for personal health, health care services, public health, and research. BMC Medical Informatics and Decision Making. 2003;3(1):1.
15. Jain AN, editor Evolution of Service Quality and Some Implications on Computer Science Research. 2011 Annual SRII Global Conference; 2011 29 March-2 April 2011.
16. Fitzmaurice JM, Adams K, Eisenberg JM. Three Decades of Research on Computer Applications in Health Care: Medical Informatics Support at the Agency for Healthcare Research and Quality. Journal of the American Medical Informatics Association. 2002;9(2):144-60.
17. Sadoughi F, Khodaveisi T, Ahmadi H. The used theories for the adoption of electronic health record: a systematic literature review. Health and Technology. 2019;9(4):383-400.

18. Berner ES, Detmer DE, Simborg D. Will the Wave Finally Break? A Brief View of the Adoption of Electronic Medical Records in the United States. Journal of the American Medical Informatics Association. 2005;12(1):3-7.
19. Aldosari B. User acceptance of a picture archiving and communication system (PACS) in a Saudi Arabian hospital radiology department. BMC Medical Informatics and Decision Making. 2012;12(1):44.
20. Alhajeri M, Shah SGS. Limitations in and Solutions for Improving the Functionality of Picture Archiving and Communication System: an Exploratory Study of PACS Professionals' Perspectives. Journal of Digital Imaging. 2019;32(1):54-67.
21. Ware P, Shah A, Ross HJ, Logan AG, Segal P, Cafazzo JA, Szacun-Shimizu K, Resnick M, Vattaparambil T, Seto E. Challenges of telemonitoring programs for complex chronic conditions: randomized controlled trial with an embedded qualitative study. Journal of Medical Internet Research. 2022 Jan 26;24(1):e31754.
22. Tan JKH. Health management information systems: Methods and practical applications: Jones & Bartlett Learning; 2001.
23. Gebre-Mariam M, Bygstad B. Digitalization mechanisms of health management information systems in developing countries. Information and Organization. 2019;29(1):1-22.
24. Bender D, Sartipi K, editors. HL7 FHIR: An Agile and RESTful approach to healthcare information exchange. Proceedings of the 26th IEEE International Symposium on Computer-Based Medical Systems; 2013, 20-22 June 2013.
25. Chen JQ, Benusa A. HIPAA security compliance challenges: The case for small healthcare providers. International Journal of Healthcare Management. 2017;10(2):135-46.
26. Ravichandran T, Rai A. Quality Management in Systems Development: An Organizational System Perspective. MIS Quarterly. 2000;24(3):381-415.
27. Martin JL, Murphy E, Crowe JA, Norris BJ. Capturing user requirements in medical device development: the role of ergonomics. Physiological Measurement. 2006;27(8):R49.
28. Thompson TG, Brailer DJ. The decade of health information technology: delivering consumer-centric and information-rich health care. Washington, DC: US Department of Health and Human Services. 2004.
29. Tsirintani M. A Base Plan for Tomorrow's Patient Care Information Systems. International Journal of Medical and Health Sciences. 2014;8(9):540-3.
30. Marcos S, Artal P, Atchison DA, Hampson K, Legras R, Lundström L, et al. Adaptive optics visual simulators: a review of recent optical designs and applications [Invited]. Biomed Opt Express. 2022;13(12):6508-32.
31. Rada R. Information systems and healthcare enterprises: IGI Global; 2007.
32. English PF. Safety performance in a lean environment: a guide to building safety into a process: CRC Press; 2011.
33. Cohen B, Vawdrey DK, Liu J, Caplan D, Furuya EY, Mis FW, et al. Challenges Associated With Using Large Data Sets for Quality Assessment and Research in Clinical Settings. Policy, Politics, & Nursing Practice. 2015;16(3-4):117-24.
34. Staggers N, Thompson CB, Snyder-Halpern R. History and Trends in Clinical Information Systems in the United States. Journal of Nursing Scholarship. 2001;33(1):75-81.
35. Tabrizi JS, Gharibi F, Wilson AJ. Advantages and Disadvantages of Health Care Accreditation Mod-els. Health promotion perspectives. 2011;1(1):1-31.
36. Collen MF, Slack WV, Bleich HL. Medical Databases and Patient Record Systems. In: Collen MF, Ball MJ, editors. The History of Medical Informatics in the United States. London: Springer London; 2015. p. 207-88.
37. Tseng P, Kaplan RS, Richman BD, Shah MA, Schulman KA. Administrative Costs Associated With Physician Billing and Insurance-Related Activities at an Academic Health Care System. JAMA. 2018;319(7):691-7.
38. Farber HJ, Schatz M. Health Plan Employer Data and Information Set (HEDIS®) Criteria to Determine the Quality of Asthma Care in Children. Disease Management & Health Outcomes. 2007;15(5):279-87.
39. Wagenaar BH, Hirschhorn LR, Henley C, Gremu A, Sindano N, Chilengi R, et al. Data-driven quality improvement in low-and middle-income country health systems: lessons from seven years of

implementation experience across Mozambique, Rwanda, and Zambia. BMC health services research. 2017;17(3):830.
40. Friedman MM. ORYX: The Next Evolution in Acccreditation: ORYX: The Next Evolution in Accreditation. Home Healthcare Now. 1998;16(4).
41. Sim K, Huak Chan Y, Chong PN, Chua HC, Wen Soon S. Psychosocial and coping responses within the community health care setting towards a national outbreak of an infectious disease. Journal of Psychosomatic Research. 2010;68(2):195-202.
42. Shi J, Jiang C, Tan D, Yu D, Lu Y, Sun P, et al. Advancing Implementation of Evidence-Based Public Health in China: An Assessment of the Current Situation and Suggestions for Developing Regions. BioMed Research International. 2016;2016:2694030.
43. Bardosh KL, Ryan SJ, Ebi K, Welburn S, Singer B. Addressing vulnerability, building resilience: community-based adaptation to vector-borne diseases in the context of global change. Infectious Diseases of Poverty. 2017;6(1):166.
44. Chapman KA, Moulton AD. The Georgia Information Network for Public Health Officials (INPHO): A Demonstration of the CDC INPHO Concept. Journal of Public Health Management and Practice. 1995;1(2).
45. Plough AL. Knowledge to action: accelerating progress in health, well-being, and equity: Oxford University Press; 2017.
46. Friede A, Reid JA, Ory HW. CDC WONDER: a comprehensive on-line public health information system of the Centers for Disease Control and Prevention. American Journal of Public Health. 1993;83(9):1289-94.
47. Stephens RC, Kaye RS, Chen H. Establishing a Target Cities Model in Cleveland. Journal of Psychoactive Drugs. 1999;31(3):219-24.
48. Pemble KR. Regional health information networks: the Wisconsin Health Information Network, a case study. Proceedings Symposium on Computer Applications in Medical Care. 1994:401-5.
49. Haugh R. CONFRONTING HIPAA. H&HN Hospitals & Health Networks. 2000 2000/03//:58.
50. Neuss MN, Steffel RC. Cincinnati's HealthBridge: Bringing Results From Multiple Service Locations to One Record. Journal of oncology practice. 2006;2(4):181-4.
51. Argaw ST, Troncoso-Pastoriza JR, Lacey D, Florin M-V, Calcavecchia F, Anderson D, et al. Cybersecurity of Hospitals: discussing the challenges and working towards mitigating the risks. BMC Medical Informatics and Decision Making. 2020;20(1):146.
52. Ferranti JM, Langman MK, Tanaka D, McCall J, Ahmad A. Bridging the gap: leveraging business intelligence tools in support of patient safety and financial effectiveness. Journal of the American Medical Informatics Association. 2010;17(2):136-43.
53. Weber RH. Internet of Things – New security and privacy challenges. Computer Law & Security Review. 2010;26(1):23-30.
54. Herath T, Rao HR. Protection motivation and deterrence: a framework for security policy compliance in organisations. European Journal of Information Systems. 2009;18(2):106-25.
55. Hoerbst A, Ammenwerth E. Electronic health records. Methods of information in medicine. 2010;49(04):320-36.
56. Elahi A, Dako F, Zember J, Ojetayo B, Gerus DA, Schweitzer A, et al. Overcoming Challenges for Successful PACS Installation in Low-Resource Regions: Our Experience in Nigeria. Journal of Digital Imaging. 2020;33(4):996-1001.
57. Castaneda C, Nalley K, Mannion C, Bhattacharyya P, Blake P, Pecora A, et al. Clinical decision support systems for improving diagnostic accuracy and achieving precision medicine. Journal of Clinical Bioinformatics. 2015;5(1):4.
58. Wu Z, Trigo V. Impact of information system integration on the healthcare management and medical services. International Journal of Healthcare Management. 2021;14(4):1348-56.
59. Hains IM, Georgiou A, Westbrook JI. The impact of PACS on clinician work practices in the intensive care unit: a systematic review of the literature. Journal of the American Medical Informatics Association. 2012;19(4):506-13.
60. Paré G, Trudel M-C. Knowledge barriers to PACS adoption and implementation in hospitals. International Journal of Medical Informatics. 2007;76(1):22-33.
61. França RP, Monteiro ACB, Arthur R, Iano Y. Chapter 5 - An overview of the impact of PACS as health informatics and technology e-health in healthcare management. In: Zhang Y-D, Sangaiah AK,

editors. Cognitive Systems and Signal Processing in Image Processing: Academic Press; 2022. p. 101-28.
62. Strickland NH. Some cost-benefit considerations for PACS: a radiological perspective. British Journal of Radiology. 1996;69(828):1089-98.
63. Siegel EL, Reiner BI, Knight N. Reengineering Workflow: The Radiologist'S Perspective. In: Dreyer KJ, Thrall JH, Hirschorn DS, Mehta A, editors. PACS: A Guide to the Digital Revolution. New York, NY: Springer New York; 2006. p. 97-123.
64. Pilares IC, Azam S, Akbulut S, Jonkman M, Shanmugam B. Addressing the challenges of electronic health records using blockchain and ipfs. Sensors. 2022 May 26;22(11):4032.
65. Kawamoto K, Lobach DF, Willard HF, Ginsburg GS. A national clinical decision support infrastructure to enable the widespread and consistent practice of genomic and personalized medicine. BMC Medical Informatics and Decision Making. 2009;9(1):17.
66. Rahal RM, Mercer J, Kuziemsky C, Yaya S. Factors affecting the mature use of electronic medical records by primary care physicians: a systematic review. BMC Med Inform Decis Mak. 2021;21(1):67. Published 2021 Feb 19. doi:10.1186/s12911-021-01434-9.
67. Xie R, Khalil I, Badsha S, Atiquzzaman M. Fast and peer-to-peer vital signal learning system for cloud-based healthcare. Future Generation Computer Systems. 2018;88:220-33.
68. Ali MS, Vecchio M, Putra GD, Kanhere SS, Antonelli F. A Decentralized Peer-to-Peer Remote Health Monitoring System. Sensors [Internet]. 2020; 20(6).
69. Hou W, Jiang Y, Lei W, Xu A, Wen H, Chen S. A P2P network based edge computing smart grid model for efficient resources coordination. Peer-to-Peer Networking and Applications. 2020;13(3):1026-37.
70. Andriopoulou FG, Birkos K, Lymberopoulos D. P2Care: A dynamic peer-to-peer network for collaboration in personalized healthcare service delivery. Computers in Industry. 2015;69:45-60.
71. Adane A, Adege TM, Ahmed MM, Anteneh HA, Ayalew ES, Berhanu D, et al. Routine health management information system data in Ethiopia: consistency, trends, and challenges. Global health action. 2021;14(1):1868961.
72. Adane A, Adege TM, Ahmed MM, Anteneh HA, Ayalew ES, Berhanu D, et al. Routine health management information system data in Ethiopia: consistency, trends, and challenges. Global health action. 2021;14(1):1868961.
73. Moreno A, Moreno J, González V, Salas S, Segura C, de Luque V, et al. GeoHealth: Geographic Information System for Health Management and Clinical, Epidemiological and Translational Research. Studies in health technology and informatics. 2022;290:1084-5.
74. Mboera LEG, Rumisha SF, Mbata D, Mremi IR, Lyimo EP, Joachim C. Data utilisation and factors influencing the performance of the health management information system in Tanzania. BMC health services research. 2021;21(1):498.
75. Krishnan A, Nongkynrih B, Yadav K, Singh S, Gupta V. Evaluation of computerized health management information system for primary health care in rural India. BMC health services research. 2010;10:310.
76. Moukénet A, de Cola MA, Ward C, Beakgoubé H, Baker K, Donovan L, et al. Health management information system (HMIS) data quality and associated factors in Massaguet district, Chad. BMC Medical Informatics and Decision Making. 2021;21(1):326.
77. Omer MK. The Contribution of Health Management Information Systems to Enhancing Healthcare Operations. 2021; 2: 3241
78. Sittig DF, Wright A, Coiera E, Magrabi F, Ratwani R, Bates DW, et al. Current challenges in health information technology-related patient safety. Health informatics journal. 2020;26(1):181-9.
79. Shen Y-C. The effect of financial pressure on the quality of care in hospitals. Journal of Health Economics. 2003;22(2):243-69.
80. Jalghoum YA. Drivers, Challenges and Recommendations to E-Health Development: A Case Study of Jordan: The University of Manchester (United Kingdom); 2015.
81. Diallo CO, Schiøler KL, Samuelsen H, Drabo KM. Information System as part of epidemic management in Burkina Faso: from plan to reality (Field Findings). BMC public health. 2022;22(1):1726.

82. Kim K, Choi JS, Choi E, Nieman CL, Joo JH, Lin FR, et al. Effects of Community-Based Health Worker Interventions to Improve Chronic Disease Management and Care Among Vulnerable Populations: A Systematic Review. American Journal of Public Health. 2016;106(4):e3-e28.
83. Desai AN, Kraemer MUG, Bhatia S, Cori A, Nouvellet P, Herringer M, et al. Real-time Epidemic Forecasting: Challenges and Opportunities. Health Security. 2019;17(4):268-75.
84. Gomes J, Romão M. Information System Maturity Models in Healthcare. Journal of Medical Systems. 2018;42(12):235.
85. Sahu M, Gupta R, Ambasta RK, Kumar P. Chapter Three - Artificial intelligence and machine learning in precision medicine: A paradigm shift in big data analysis. In: Teplow DB, editor. Progress in Molecular Biology and Translational Science. 190: Academic Press; 2022. p. 57-100.
86. Kuziemsky CE, Peyton L. A framework for understanding process interoperability and health information technology. Health Policy and Technology. 2016;5(2):196-203.
87. Malathi V, Kavitha V. Innovative Services Using Cloud Computing in Smart Health Care. In: Tyagi AK, Abraham A, Kaklauskas A, editors. Intelligent Interactive Multimedia Systems for e-Healthcare Applications. Singapore: Springer Singapore; 2022. p. 59-80.
88. Mishra DK, Yang XS, Unal A, editors. Data Science and Big Data Analytics: ACM-WIR 2018. Springer; 2018 Aug 1.
89. Guha S, Kumar S. Emergence of Big Data Research in Operations Management, Information Systems, and Healthcare: Past Contributions and Future Roadmap. Production and Operations Management. 2018;27(9):1724-35.
90. Vasey B, Ursprung S, Beddoe B, Taylor EH, Marlow N, Bilbro N, et al. Association of Clinician Diagnostic Performance With Machine Learning–Based Decision Support Systems: A Systematic Review. JAMA Network Open. 2021;4(3):e211276-e.
91. Collen MF, Hammond WE. Development of Medical Information Systems (MISs). In: Collen MF, Ball MJ, editors. The History of Medical Informatics in the United States. London: Springer London; 2015. p. 123-206.
92. Wang Y, Wang L, Rastegar-Mojarad M, Moon S, Shen F, Afzal N, et al. Clinical information extraction applications: A literature review. Journal of Biomedical Informatics. 2018;77:34-49.
93. Salem AB, editor. Innovative smart healthcare and bio-medical systems: AI, intelligent computing and connected technologies. CRC Press; 2020 Dec 27.
94. Ahmed RAA, Al-Bagoury HYHE. Artificial Intelligence in Healthcare Enhancements in Diagnosis, Telemedicine, Education, and Resource Management. Journal of Contemporary Healthcare Analytics. 2022;6(12):1-12.
95. Kafi MA, Adnan T. Machine Learning in Accounting Research: A Computational Power to Wipe Out the Challenges of Big Data. Asian Accounting and Auditing Advancement. 2020;11(1):55-70.
96. Thomas Craig KJ, Fusco N, Gunnarsdottir T, Chamberland L, Snowdon JL, Kassler WJ. Leveraging Data and Digital Health Technologies to Assess and Impact Social Determinants of Health (SDoH): a State-of-the-Art Literature Review. Online journal of public health informatics. 2021;13(3):E14.
97. Fuller A, Fan Z, Day C, Barlow C. Digital twin: Enabling technologies, challenges and open research. IEEE access. 2020 May 28;8:108952-71.
98. Shah JL, Bhat HF, Khan AI. Integration of cloud and IoT for smart e-healthcare. InHealthcare paradigms in the internet of things ecosystem 2021 Jan 1 (pp. 101-136). Academic Press.
99. Sultan N. Making use of cloud computing for healthcare provision: Opportunities and challenges. International Journal of Information Management. 2014;34(2):177-84.
100. Shanmugasundaram G, Thiyagarajan P, Janaki A, editors. A Survey of Cloud Based Healthcare Monitoring System for Hospital Management. Proceedings of the International Conference on Data Engineering and Communication Technology; 2017 2017//; Singapore: Springer Singapore.
101. Bhamare D, Zolanvari M, Erbad A, Jain R, Khan K, Meskin N. Cybersecurity for industrial control systems: A survey. Computers & Security. 2020;89:101677.
102. Arora D, Gupta S, Anpalagan A. Evolution and Adoption of Next Generation IoT-Driven Health Care 4.0 Systems. Wireless Personal Communications. 2022;127(4):3533-613.
103. Khalique F, Khan SA, Nosheen I. A Framework for Public Health Monitoring, Analytics and Research. IEEE Access. 2019;7:101309-26.

104. Ahmed Z, Mohamed K, Zeeshan S, Dong X. Artificial intelligence with multi-functional machine learning platform development for better healthcare and precision medicine. Database. 2020;2020:baaa010.
105. Cancela J, Charlafti I, Colloud S, Wu C. Digital health in the era of personalized healthcare: opportunities and challenges for bringing research and patient care to a new level. Digital Health. 2021 Jan 1:7-31.
106. Javaid M, Haleem A, Singh RP, Rab S, Suman R, Khan IH. Evolutionary trends in progressive cloud computing based healthcare: Ideas, enablers, and barriers. International Journal of Cognitive Computing in Engineering. 2022;3:124-35.
107. Sahay S. Big data and public health: Challenges and opportunities for low and middle income countries. Communications of the Association for Information Systems. 2016;39(1):20.