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Exploring the Trend of Technology Use and Innovation in Health Care Service in Hospitals through a Bibliometric Analysis

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Abstract

Background: Information technology innovation is needed in various fields, including health. In the health sector, technological innovations can be applied to patient care, hospital management and research. Technological innovation can be applied to various hospital activities, from patient data collection to cleaning staff activities. Various innovations are needed to simplify health service activities to make services more effective and efficient.

The purpose of the study was to explore the trend of technology use and innovation in health care services in hospitals by analyzing network visualization, overlay visualization, and density visualization on the topic through bibliometric analysis.

Main body: In this research, bibliometric analysis was used. Records were identified through a database search at https://app.dimensions.ai/. The data obtained was then selected further by the PRISMA flow diagram. Papers were limited to publication years 2020-2023. The publication type is the article only, on the other hand, book chapters, thesis and proceeding publications are excluded. Data were analyzed using VOSviewer, and then reviewed by co-occurrence and co-authors.

From the network visualization, it was identified that there were 199 items divided into 8 clusters with 9,504 links with a total link strength of 54,785. After identifying the clusters, the trends of technology use and innovation in health care services in hospitals were artificial intelligence, digital health technology, electronic health records, health information technology, smart health, telemedicine, virtual care, communication technology, electronic medical records and health care delivery.

From the overlay visualization, it was indicated that the newest topics that were widely researched related to this theme were digital health service, digital transformation, digital health technology, digital tools, and telehealth service.

From density visualization, it was indicated that topics that were rarely researched related to trends of technology use and innovation in healthcare services in hospitals were communication technology, healthcare organizations, and digital solutions.

Conclusion: Technological developments have had a major impact on improving the quality of services in hospitals. Health professionals need to develop and improve their competencies so that they can continue to keep up with current technological developments and innovations.

Keywords: Technology, Innovation, Hospitals, Bibliometric Analysis

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Background

Hospitals have various complexities as health service facilities from every dimension including, situational complexity, system complexity, and medical complexity (1, 2). The use of technology and innovation need to be used in hospitals to improve the quality of service to patients (3, 4). Technology plays an important role in supporting the entire service process. Technology is needed to integrate all services in hospitals so that they are comprehensive, and integrated further also facilitate administrative processes, finances, and clinical aspects of hospitals and health service facilities. Those elements are an important focus as a basis for providing care for patients (5, 6, 7). The complexity of providing care in hospitals is increasing in the face of various government regulations and the national health insurance system which are continuously being updated to achieve the best quality of care for patients (8, 9, 10). This gives rise to complexity in terms of the system, namely related to the patient administration process in health services, with the existence of technology and innovation integrating the system becomes easier to minimize the negative impact of this complexity, and can improve the quality of care for patients to achieve patient satisfaction (11, 12).

Barriers to health services in the form of uncertainty in the patient care process are related to the complexity of the hospital, especially the relationship between services and hospital capacity which is unable to properly process information regarding the patient's condition and all services in the hospital because the system is not integrated (13, 14). Other fundamental problems relate to a lack of expertise in using computers, and the complexity of tasks and functions as well as ethical issues such as certification, security, privacy and confidentiality (15). Technology has the potential to improve individual health and the performance of health service providers and minimize costs, with these improvements, improving the quality of hospitals. There are many benefits to implementing technology and innovation in health services, especially hospitals. The studies show that current technology is capable of increasing access to information, increasing the productivity of health service professionals, increasing efficiency and accuracy, improving the quality of health services, improving clinical management in terms of patient diagnosis and treatment, reducing the cost of paper for medical records, minimizing errors. medical care, improving patient safety, improving patient care outcomes and increasing patient satisfaction (6,16, 17, 18, 19).

Researchers consider it important to collect information regarding the extent of technological developments that have been developed by researchers and industry for hospitals. Currently, no study has researched this area. Thus, the purpose of the study was to explore the trend of technology use and innovation in health care services in hospitals by analyzing network visualization, overlay visualization, and density visualization on the topic through bibliometric analysis

Main body

Design

The measurement study analysis used in this study is bibliometric. Bibliometric analysis is a quantitative method found in a journal and is also more suitable for searching for terms and keywords in determining research trends. In addition, bibliometric analysis is a research method used in library and information science to evaluate research performance (20, 21).

Data Sources

The data sources used in this study are based on online searches via https://app.dimensions.ai/. Data was collected on November 28, 2023. The literature search used the stages following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (22).

Inclusion criteria of articles

Paper restricted to publications years 2020-2023, focusing on the fields of health science, biomedical and clinical science, health services and systems, clinical science, and nursing. The publication type is the article only, on the other hand, book chapters, thesis and proceeding publications are excluded.

Selecting data

Data selection was carried out using the stages in PRISMA including identification, filtering, and inclusion as shown in Figure 1. Stage 1 (Identification) detects 658,098 articles from https:app.dimensions.ai/, taking into account, each of the main search terms (Technology use AND innovation AND health care service AND hospital), “article document type” and “all published data ranges from 2020 to 2023. In stage 2 (screening), the option “title, article, abstract” was selected in the field of each search term, resulting in 80,610 articles. In stage 3 (included), the final sample yielded 654,60 articles. The process details are shown in Figure 1 below:

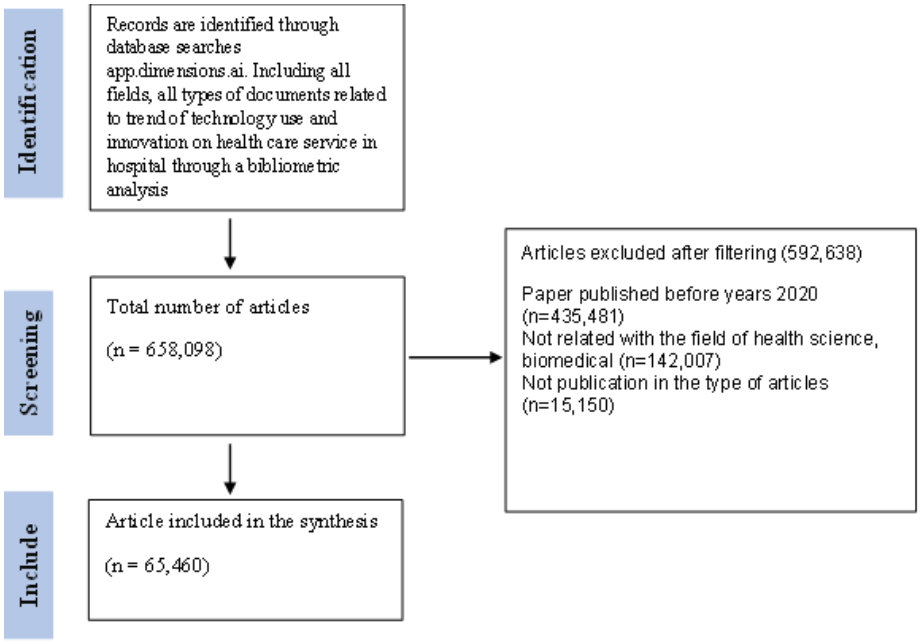

Figure 1. PRISMA Flowchart

Data Analysis

Data were analyzed using VOSviewer. VOSviewer is a software tool for building and visualizing bibliometric networks. These networks can include individual journals, researchers, or publications, and all of these can be obtained by citation, bibliographical merge, co-citation, or co-author links. VOSviewer also offers text mining functionality which can be used to build and visualize co-occurrence networks of key terms extracted from collections of scientific literature. The analysis type is selected to create maps based on text data. In this study, analyses were reviewed by co-occurrence and co-authors.

Co-occurrence procedures

The co-occurrence analysis procedure goes through several steps, namely selecting the data source, and reading data from the reference manager file. Select "Fields from which terms will be extracted", and click "title and abstract fields", check "ignore structured abstract labels and ignore copyright statements", then select the calculation method "full counting". The minimum threshold for the appearance of a selected term is 10, click "Next" then click "Number of terms to be selected: 199".

Co-author procedures

The co-author's analysis procedure goes through the following stages: Selecting the type of data: create a map based on bibliographic data". Next, select the data source "Read data from references manager files". Select a file type that RIS supports. Select the analysis type and calculation method: co-authorship analysis type and full calculation method. Select "Choose the type of analysis and calculating method". Click "co-authorship" as the type of analysis and click "full counting" as the counting method. Select "Maximum number of authors" per document as 25. Of the 2,763 authors, 14 met the threshold. Select an author for each of the 14 authors. Total co-author links with other authors were included. Authors with total spread links will be selected. After verification, the number of authors is 14.

Results

Network visualization of the trend of technology use and innovation on health care service in hospital concept in publications

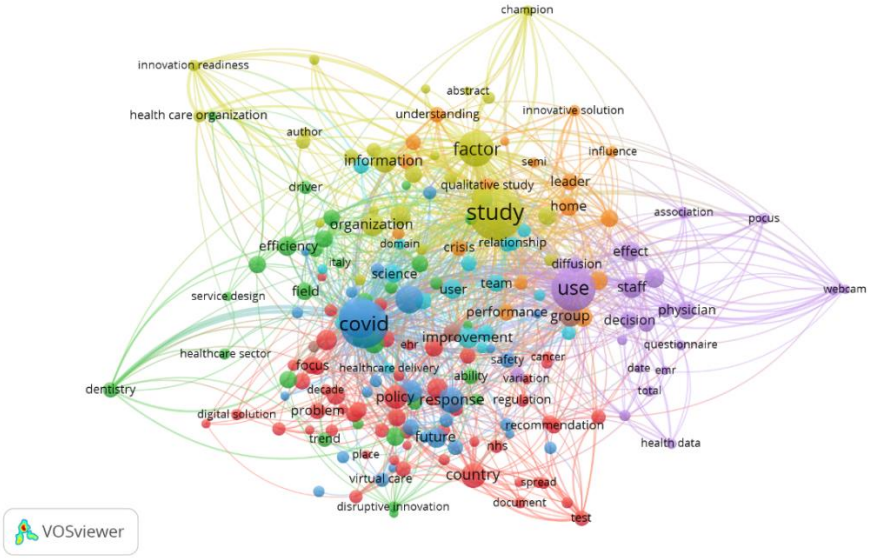

Figure 2: Network visualization (sources: VOS viewer)

In Figure 2, it was identified that there were 199 items divided into 8 clusters with a total of links of 9,504 with a total link strength of 54,785. After identifying the clusters, the trends of technology use and innovation in health care services in hospitals were Artificial Intelligence, digital health technology, electronic health records, health information technology, smart health, telemedicine, virtual care, communication technology, electronic medical records and health care delivery

Overlay visualization of the trend of technology use and innovation on health care service in hospital concept in publications

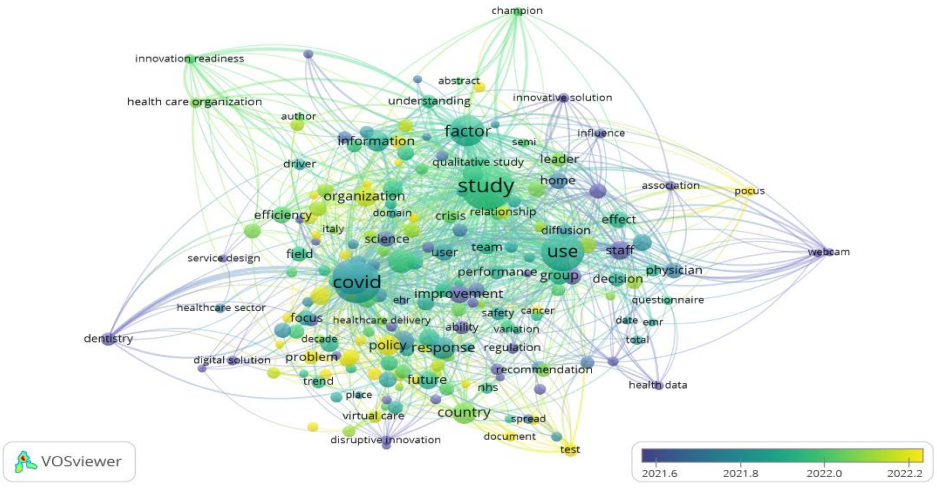

Figure 3: Overlay visualization (sources: VOSviewer)

In Figure 3, it was indicated that the newest topics that were widely researched related to the trend of technology use and innovation in health care service in hospitals were digital health service, digital transformation, digital health technology, digital tools, and telehealth service.

Density visualization of the trend of technology use and innovation on health care service in hospital concept in publications

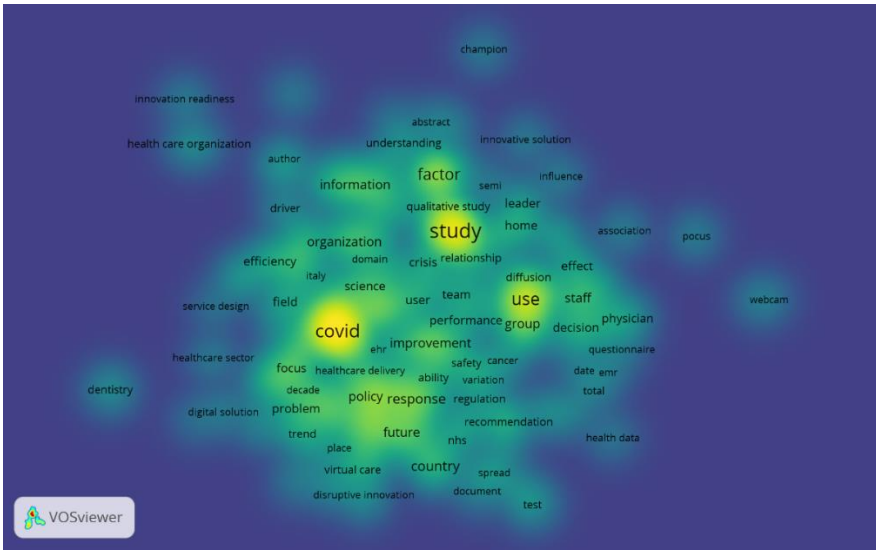

Figure 4: Overlay visualization (sources: VOS viewer)

In Figure 4, it was indicated that topics that were rarely researched related to trends of technology use and innovation in healthcare services in hospitals were communication technology, healthcare organizations, and digital solutions.

Discussion

Artificial Intelligence

The potential of Artificial Intelligence (AI) in healthcare and life sciences is enormous. AI has the potential to help doctors and researchers prevent disease, speed up recovery, and save lives by unlocking complex data (23, 24). AI can also free them from monotonous tasks, so they can focus on patients or research (25).

Artificial intelligence or AI is a branch of computer science that creates machines within the computer, later these machines can do work by themselves without being regulated by a programmer (26). The role of the programmer is indeed important when it comes to AI, where the programmer only ensures that the AI runs without being monitored continuously. Computer science has many branches, but unlike AI, this branch can do everything that humans do (27).

AI technology has not been distributed to all countries, particularly to developing countries. There is a common need for health services by the community, presenting technology as an effort to make activities easier (28). New media in the form of digital-based health applications or digital health is one of the technologies that emerge from the social construction of technology in answering social problems in the health aspect. Digital health provides digital information about health, online consultations, online pharmacies, booking doctor's appointments at various hospitals that are equally affordable for all levels of society (29).

One of the advances in information technology has penetrated the health sector. The use and utilization of this technology is one of the right solutions for solving public service problems. At least using this will overcome geographical, time and socio-economic problems (30).

Digital health technology

There is no doubt that the health sector is currently entering an era of disruption. Patients can now consult doctors through various mobile applications. Home care services, laboratory tests and medication orders can also be done via mobile applications, integrated with online transportation services (31, 32). Increasingly, advanced digital technology has been utilized by health facilities to increase effectiveness, and efficiency and improve the quality of services. Several hospitals have implemented an integrated electronic decision support system in an electronic medical record to assist doctors in making more precise therapeutic decisions according to clinical guidelines through electronic prescribing (33).

Digital Health is a phenomenon that is increasingly developing in the world of health (34). Digital health is defined as a cultural transformation regarding how technology provides digital and objective data that can be accessed by both health workers and patients, towards an equal doctor-patient relationship with shared decision-making and the democratization of care. Various hardware and software revolutions, such as new medical devices and internet access, make it easier for anyone to obtain information (31, 32, 35).

This not only increases the opportunity to improve the quality and quantity of information but also encourages opportunities for self-care. In traditional health systems, patients are less

involved in decision making so patients become more dependent on health workers (31). Patients, however, are beginning to seek second opinions and to be more involved in decision-making, involve other health professionals and gather information from other patients before making a decision. Health workers are expected to be able to answer various medical and technology-related questions that can be easily accessed (33).

In implementing technology in health services, it is important to pay attention to the human component and not just the technology itself. Some studies involving health sensors to encourage behavioural change in patients do not involve training in understanding and using the technology (34, 36). One example is when patients are given access to obtain Hemoglobin A1c or blood pressure test results via the web, but are not given prior training, there is a possibility that they will later experience problems during the registration process or have difficulty understanding the tools provided to access health data or information. When patients are trained and given a better understanding, the technology will be more beneficial to patients (32, 34).

One of the problems faced in the digital era is that policies related to health technology are not yet clear, this is believed to be one of the reasons why the use of digital health is not yet optimal. This is no different from the challenges related to digital health globally. Policies related to technology are also important when sensitive data owned by patients has the possibility of being accessed by other health professionals and the risk of genetic discrimination may appear to the Genetic Non-Discrimination Act in the United States which is expected to protect patients from companies involved in collecting data regarding examination results (37, 38). Genetic information will be dangerous if it can be accessed by other people. Another challenge related to digital health is information from digital health tools or unreliable online sources which can then be misinterpreted if professional health workers are not involved and can harm patients (37, 39).

Electronic health records

Developed countries have long considered the need for information systems that contain public health records. The purpose of using EHR (electronic health records) is to store patient data, improve public health, and use data to improve the health service system for the community (40, 41). Documenting client health records is one of the most important aspects of providing health care in the healthcare area. One area of health services that requires accurate documentation is nursing services. Nursing documentation is proof that the nurse's legal & ethical responsibilities towards the client have been fulfilled and that the client has received quality nursing care (42, 43).

The development of information technology and health technology as well as the high demand from society for better quality health services requires the use of technological advances, including the development of an information technology-based health documentation system (40). Electronic health records are collected primarily to be managed for individual health services and are also used to monitor potential population health. Doctors, nurses, pharmacists and public health as health service providers need public health data to identify and create health programs. EHRs have many benefits, namely, the data obtained is more detailed, preventing delays, structured data, and providing information in real-time. Other benefits include improving patient safety and facilitating communication between health professionals and in the long term, it can be used as disease prevalence survey data (44).

Health information

The increasing number of people who are currently receiving treatment at several health service agencies makes it important to have integrated health information so that it allows someone to continue the health examination process in other cities and even abroad, so there is a need for Health Information Management (HIM) activities (45). The idea of managing patient health information is not something new, many health service agencies have started to manage patient health information by storing data on laboratory results, archives regarding treatment and so on, but this data is only managed by each agency in the form of conventional paper-based records (33).

Current technological developments have made many contributions to improving the health services provided to patients more effectively (46). Including health information management activities, several health service agencies are starting to implement electronic health information systems so that patient health data can be managed more effectively. Several hospitals have also transferred patient health data media from paper to digital format. They also began creating Electronic Health Records (EHR) records that contain patient demographic data, medical and medication history, diagnostic information, vital signs, medical history, laboratory data, and radiology reports. What is unfortunate is that this information is not yet open for access by other health service institutions, because the system for managing patient health

information is only carried out independently, at each health service institution (45, 46).
Health Information Management (HIM) aims to collect, store and make patient health information available and easy to access when needed so that the HIM can help health service workers provide better health services to patients. On this basis, having integrated management of patient health information is important, to facilitate several medical service providers in exchanging and sharing patient health information (45).

SmartHealth
The application of smart health involves the latest developments in information and communication technology that support medical services. Utilization of technology information and communication needs a policy with wide flexibility to adapt to various needs and opportunities changed with consideration of strong protection to protect privacy, data security, and equality of health. The objective of the development of information and communication technologies is to improve efficiency and sustainability in the application of smart health (47, 48).
The application of smart health can be applied to both home and hospital medical services. Smart health in the application at home can be developed as an early diagnosis or help activity in daily life at home. Smart health within hospital health services makes hospitals intelligent so that they can influence health and medical policies and create new medical values by defining and measuring quantitatively with detailed indicators (4, 49).
The services provided by smart hospitals are based on digital health which aims to increase the number of people who are accessible, accessible, flexible, organized, responsive, and able to provide comprehensive care. Smart health is strongly influenced by policy either by the government or developer, consolidation interdisciplinary, and participation from industry to encourage and facilitate smart health (4).

Telemedicine
Telemedicine can contribute to the development of medical services in a new way of medical consultation and can continue to evolve as the times evolve. Telemedicine has a weakness in that is not effective in maintenance; taking care stays or special units. Telemedicine works as a diagnostic, therapeutic and educational facility (50, 51). Telemedicine is an innovation that has the advantages of facilitating access to medical services and providing more affordable treatment. Telemedicine is a major modality in the provision of services with wide reach and flexibility in healthcare. Telemedicine is influenced by several factors including image, decision autonomy, perception interaction with patients, and technological factors (52). The results of Diaka's research, in 2021 suffered barriers to the application of telemedicine especially in remote villages in the participation in telemedicine by all stakeholders (53).

Virtual Care
Virtual care has the to provide services to socially and economically disadvantaged communities, centred on the user design of virtual-care technology, and the integration of repeated evaluations to ensure the desired outcomes efficiently (54, 55). Virtual care very much needs infrastructure innovations that will further promote health care and efficiency in the health system. Virtual care has benefits for conditions and emergencies such as COVID-19 and virtual care can be utilized for the development of medical services in the future. Virtual care has some shortcomings, among them is that it does not apply to all patients, health references and digital literacy are very much needed in virtual care activities so accuracy in patient selection greatly defines the success of virtual care (56, 57). Virtual care is included in the development in the world of health and sufficiently new in its implementation so that it requires greater infrastructure support, long-term subsidy, opportunities and education, and improved quality of work. Virtual care is greatly influenced by 4 factors namely, the well-being of patients, accessibility, resources power, and infrastructure (58, 59).

Communication technology
The birth of the internet can create innovation in various areas of life, even this digital technology is widely used for communication. The emergence of various types of communication media has become digital technology which makes it easier for people to obtain information. Based on Sk Ios analysis from the Data Report, there were 204.7 million internet users in Indonesia in January 2022. Meanwhile, Indonesia's internet expansion reached 73.7% of the total population at the beginning of 2022. This figure has increased by 2.1 million or 1 % from 2021 to 2022 (60). The use of communication media, such as websites, is one of the most complete media as information media, there are Google and Chrome services available. This site is a medium for people looking for information about services at the hospital (61).
Using effective digital communication in hospital services will certainly get satisfaction from the public because all the information needed in the hospital can be easily accessed. The birth of communication technology can provide a bridge between the community and health workers (62,

63). However, the use of digital communications in the health sector cannot be utilized optimally due to several factors of use and implementation, availability of qualified resources and involvement of hospital institutions (63).

Electronic medical records

Currently, world technology is entering the era of revolution 4.0, which also has an impact on the world of health development, especially hospital digital information technology related to EMR (64). Currently, hospitals are being asked to make changes and innovations in all fields to keep up with the demands and needs of hospital consumers in the future (65). In one study, one effective form of communication was using EMR. Thus, nurses' perceptions of EMR implementation can positively improve patient safety culture However, it must also be ensured that the human resources who will operate the system can use the system according to procedures and standards so that they can improve health services and increase the quality and quantity of electronic-based nursing documentation which can streamline nurses' time on documentation (41).

Other benefits of EMR are: communication improved intra and interpersonal relationships between fellow medical personnel, such as interactions with patients, can directly affect patient safety such as the number of patient falls, patient injury incidents, drug safety and so on, can also identify risk factors for infection/sepsis, for example, urinary tract infections/UTIs related to use. The EMR function also helps improve routine monitoring in terms of disease management and long-term care for patients with chronic diseases in the treatment process (66).

Health care delivery

Health services are the totality of professional activities in the field of curative services for humans, or medical activities for the benefit of other people and the purposes of prevention (31, 67). Fulfilment of health services is not just about creating a good environment and receiving equal treatment but also includes improving health services in a humane manner that refers to the level of honour and dignity. A hospital is a health service institution that provides complete individual health services and also provides outpatient and emergency care. The task of a hospital as a health service institution is to provide quality and responsible health services to the community in its area. Meanwhile, the function of the hospital is to provide specialist or secondary medical services and subspecialist or tertiary medical services, therefore the main product of the hospital is the provision of medical health services (68).

In Health care delivery, resource management is an important component in providing quality health services today. The costs of providing quality services are increasing. High-tech treatments and diagnostic tests are now available and expensive (69, 70). Economic pressures have forced service providers to ensure that resources are well-managed, well used and not wasted. Clinical resources such as blood tests, X-rays and medications must be managed efficiently (71, 72).

Implication and Limitation

The Information we offer in this article might not be comprehensive because there may be some information missing from the analysis.

Conclusion

Currently, technological developments have had a major impact on improving the quality of service in hospitals. Artificial Intelligence, digital health technology, electronic health records, health information technology, smart health, telemedicine, virtual care, communication technology, electronic medical records and health care delivery are the popular technological improvements in health care services. Health professionals need to develop and improve their competencies so that they can continue to keep up with current technological developments and innovations.

List of Abbreviations

AI: Artificial Intelligence
HER: Electronic Health Records
HIM: Health Information Management

Declarations

Ethical Approval and Consent to Participate

None

Consent for publication

All the authors gave consent for the publication of the work under the Creative Commons Attribution- Non-Commercial 4.0 license.

Availability of data and materials

The data and materials associated with this research are available in the public domain.

Competing interests

No conflict of interest has been declared by the authors.

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Author contributions
All authors contributed to this research, Conceptualization, methodology and writing the original draft. Methodology writing review and editing was carried out by PS and WS. Formal analysis, investigation and validation, funding acquisition, writing, review, editing and project administration were carried out by SFB and ML. All authors read and agreed to the final version of the manuscript.

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