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Recent Advancement In Healthcare Management By Using Technology

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Abstract:

Recent advancements in healthcare management through the use of technology have revolutionized the way healthcare is delivered and managed. Here are some starting points to explore this topic: Information and communication technologies (ICT), Electronic Health Records (EHRs), Wearable Health Devices, and Big Data. Information and communication technologies (ICT) are being widely used in healthcare management systems. Rapid advancements in ICT provide solutions to the problems in healthcare management systems. Also, particular advances in the field of Information Technology (IT) are assisting in better management of health appointments and record management. With the proliferation of IT and management, data is now playing a vital role in diagnostics, drug administration, and management of healthcare services. Smart healthcare uses a new generation of information technologies, such as the Internet of Things (IoT), and big data, to transform the traditional medical system in an all-around way, making healthcare more efficient, more convenient, and more personalized. Advancements in Wearable Healthcare Devices have transformed the healthcare system by reducing hospital workload and giving more accurate and timely data. Wearable technology has made remarkable advancements in healthcare, and its future perspective is promising. By providing continuous monitoring, personalized insights, and remote patient management, wearables have the potential to improve healthcare outcomes, enhance preventive care, and contribute to population health management. Advanced healthcare sensors are used for the easy monitoring of patients. These technologies allow the monitoring and analysis of various health parameters in real-time. Electronic Health Records (EHRs) to the utilization of telemedicine, and wearable devices, technology has enabled healthcare professionals to provide better, more accessible, and more personalized care. As we move forward, it is crucial to strike a balance between the benefits of technology and the essential human element of care, all while addressing the associated challenges to ensure a bright and sustainable future for healthcare management.

Keywords: Information and communication technology (ICT), Wearable Health Devices, Internet of Things (IoT), Big Data

Introduction

Information and communication technologies (ICT) can be utilized to serve the broader objectives of raising the current standard of treatment and maximizing its efficacy. According to ICT, the quality of medical services offered to patients has significantly improved. Healthcare providers can now diagnose diseases more precisely, monitor patients more closely, and offer individualized treatment plans by using technology. Patients can access medical services remotely, which saves time and money. Overall, ICT has revolutionized the healthcare industry and has made it more efficient, effective, and patient-centric.[1] While patient engagement technologies increase patient involvement, they also raise questions about the accuracy of the data. The use of portable devices without password protection leaves the patient record open to privacy invasion.[2] Devices placed on the body or clothing are referred to as wearable devices.[3] Due to its capacity to gather real-time data, monitor patient status, and encourage proactive treatment, wearable health gadgets have grown in significance in the administration of healthcare. These gadgets can be utilized for a variety of tasks in the management of healthcare and come in a variety of shapes and sizes, including smartwatches, fitness trackers, and wearables of a high enough quality for medical usage. The need for modern technology to track critical data is growing daily to save maintain and quickly and efficiently monitor people's health. New techniques were used to measure the vital signs in place of the associated outdated ones.[4] IoT (the internet of things), The idea of linking everyday objects, devices, and appliances to the internet so they may gather and share data is known as the "Internet of Things" (IoT). IoT technology can be used to connect these items with centralized systems, typically without the assistance of a human. This connectivity and data exchange may lead to greater efficiency, automation, and new capabilities in various sectors.[5] Technology for wearable sensor systems with IoT support is a rapidly expanding area in the healthcare sector. We require immediate treatment with simple data monitoring and control as the medical profession grows. The long-term objective is to integrate IoT into emergency services, connected homes, intelligent hospitals, etc.[6] Big data is crucial for enhancing patient care, minimizing administrative processes, promoting scientific inquiry, and directing managerial choices in healthcare. It promotes innovative approaches to healthcare issues and offers data-based knowledge to healthcare professionals. It also presents complex difficulties relating to data privacy, security, and ethical considerations that need careful attention and resolution to sustain legitimate data usage in the healthcare sector.[7] Risks do exist as a result of the extensive usage of big data and data collection from organizations. Mainly, using potentially sensitive and private data from customers and users opens the discussion on the morality of using this kind of data for managerial and strategic purposes while taking advantage of the potential for vital information sharing for growth and innovation.[8]

1. INFORMATION AND COMMUNICATION TECHNOLOGY

Information and Communication Technology (ICT) plays a crucial role in healthcare management, helping improve patient care, streamline administrative processes, enhance decision-making, and increase overall efficiency.

For example, electronic health records make it possible for healthcare practitioners to share patient data easily, thereby minimizing errors and maintaining continuous care. Furthermore, ICT enables remote patient monitoring, which is extremely advantageous for people with chronic conditions or those who live in remote areas.

With the use of this technology, medical personnel can keep an eye on their patient's vital signs and make early treatments, thereby enhancing their quality of life and reducing hospitalization rates.[1]

Here are some key aspects of ICT in healthcare management:

Electronic Health Records (EHRs), Telehealth and Telemedicine, Decision Support Systems (DSS), Mobile Health (mHealth), Data Security and Privacy

1.1 Electronic Health Records (EHRs)-

EHRs convert paper-based patient records into digital files, ensuring the security and accessibility of patient data. Healthcare professionals can obtain patient histories, lab findings, medication lists, and other essential data quickly via EHRs, which helps them make better treatment decisions.[9]

1.2 Telehealth and Telemedicine -

Telehealth-Telehealth can improve access to care, reduce travel time and costs, and enhance patient engagement.

Telemedicine- Telemedicine is the use of information and communication technologies to provide and support healthcare services at distant locations. Telemedicine can give a new model for interaction with patients such as hospitals, pharmacies, physicians, and governmental agencies. Another crucial piece of technology is video conferencing, which enables clinicians\surgeons, and doctors to consult with patients who are physically separated from them in real-time and even engage in direct patient interaction.[10]

1.3 Decision Support Systems (DSS)- DSS tools utilize data analytics and artificial intelligence to assist healthcare professionals in making clinical decisions. They can provide insights into treatment options, risk assessments, and predictive modeling for disease management.[11]

1.4 Mobile Health (mHealth)- M-health refers to the combination of such wireless technologies with e-health. Mobile computing, medical sensors, and healthcare communications technology are the broad characteristics of m-health.[12]

1.5 Data Security and Privacy- Healthcare organizations must prioritize data security and patient privacy. Compliance with regulations like the Health Insurance Portability and Accountability Act (HIPAA) is essential to protect patient information.[13]

2. WEARABLE HEALTH DEVICE

Wearable technology is still in its early stages of development. For a variety of reasons, wearable medical technology is becoming more and more significant in the management of healthcare.[14] Wearable technologies might be used to increase physical activity among employees, make it easier for them to relax, and raise workplace productivity and safety. Smartwatches, wristbands, hearing aids, electronic/optical tattoos, head-mounted displays, subcutaneous sensors, electronic footwear, and electronic fabrics are examples of wearable technology.[15]

Here are some of the key ways in which these devices are being used:

2.1 Stress and Mental Health Management

2.1.1. Heart Rate Variability (HRV) Sensors:

Location: Heart Rate Variability (HRV) sensors are typically found in smartwatches and fitness trackers, rather than being standalone smart app devices.

Smartwatches and fitness trackers are only two examples of wearable technology that include HRV sensors. HRV is a stress indicator since it measures the change in time between subsequent heartbeats. Increasing stress is frequently correlated with a decrease in HRV**.** [16]

2.2 Sleep Monitoring:

2.2.1. Xiaomi Mi Band:

Location: The Xiaomi Mi Band is not a smartwatch; it is a fitness tracker or activity tracker with some smartwatch-like features.

The Xiaomi Mi Band 5 has a photoplethysmography sensor, a 3-axis gyroscope, and a 3-axis accelerometer to assess some biological parameters. This gadget has updated software that continually records daily activity (such as steps, distance traveled, activity time, and calories), sleep (such as light and deep sleep, waking times at the beginning and conclusion of the sleep cycle, and naps)[17]

2.3 Physical Activity Tracking:

2.3.1. Polar Vantage activity tracker:

Location: wrist(smartwatch)

To track physical activity, the Polar Vantage activity tracker (Polar Electro Oy) was introduced in 2018. It has a 50-Hz (i.e., 50 measurements per second) triaxial accelerometer.[18]

2.4 Medication Adherence:

2.4.1. Medi safe, Medication reminder (released on 19 July 2023)

Location: Mobile App

An automatic alarm system for medications and dosages alerts consumers using this Android application program. Patients frequently forget the precise moment they were supposed to take their medication. This app will notify users when it's time to take their medications, what they want to eat before or after, and other information.[19]

2.5 Real-Time Health Monitoring:
2.5.1. Remote Patient Monitoring Systems:
Location: Remote Patient Monitoring (RPM) systems typically involve a combination of devices, including smartwatches or wearable sensors, and smart apps.
These systems employ various tools (such as wearable sensors, scales, and blood pressure cuffs) to gather and communicate real-time health data to healthcare professionals, enabling ongoing patient monitoring, particularly in the management of ongoing illnesses.[20]

3. INTERNET OF THING (IoT):

It is possible to make objects "smart" by connecting them to the internet, such as with smart watches, smart lighting, etc. IoT increases humans' independence by enabling them to cooperate, participate, and engage with things.[21] The Internet of Things expands the number of physical sensors and gadgets that can connect to the Internet and collect data. Today, the Internet of Things (IoT) has an impact on every aspect of our lives, including transportation, smart cities, and health care. The health monitoring system was described in this study to provide clinicians working remotely with enough information about patient's health state.[22]
some common categories and examples of IoT devices:

3.1 Real-time Location Services (RTLS):
Location: Quuppa (Software)
Real-time location services are essential to improving asset management, security, and productivity in a variety of industries. Organizations can gain useful information and insights to improve their operations by being able to track and monitor the position of assets and devices in real time. Utilize RTLS technology to track the whereabouts of assets, and personnel, increasing security and enhancing emergency response times.[23]

3.2 Hospital Inventory Management:
Location: Smartsheet (Mobile App)
Supply chain management (SCM) is another name for hospital or healthcare inventory management.
It is a workflow that records the inventories, transactions, bookings, payments, and other information for your health system.[24]

3.3 Diet and Nutrition Tracking:
3.3.1 Smart Kitchen Scales Tracking Devices
IoT-enabled kitchen appliances and mobile apps help patients track their dietary choices and nutritional intake. This is especially beneficial for managing conditions like obesity or food allergies.[25]

3.4 Personalized Health Plans:
Location: MyHealthBuddy (Released on- January 25, 2023)
IoT devices can gather and analyse patient data to develop recommendations and plans for individualized healthcare.
For their specific diet, exercise, medicine, and other health needs, patients can get individualized guidance.[26]

4. BIG DATA

The health sector has always generated a large amount of data due to the increased record-keeping needs in the context of patient care. The use of vast and complex data in the healthcare sector to enhance a variety of patient care, operational efficiency, research, and decision-making elements is known as "big data in healthcare management." Electronic health records (EHRs), medical imaging, patient demographics, clinical notes, insurance claims, and other data are frequently included in these datasets.[7]

4.1 Here are some key features of big data in healthcare Management:
4.1.1 Volume:
This volume feature is one of the defining characteristics that categorize healthcare data as "big data."
Here's a deeper exploration of the significance of volume in healthcare data:

Medical Images- Medical imaging technology like MRIs, CT scans, and X-rays generates vast files for each patient. The amount of healthcare data overall is greatly increased by the buildup of these photographs over time.[27]
Sensor Data- A steady stream of information about patients' vital signs, levels of activity, and health indicators is produced by the widespread use of wearable technology and sensors in the healthcare industry. The large amount of healthcare data is increased by this real-time information.[28]
Genomics Data- Large databases are produced as a result of genomic research, including information on variants, gene expression patterns, and genetic sequencing data. These datasets are incredibly big and are expanding as genomics research develops.[29]
Claims and Billing Data- Billing information and insurance claims are included in the total amount of healthcare data. These records provide data on the costs incurred, healthcare services provided, and payment information. [30]
Historical Data- Historical patient data is frequently kept on file by healthcare organizations for compliance, research, and care continuity reasons. This historical data gathers and increases the amount of data over time.[31]
Public Health Data- The huge datasets that are collected and managed by public health agencies are relevant to epidemiological research, illness surveillance, and health trends. These datasets assist in monitoring and managing public health situations.[32]
Personal medical records, radiography and fluoroscopy images, clinical trials, surveys, demographic information, human genomes, genetic sequences, and other types of data compose the volume of data that is currently available. The inclusion of new types of big data, such as three-dimensional photographs, biological data, and data from sensor technologies, has led to an exponential increase in data in the healthcare sector. To manage the massive amounts of healthcare data. The inclusion of new types of big data, such as three-dimensional photographs, biological data, and data from sensor technologies, has led to an exponential increase in data in the healthcare sector. To manage the massive amounts of healthcare data.[33]

4.1.2 Variety:

The variety of data in healthcare is a significant feature, encompassing a wide range of formats and types of information. This diversity presents unique challenges and opportunities in healthcare management.
Here's a deeper exploration of the significance of variety in healthcare data:
Structured Data- Data that is highly prepared and arranged falls under this category. Examples include electronic health records (EHRs), test results, and medication records. Using conventional database management systems, structured data can be quickly arranged into databases and analyzed.[34]
Unstructured Data- Free-text clinical notes, patient accounts, emails, and medical literature are examples of unstructured data. This kind of data is very changeable in both content and presentation and lacks a predetermined framework. To acquire insights about patient care, it can be difficult but crucial to extract useful information from unstructured data.[35]
Semi-Structured Data- Between structured and unstructured data is semi-structured data. It Includes formats like XML and JSON, which offer some degree of flexibility and organization. Semi-structured data is frequently utilized in the healthcare industry in data standards like HL7 as well as for data interchange across systems.[36]
Patient Demographics- Although names, addresses, and contact information for patients are all structured data, the formats used by various healthcare organizations and systems can differ.[37]
Genomics Data- Another type of varied data is genomic data, which includes genetic sequences, gene expression patterns, and variation information. Utilizing specialist bioinformatics tools and knowledge is necessary for genomic data analysis.[38]
Healthcare data is available in a variety of formats, including semi-structured (XML, JSON), unstructured (such as medical records and handwritten notes from medical and nursing staff documenting symptoms, indications, behaviour, medical imaging, etc.,), and structured (EHRs, lab results). Big data platforms can effectively handle this variation. Quantitative data from instruments and test measures, general data, and structured data are all meant to gather information in a single framework that may be used as an initial basis for data analysis.[39]

4.1.3 Velocity:

The velocity feature is particularly - critical in healthcare management due to the dynamic nature of healthcare information.
Here's a closer look at the significance of velocity in healthcare data-

Patient Engagement- To encourage participation and treatment plan adherence, digital health applications must give timely reminders, notifications, and alerts to patients.[40]
Streaming Data- Streaming data is received by healthcare institutions from a variety of sources, including clinical sensors, diagnostic tools, and patient records. Making timely judgments, detecting diseases, and providing appropriate care all depend on processing this data rapidly.[41]
Emergency Care- Rapid access to patient information, such as medical history, allergies, and medication information, is crucial for healthcare providers in emergencies. Critical patient information is made available to emergency response teams with the use of velocity.[42]
Outbreak Detection-Speed is crucial for tracking disease outbreaks. Public health organizations can predict possible outbreaks and respond to them more skillfully with the help of quick analysis of health data, halting the spread of disease.[43]
Clinical Decision Support- Clinical decision support systems can now offer real-time information and suggestions based on the most recent patient data thanks to Velocity. Making timely and educated clinical judgments is made easier as a result.[44]
Traditionally, the majority of data used in healthcare is gathered from static sources like X-rays, hospital records, patient files, health logs, etc. However, in some applications, such as monitoring blood pressure and heart function during surgery, it is vital to process and use the data in real time.[45]

4.1.4 Veracity:
Veracity in healthcare data is of paramount importance because it signifies the accuracy, reliability, and overall quality of the data.
Here's a deeper exploration of the significance of veracity in healthcare management:

Regulatory Compliance- Veracious data management is required to achieve these regulatory standards and avoid legal ramifications because healthcare firms are subject to strict regulations, such as HIPAA (Health Insurance Portability and Accountability Act) in the United States, which regulate data privacy and security.[46]
Preventive Measures- Veracity is essential for accurately recognizing health trends and risk factors in community health management. Healthcare companies can carry out efficient public health initiatives and preventive actions thanks to reliable data.[47]
Data-Driven Insights- Meaningful data-driven insights start with accurate data. High veracity ensures that insights are credible and valuable, but data quality concerns might result in incorrect conclusions and misguided plans.[48]
Research Credibility- Data integrity is crucial for achieving reliable and repeatable results in the field of medical research. Studies and clinical trials that make use of reliable data are more likely to make significant contributions to science.[49]
Resource Allocation- For resource allocation, including staffing levels, equipment purchases, and infrastructure improvements, accurate data is crucial. Realistic data-based decisions are more likely to result in Economical decisions.[50]
To make intelligent choices, healthcare data needs to be accurate and trustworthy. To avoid medical errors, inaccurate diagnoses, and treatment decisions, it is essential to ensure the accuracy of big data in the healthcare sector. Several methods, including data cleansing, data validation, data integration, and normalization, are utilized to handle this problem.[51]

4.1.5 Value:
Value extraction from big data in healthcare management is a central objective, leading to several tangible benefits:
Predictive Analytics- Disease outbreaks, readmissions of patients, and treatment outcomes can all be predicted using big data analytics. Healthcare businesses can more efficiently allocate resources and take proactive steps to address health issues because of this predictive capability.[52]
Improved Patient Care- Big data makes personalized medicine possible by allowing treatments to be customized based on unique patient profiles. This improves patient happiness and adherence to treatment plans in addition to improving the quality of care.[53]
Cost Savings- Significant cost reductions are achieved through effective resource allocation, fewer hospital readmissions, and improved operations. Big data makes healthcare businesses more efficient by pointing up areas where expenses can be reduced without sacrificing patient care.[30]

Better Decision-Making- Clinical decisions are aided by data-driven insights, which assist healthcare providers. The results of patients are eventually improved by real-time access to patient data, research findings, and therapy recommendations.[54]
Quality Assurance- Big data can be used by healthcare organizations to monitor the effectiveness and security of care. They can continuously improve the quality of healthcare services by recognizing negative incidents and potential improvement areas.[55]
Early Intervention- High-risk patients can be identified using predictive models, enabling early intervention and preventative actions. By doing so, problems and the high cost of treating serious illnesses can be avoided.[56]
Predictive analytics, better patient care, financial savings, and better decision-making are all made possible by it. The price of healthcare is unaffordable and is always going up. The numerous advantages provided by the usage and exploitation of big data in healthcare,
however, are significantly more numerous.[57]

Conclusions

Information and Communication Technology (ICT) is reshaping healthcare. To ensure equitable benefits, address security, interoperability, and digital access. ICT holds the promise of better care, outcomes, and system efficiency.
Wearable medical technology is transforming healthcare. For data privacy and integration concerns to be fully realized, they must be solved. These tools claim to provide better patient care and preventative measures.
The Internet of Things is transforming healthcare, but interoperability and data security are crucial. Better medical results and more efficient healthcare operations are promised by utilizing IoT.
Big data analysis aids in providing patients with affordable treatment and care. By performing proactive diagnosis to construct the nation in economy mode with less risk.

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