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The Impact of Information Technology on Patient Health and Safety

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ABSTRACT

Technological breakthroughs have resulted in significant changes in healthcare in the twenty-first century. While electronic health records (EHR) have had a substantial impact, additional technologies have emerged that are improving healthcare efficiency while also improving patient safety and health outcomes. Keeping these developments in mind, the authors will deliberate upon different technologies used in health sector to improve the patients' health. Further, the authors ponder upon the patient safety and future of information technology.

Keywords: Patient safety, IT, Health care, electronic health record

1. INTRODUCTION

Customer expectations never stay the same in a world that is always changing and evolving. A recent example is the pandemic. It had a negative impact on many industries, but healthcare was the worst hit. Providers, healthcare workers, and patients all had to prepare for and accept new ways to deal with a scenario in which physical touch was deemed lethal. Telehealth saved providers and allowed people to consult doctors from the convenience of their own homes. Hospitals have been nudged by technology and connected care to automate workflows and extend healthcare services beyond the hospital's four walls. It has enhanced processes that previously took a long time and appeared to be unattainable (p2).

Today's facilities, providers, hospitals, and health companies want powerful and flexible healthcare IT systems that not only fulfil current needs but also prepare them for future prospects. The storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making is defined as "the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making."

HIT is defined as the application of information processing involving both computer hardware and software that deals with the storing, retrieval, exchange, and use of health care information, data, and knowledge for communication and decision making (Brailer, 2004). From simple charting to more advanced decision assistance and interaction with medical technology, health information technology encompasses a wide range of technologies. HIT has a substantial impact on patient care and patient safety in healthcare settings. The electronic health record (EHR) has quickly become an integral part of daily practise. To ensure adequate user buy-in, it has built a seamless transition for patients throughout the care continuum. It has been shown to result in better and more efficient nursing care, greater care coordination, and patient safety (P3). According to a study conducted by the Congressional Budget Office, electronic health records (EHRs) can reduce prescription errors by 95%. Furthermore, the recent decade saw widespread use of EHR around the world. This has resulted in a huge shift, with the migration from paper records to electronic health records (EHR) benefiting clinicians, payers, and patients in a variety of ways. There's no need to look through paper records, copy and fax records to other hospitals and doctors, or make phone calls to discuss the patient's health during an emergency or before interstate or intrastate transfers. It is simple for a physician to send patient data to other providers using modern EHR (p2).

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Patient-centered care and the requirements of patients and healthcare teams have become the focus of EHRs, which have grown from transition systems. Newly developed technologies such as telemedicine and health information exchanges have enormous potential to improve patient care coordination significantly and favourably. The usability of EHR may be essential to the technology's sustained adoption. All of these considerations point to the need for fresh focus and attention on enhancing the usability of health IT in order to improve patient safety and care quality (P3).

2. BENEFITS OF DEPLOYING INFORMATION TECHNOLOGY IN HEALTH SECTOR

The Internet of Healthcare Things (IoHT) and health information technology (HIT) are critical in minimising errors, saving time, ensuring safety, and providing alarms. HIT encompasses a wide range of technologies, including simple charting, advanced decision assistance, and medical technology integration (PAPER 2). HIT has immense potential for transforming healthcare, as evidenced by the following examples.

- Reducing human error
- Clinical outcomes are improving
- Aiding in the care coordination
- boosting practice effectiveness
- Tracking & analyzing data (P2, P4)
- Time spent on documentation has decreased.
- Errors in medicine delivery are being reduced.
- Documentation quality has improved, as has communication and workflow.
- Integration of technological systems into workflow processes has been improved (patient discharges and transfers) (P3)

3. HOW DOES INFORMATION TECHNOLOGY AFFECT PATIENT SAFETY AND CARE?

As diverse as the systems and technologies already in use, the influence of health information technology on patient safety and care is diverse. However, much of it may be traced back to medical facilities' use of electronic health records (EHR) in the recent decade. These records serve as a central repository for a patient's medical history, allowing clinical information such as physician notes, test results, and prescription drug information to be shared.

EHRs take human elements into account in healthcare, enhancing communication and offering a “single source of truth” on patient health and treatment for improved patient care coordination.

Information technology's effect has widened beyond information visibility and sharing to include the use of data for data-driven patient care. Advanced data analytics is becoming increasingly important in enhancing patient safety. The coronavirus pandemic has highlighted the value of health data, with analytics algorithms able to construct COVID-19 patient risk profiles in the early days of the pandemic, better identifying those most at risk of lethal effects.

With so much technology accessible, healthcare leaders and health IT experts must take a systematic approach to implementing the technology that best suits their needs. According to the Institute for Healthcare Improvement, this works best when three important elements of technology in healthcare are understood.

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1. Understanding Needs

Administrators, clinical leaders, and IT executives must work together to identify areas where technology might help their specific operation, then define goals for what they want to accomplish with it.

2. Asking the Right Questions

Both health IT workers and physicians must assess how each proposed technological solution will affect clinicians' work, lead to enhanced patient care and safety, and, ultimately, favourable health outcomes.

3. Bringing Health IT and Health Clinicians Together

Asking the correct questions necessitates a collaboration between health professionals and health IT for better coordination of each group's work. That's the most effective technique to get everyone on the same page about how to approach technology integration. Attending clinical meetings with IT personnel, for example, could provide more insight into medical procedures (PAPER 2).

4. APPLICATION OF INFORMATION TECHNOLOGIES IN PATIENT SAFETY AND CARE

The application of information technologies in patient safety and care are mentioned below:

1. E-prescribing and computerised physician orders (CPOE): The use of an electronic, computer, or mobile device platform to submit physician orders, including pharmaceutical orders, is referred to as computerised physician order entry. CPOEs were originally created to increase the safety of prescription orders, but newer systems also include capabilities such as electronic ordering of tests, treatments, and consultations. Clinical decision support (CDS) is connected with CPOE and serves as an error prevention tool by helping the prescriber through the recommended drug dosages, route, and frequency of administration. Modern systems also have features that help prescribers, including as prompts for patient allergies, drug-lab interactions, and, with advanced systems, prompts for prescription intervention based on clinical guideline recommendations (P2,4).

2. Clinical Decision Support: Clinical Decision Support (CDS) delivers patient-specific information to help healthcare teams and physicians make better decisions about patient care. This data is filtered rationally and delivered to the team at the appropriate moment. CDS is a collection of tools aimed to improve physician and care team efficiency and clinical workflow. Notifications, reminders, and alerts for caregivers and physicians, condition-specific order sets, patient-specific clinical summaries, documentation templates, investigation and diagnostic help, and more are among the options available. Previously, numerous incidences of healthcare staff forgetting to monitor vital signs or administer medications to patients were documented. Without the cues and notifications that affected Patient Care, a physician would be unable to make an informed choice concerning a patient's allergies. The use of on-screen reminders for physicians resulted in minor to modest increase in process adherence, prescription ordering, laboratory ordering, and clinical outcomes. A research conducted in Boston looked at 18,115 medication notifications and found that ordering physicians ignored 33% of them. Other clinical trials that looked at the impact of various CDS system enhancements aimed at improving physician compliance with alerts found that "tiering" and "alert automation" enhanced physician compliance with CDS warnings. In other meta-analyses, it was discovered that CDS systems that required healthcare practitioners to justify overriding CDS guidance were more likely to enhance patient outcomes than CDS systems that just provided advise (p2,4).

3. Electronic sign-out and hand-off tools: For interstate and intrastate patient transfers, electronic sign-out or 'hand over' is critical. This communication refers to the exchange of patient-specific information from one care provider to the next, from one hospital care team to the next, or from care providers to the patient's family, all with the goal of ensuring care continuity and patient safety. In the United States, a breakdown in the handover of patient information has been identified as one of the

major causes of sentinel occurrences (Popovich, 2011). Electronic sign-out applications are standalone or EMR-integrated systems that ensure a systematic transfer of patient information during 'transfers' or 'handoffs' between healthcare providers (p2,4).

4. Bar code medication administration: Electronic systems that combine electronic medication administration records and bar code technology are known as bar code medication administration systems. These systems are designed to avoid medication errors by ensuring that the correct patient receives the correct drug at the appropriate time. Additionally, existing barcode systems differ in their sophistication. When sound-alike or look-alike drugs are mixed up, for example, some software sends out alerts. Others may provide clinical recommendations for specific prescriptions when scanned, while others may help with documentation, such as recording drug administration in the eMAR and other pertinent clinical details (Li et al., 2013, p2,4).

5. Smart Pumps: A smart pump is defined as a "electronic infusion device with integrated computer software intended at reducing drug dose errors through the existence and usage of a drug library" in the 2016 Infusion Nurses Society (INS) Infusion Therapy Standards of Practice. When the infusion parameters exceed or are placed outside of the pre-configured safety limit, the software warns the operator. Smart pumps may reduce programing errors (Ohashi et al., 2014), but they do not eradicate them (p2,4).

6. Automated Medication Dispensing Technology (ADC): ADCs (automated medication dispensing cabinets) are drug storage cabinets that store medication at the point of care and give electronic control for medication delivery and tracking. In recent years, this decentralised medicine distribution has progressed, with more sophisticated software and digital interfaces being introduced to integrate high-risk elements in the prescription administration process. ADCs have been used as a pharmaceutical inventory management tool to reduce the workload on the central pharmacy while also tracking and monitoring drug distribution and patient billing. It's worth noting that there's only one study (published controlled trial) that indicated that using ADC reduced the rate of medication errors in hospital critical care units by 28% (p2,4).

7. Patient electronic portals. A patient portal is a secure online programme that allows patients to access their personal health information and communicate with their healthcare providers in a two-way electronic format via a computer or mobile device. Patient portals have been proven in numerous studies30-32 to increase preventative care, disease knowledge, and self-management outcomes (Nagykaldi et al., 2 012; Fiks et al., 2015; Kruse et al., 2015).

8. Telemedicine: Telemedicine refers to the use of electronic information and telecommunication technology to deliver distant therapeutic services. It allows the patient and the practitioner to communicate in both directions. Synchronous telemedicine refers to two-way video conversation in real time. The (store and forward) communication of a patient's data to a physician is referred to as asynchronous telemedicine (p2,4).

9. Synchronous Telemedicine: A virtual visit is a two-way audio/video conversation between a healthcare provider and a patient that takes place in real time. The influence of virtual visits on patient outcomes in critical care, chronic illness care, and psychiatric care has been explored in a number of systematic reviews (Tan and Lai, 2012; Kew and Cates, 2016; Gregersen et al., 2016; Salmoiraghi and Hussain, 2015). In terms of specific clinical outcomes, all have shown that telemedicine is as successful as face-to-face therapy, although there is minimal information regarding patient safety results. An e-consultation is a secure communication platform that allows the patient's primary care provider and a specialist to communicate electronically. This technology allows the specialist to provide advise on the patient's management without the requirement to refer the patient (p2,4).

10. Asynchronous Telemedicine: It involves the communication of data from a patient or a physician to a specialist for diagnosis and treatment expertise (store and forward). It refers to the collecting of digital samples from one site, such as electrocardiograms (EKGs), spirometry findings, and radiological pictures, and their transfer to another location for

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examination by a professional. Asynchronous telehealth, unlike synchronous telemedicine, is helpful in reducing wait times since it does not require real-time interactions between patients and clinicians. Its low-cost infrastructure makes it a favoured alternative in a high-demand environment, as it can encourage equal access to physicians, specialists, and health professionals, as well as services, for those with inadequate health resources. Text messages, laboratory and radiology reports, and other digital samples can be sent to remote locations rapidly and at a minimal cost. When these (asynchronous) services are integrated with centralised servers to manage digital samples, work lists can be divided and distributed among a team of specialists who can interpret them according to their availability. In scenarios where cases and work-lists are prepared ahead of time, specialists could report a higher turnover of their assessments without requiring face-to-face interaction.

11. Remote patient monitoring: Community-based Remote patient monitoring) telemonitoring (40-44) has been proven to enhance patient outcomes for a variety of chronic illnesses, including heart failure, stroke, COPD, asthma, and hypertension (Klersy et al., 2016; Inglis et al., 2010; Lieber et al., 2015; Kew and Cates; 2016; Omboni and Guarda, 2011). Patient data management systems, or PDMS, are systems that automatically retrieve data from bedside medical equipment, such as a patient monitor, ventilator, or pump. The data is then summarised and rearranged to make it easier for healthcare providers to analyse it (Cheung et al., 2015). PDMS can now be integrated with clinical decision support and the patient's electronic medical record thanks to recent advancements in integration. A systematic review of the therapeutic impact of PDMS indicated that by lowering the time spent on charting, such systems boosted the time spent on direct patient care. PDMS systems also reduced the number of errors (medication errors, ventilator incidents, intravenous events, and other mishaps) (Cheung et al., 2015).

12. Electronic incident reporting: Electronic incident reporting systems (EIRS) are web-based platforms that allow healthcare practitioners involved in safety accidents to report them voluntarily. These systems can be linked to an electronic health record (EHR) to allow for data abstraction and automatic identification of bad events using trigger tools. Standardize reporting format, standardise incident action procedure, quick identification of major incidents and trigger events, while automating data entry and analysis are all potential benefits of electronic incident reporting systems. According to published studies, healthcare institutions that switched to an electronic reporting system saw a considerable rise in the frequency of reporting (Savage et al., 2005). Although incident reporting systems may improve clinical processes, there is limited evidence that they reduce medical errors in the long run (Stavropoulou et al., 2015). The evidence on the impact of various HIT technologies on patient safety is summarised in Table 1.

Table 1 - Summary of the evidence of Health Information Technology (HIT) on patient safety.

Health Information Technology	Summary of Evidence
Computerized Physician Order Entry	Only when combined with CDS was a reduction in the rate of medication mistakes observed
Clinical Decision Support	Process adherence, prescription ordering, vaccination, lab ordering, and clinical outcomes have all improved
Electronic sign out/hand off tools	Handover process has improved, and there are fewer omissions of vital patient information

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Bar Code Medication Administration (BCMA)	• Medication mistakes and harmful drug reactions are reduced. • The number of mislabeled laboratory specimens has decreased.
Smart Pumps	• There is insufficient evidence on how to reduce pharmaceutical errors. • Errors in pump programming are reduced.
Patient Data Management Systems (PDMS)	Reduction in charting time, increase in time spent on direct patient care, and decrease in errors
Automated Medication Dispensing	Medication mistakes in critical care units are being reduced
Patient Portals	Medication adherence, disease awareness, disease self-management, and patient satisfaction have all improved
Telemedicine-Virtual Visits	In terms of specific clinical results, it's just as good as face-to-face care
Telemedicine-Telemonitoring	Patients with specific chronic diseases such as CHF, COPD, and hypertension, have better clinical outcomes
Electronic Incident Reporting	Significant rise in the number of adverse events reported

Finally, health information technology enhances patient safety by reducing medication errors, adverse drug responses, and adherence to practise recommendations. There is no doubt that health information technology is an important tool for improving healthcare quality and safety, but healthcare organisations must be selective in which technologies they invest in, as research shows that some technologies have limited evidence for improving patient safety outcomes.

5. THE MOST IMPACTFUL INFORMATION TECHNOLOGY ON PATIENT SAFETY

While each medical procedure has its own set of requirements, the following are the areas where health IT has the most impact on patient safety thus far.

1. Information is more easily accessible: Health IT workers have been working on interoperability, or the ability to share patient data across several systems, for years. As digital systems improve in this area, practitioners will be able to share patient information, reducing the likelihood of treatment errors. For example, a doctor at a hospital can gain access to a patient's medical records through their personal physician. It can also be useful in warning healthcare practitioners at the initial breakout of a pandemic, as the COVID-19 incident revealed.

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2. Adoption of Electronic Medical Records (EMRs)

Nurses' and other personnel's work has been greatly impacted by electronic medical records and electronic health records. Nurses now need to know how to enter patient data into the system. Medical coders make sure that the records are up to date with the correct codes. These records are also used by the billing department to file insurance claims. Overall, digital medical records help patients receive better, more efficient care.

3. Drug-Related Errors are Reduced: Prescription medication errors are a medical blunder with potentially fatal effects. In this area, electronic prescribing has helped to reduce hazards. These systems reduce the risk of medication errors by converting handwritten scripts to electronic entry on a secure device, checking for drug interactions automatically, automating re-fill requests and reminders, and raising warnings if a suspected medication error is made.

4. Public Health Improvements: Public health entails developing preventative initiatives to assist people stay healthy for extended periods of time, as well as detecting chronic health issues in certain demographic groups. In order to help healthcare professionals and government organisations handle and prepare for new health hazards, public health informatics uses data from a range of sources, including hospitals, social services, surveys, and more. For example, EHR data is particularly important in population health management analytics, allowing researchers to notice a problem early (such as a flu outbreak) and respond more quickly (in the case of flu, getting more vaccines into the affected community).

5. Support for Clinical Decision Making: One of the most important areas where technology may improve patient safety is clinical decision support (CDS). CDS entails putting all essential information about a patient, as well as standardised standards for prospective treatments, in the hands of a clinician in real time. A review of CDS in oncology treatment indicated "enhanced clinical practise guideline utilisation and concordance, improved care process measures, and fewer safety events," according to the Agency for Healthcare Research and Quality (AHRQ).

6. PATIENT SAFETY AND THE FUTURE OF INFORMATION TECHNOLOGY

The future of healthcare will be driven by technological advancements. Graduate certificate and degree programmes in health informatics and healthcare analytics can provide the expertise needed to lead in the industry for people who want to be on the cutting edge of using technology to improve patient safety and health outcomes.

AI and machine learning can also be used in the healthcare industry. Many mundane billing and coding operations may be handled by advanced computers, allowing humans to focus on more complicated tasks.

Predictive health analytics is another topic that has emerged in recent years. Advanced systems will be able to suggest the optimum course of therapy for a patient and compare prospective outcomes based on the various options available to clinicians in the future.

7. DISCUSSION AND CONCLUSION

There's a lot of evidence that using an electronic medical record minimises medical errors and increases patient safety. One of the most effective health information technologies for enhancing patient safety is computerised physician order entry and CDS. Furthermore, in the critical care context, ADC systems and PDMS appear to improve patient safety. For the following health information technologies, there is currently insufficient evidence to reach a conclusion on patient safety outcomes: electronic sign-out and hand-off tools, smart pumps, bar-code medication administration, retained surgical item detectors, patient portals, telemedicine, and electronic incident reporting. It's worth noting that there's evidence that the aforementioned technologies appear to improve healthcare processes and results that aren't safety-related.

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