The Safety Implications of Information Technology in Nursing: Japanese Incident Data Analysis

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Abstract. This study delves into the impact of Information Technology (IT) on nursing practice in Japan, focusing on patient safety within the 2021-2022 Japanese Medical Accident Report Data. The research aims to understand how IT factors contribute to nursing-related medical incidents in a healthcare landscape rapidly integrating IT. The study identifies IT-related incidents through a retrospective analysis of medical incident reports, primarily in nursing, by analyzing categorized data and free-text descriptions for IT-related keywords. The findings indicate significant IT-related issues, with 'Other EHR Related' problems (36%) and 'EHR Reporting' errors (25%) being the most prevalent. These incidents often involve challenges in patient identification and medication management. The study suggests improvements like enhanced verification processes and automated systems to mitigate these risks. Conclusively, it underscores the dual nature of IT in nursing: while it holds the potential to enhance patient care, it also introduces challenges that necessitate specialized informatics expertise to ensure its beneficial integration into nursing practices.

Keywords. nursing informatics, patient safety, electronic health records, medical incident analysis, healthcare technology integration

1. Introduction

The integration of information technology (IT) into healthcare has steadily transformed nursing practice, including in Japan, where the implementation of these technologies has been a notable development. Electronic health records (EHRs) and other IT systems have become increasingly common, offering benefits such as enhanced patient safety and improved care management.[1] These systems are known to improve patient outcomes through more accurate documentation and error reduction [2]. However, IT in healthcare also introduces complexities, necessitating specialized skills within nursing to address potential challenges and patient safety concerns.

As IT becomes more prevalent in healthcare, it is important to understand its impact on nursing practices and patient outcomes. While IT systems like EHRs are designed to support quality patient care, they also pose the risk of introducing new

types of errors, highlighting the need for a comprehensive evaluation of their role in nursing-related incidents [1]. This study seeks to explore the dynamics between IT and nursing practice, examining the prevalence of IT-related incidents and proposing potential improvements to mitigate risks associated with integrating the technologies in healthcare.

In this context, the study aims to answer a pivotal question: How do IT factors contribute to medical incidents in nursing, as evidenced in the Japanese Medical Accident Report System data from 2021-2022. There are several previous studies utilizing Japanese Medical Accident Report System data [2][3]. These studies include the prevention of medical accidents by nurses and case analyses on herbal preparations, but none focused on information systems.

2.   Methods

Study Design & Data Source

We conducted a retrospective analysis of medical incident reports for 2021-2022, focusing specifically on incidents where nursing or midwifery was the main discipline involved. We focused on this period because of Japan's rapid adoption of IT technologies in the last few years. The data for this study was extracted from the Japanese Medical Accident Report Data, hosted by the Japan Council for Quality Health   Care   and   publicly   available   at https://www.med-safe.jp/contents/report/index.html. This dataset encompasses a comprehensive collection of medical incident reports, focusing on various aspects of healthcare delivery, including nursing. The reports provide detailed accounts of incidents, their contributing factors, and potential suggestions for improvements. The number of medical institutions providing information to this database is 1,158 in 2022. Of these, 275 are operated by the National Hospital Organization, national university corporations, educational corporations, and other medical institutions required by law to provide information on medical accidents. This study was exempt from the institutional review board since this is publicly available data with no patient identifiers.

IT-Related Incident Identification

We first examined reports categorized under "primary reason for incident" related to IT to identify IT-related incidents, finding only a small number of cases. However, a closer reading of the free-text case descriptions revealed more IT-related incidents. Consequently, a team of experts, including three PhD-level faculty with expertise in informatics and three nursing graduate students, created a list of keywords to identify IT involvement in medical incidents. Categories covered Electronic Records and Systems (e.g., 'Electronic Health Records' [EHR]), Technical Components ('Database,' 'Information Technology'), System Issues ('System Error,' 'Data Breach'), Maintenance and Security ('Backup,' 'Security'), and more. These terms, encapsulating diverse IT aspects like Operational Challenges and Hardware Failures, were searched in the accident reports using regular expressions for a thorough analysis.

Screening and Review Process: Cases where one or more of the identified terms were present underwent screening by three reviewers. The reviewers reached a

consensus on whether IT contributed to the incident. The final list of IT-related cases was analyzed to categorize the type of IT involved, create a short incident description, and provide recommendations for safeguards or improvements to prevent similar incidents in the future.

3.   Results

Overall, 36 cases were identified, and Table 1 provides descriptions of example cases included in this analysis.

Table 1: Example incidents included in the analysis

IT Type	IT-Related Failures and Suggested Improvements
Other EHR Related 31% (N=11)	Example 1: EHR patient identification errors causing sample mix-ups. Enhanced verification processes, including barcodes or biometrics, are recommended. Example 2: Miscommunication of blood test results leading to surgical complications. Real-time lab result updates and automated alerts for critical values are suggested.
EHR Reporting 25% (N=9)	Example 1: Failure to integrate endoscopy results into EHR. Suggested improvement is the automation of test result integration with improved check procedures. Example 2: Overlooked MRI report indicating brain metastasis. Ensuring radiation reports are confirmed and diagnosis is prominently displayed is suggested.
EHR Allergy and Sensitivity 17% (N=6)	Example 1: Miscommunication led to drug administration despite an allergy. Suggested improvement includes a robust, real-time allergy alert system with mandatory cross-checking before drug administration. Example 2: EHR system failed to flag an allergy. Enhancement of EHR allergy alerts and integration of prescription error prevention systems are suggested.
EHR Medication Management 17% (N=6)	Example 1: Incorrect medication date entry in EHR. Implement automatic date verification with a secondary staff check system. Example 2: Prescription error from drug concentration confusion. Suggest clearer drug dosage display and automated alerts for unusual dosages.
Monitoring Equipment 11% (N=4)	Example 1: Incorrect ECG monitor setting led to the wrong pacing rate. Routine monitor checks and staff training on equipment sensitivity are recommended. Example 2: Inadequate monitoring resulted in a delayed response to a critical condition. System upgrades for real-time alerts and training on emergency protocols are advised.

The most common IT type, 'Other EHR Related' issues (30.56%), included a range of errors from identification mix-ups to inadequate follow-up in outpatient care. Central recommendations for this category called for implementing advanced patient identification technologies, such as biometrics, and enhancing EHR prompts for critical patient follow-ups to ensure comprehensive care continuity.

'EHR Reporting' errors (25%) often involved critical diagnostic delays due to overlooked reports or failure to integrate test results. To mitigate this, the suggested strategies included developing a more responsive EHR system that automatically flags unread reports and sends alerts for pending results, ensuring that all patient information is timely reviewed and acted upon.

For 'EMR Allergy and Sensitivity' and 'EHR Medication Management' (each at 16.67%), common issues revolved around EHR systems failing to alert caregivers to allergies or medication errors. The proposed central solutions involved integrating a sophisticated alert system that cross-references patient allergies and medication orders in real-time, along with improved interfaces that clearly display drug names and dosages to minimize human errors.

Finally, 'Monitoring Equipment' failures (11.11%) included incorrect equipment settings and inadequate patient monitoring leading to adverse events. Recommended improvements focused on routine checks and calibration of equipment, comprehensive staff training on the operation of monitoring devices, and system upgrades to ensure more reliable and immediate alerts for patient monitoring deviations.

4.   Discussion

The integration of IT within healthcare systems has profoundly impacted nursing practice, notably in Japan, where the rapid adoption of such technologies has been pivotal. This study's findings, highlighting the prevalence of IT-related incidents in nursing and suggesting potential improvements, resonate with current literature emphasizing the dual role of IT in both the facilitation and complexity of healthcare delivery [1].

Our study revealed 'Other EHR Related' issues as the most frequent IT-related incidents, aligning with the literature that underscores the potential for EHR systems to contribute to patient safety when utilized effectively [1]. Nurses in informatics have significantly contributed to enhancing patient safety through meticulous documentation and rapid access to patient information. However, the complexity and diversity of IT systems can also present new challenges, necessitating the development of specialized roles within nursing to address these issues effectively [4].

Similarly, the high incidence of 'EHR Reporting' errors found in our study is supported by findings that inadequate integration and communication of patient data can lead to critical diagnostic delays [1]. Literature suggests that IT systems have the potential to improve nursing documentation quality and reduce medication administration errors, provided that nurses are involved in all stages of IT design and implementation [4].

The study also corroborates broader research, indicating that medication administration errors are common, with factors such as wrong time and assessment being prevalent [5]. These findings align with other studies identifying human factors such as stress and lack of attention as contributing factors to patient safety incidents [1]. We acknowledge that while IT has the potential to reduce errors and improve patient care, its implementation and integration into daily nursing practice require careful consideration of design, user training, and system interoperability. Future research should focus on the longitudinal impact of IT solutions implemented, assessing their real-world effectiveness in improving patient outcomes and nursing practices. [4]

Furthermore, it is vital to explore strategies to enhance the usability and adaptability of health IT systems to diverse clinical settings. This would ensure that technology is a reliable support rather than a source of error or inefficiency. Pursuing these goals aligns with broader calls within healthcare informatics for user-centered design and robust, responsive systems that accommodate the dynamic nature of clinical environments [4].

Some cases in which information systems were included in the "main reason for the incident" category were not directly related to IT or EHR, such as power facility failure or ME equipment malfunction. This suggests that in Japanese healthcare, medical engineering and information technology are treated similarly: the function of the ME equipment itself is important, whereas the focus of information technology,

such as EHRs, is to provide the necessary information promptly in the healthcare process. From the perspective of healthcare informatics, it is necessary to clarify the distinction between the two and to work toward achieving an accurate classification.

5.   Conclusions

In conclusion, our findings contribute to the ongoing dialogue about the impact of health information technologies on nursing and patient safety [1,5]. They echo the sentiment that IT can significantly enhance the quality of care and patient outcomes with effective leadership and interdisciplinary collaboration. As healthcare continues to evolve, nursing informatics stands as a critical bridge between clinical needs and technological advancements, underscoring the importance of its role in patient safety and care improvement efforts [4].

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