Completion Report

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Subject of Research Project : "The Socio-technical and Lean Approach Towards Effective and Safe Health Information Systems: The Japanese and Malaysian Experience"

Complex socio-technical health information systems (HIS) issues can create new error risks. Therefore, we evaluated the management of HIS-related errors using the proposed human, organization, process, and technology-fit (HOPT-fit) framework to identify the lessons learned. Qualitative case study methodology through observation, interview, and document analysis was conducted at a 1000-bed **Japanese** specialist teaching hospital. Effective management of HIS-related errors was attributable to many socio-technical factors including continuous improvement, safety culture, strong management and leadership, effective communication, preventive and corrective mechanisms, an incident reporting system, and closed feedback loops. Enablers of medication errors include system sophistication and process factors like workarounds, variance, clinical workload, slips and mistakes, and miscommunication. The effectiveness of the case hospital management in handling the HIS-related errors can guide other clinical settings. The potential of HIS to minimize errors can be achieved through continual, systematic, and structured evaluation. The case study validated the applicability of the proposed evaluation framework that can be applied flexibly according to study contexts to inform HIS stakeholders in decision-making. The comprehensive and specific measures of the proposed framework and approach can be a useful guide for evaluating complex HIS-related errors. Leaner and fitter socio-technical components of HIS can yield safer system use.

Pharmacy information systems (PhIS) can cause medication errors that pharmacists may overlook due to their increased workload and lack of understanding of maintaining information quality. This study also seeks to identify factors influencing unintended consequences of PhIS and how they affect the information quality, which can pose a risk to patient safety. This qualitative, explanatory case study evaluated PhIS in ambulatory pharmacies in a **Malaysian** hospital and a clinic. Data were collected through observations, interviews, and document analysis. We applied the socio-technical interactive analysis framework to investigate the socio-technical interactions of pharmacy information systems that lead to unintended consequences. We then adopted the HOPT-fit framework to identify their contributing and dominant factors, misfits, and mitigation measures. We identified 28 unintended consequences of PhIS, their key contributing factors, and their interrelations with the systems. The primary causes of unintended consequences include system rigidity and complexity, unclear knowledge, understanding, skills, and purpose of using the system, use of hybrid paper and electronic documentation, unclear and confusing transitions, additions and duplication of tasks and roles in the workflow, and time pressure, causing cognitive overload and workarounds. Recommended mitigating mechanisms include human factor principles in system design, data quality improvement for PhIS in terms of effective use of workspace, training, PhIS master data management, and communication by standardizing workarounds. Threats to information quality emerge in PhIS because of its poor design, a failure to coordinate its functions and clinical tasks, and pharmacists' lack of understanding of the

system use. Therefore, safe system design, fostering awareness in maintaining the information quality of PhIS and cultivating its safe use in organizations is essential to ensure patient safety. The proposed evaluation approach facilitates the evaluator to identify complex socio-technical interactions and unintended consequences factors, impact, and mitigation mechanisms.

Publication of the Results of Research Project:

Verbal Presentation (Date, Venue, Name of Conference, Title of Presentation, Presenter, etc.)

1. October 2025, Osnabruck, Germany. European Fed. Medical Inform. Special Topic Conference: Good evaluation-better digital health. Title: Validating the HOPT-Fit Evaluation Framework for Health Information Systems via Case Studies. Presenter: Yusof, MM
2. 19-21 May 2025, Glasgow, Scotland. Medical Informatics Europe (MIE) 2025, Title: Safe Medication: An Integrated Approach. Presenter: Yusof, MM (online).
3. January 2025, Mithi, Pakistan. Invited speaker. Health information systems evaluation, effectiveness and safety: Case studies from Malaysia and Japan. Presenter: Yusof, MM.
4. January 2025, Karachi, Pakistan. Workshop. Title: Masterclass in Health Information Systems—A Global Perspective. Presenter: Trainer/ Presenter: Yusof, MM.
5. 23-24 October 2024, Sulawesi, Indonesia. Guest Lecture. Health information systems evaluation, effectiveness and safety. Presenter: Yusof, MM

Thesis (Name of Journal and its Date, Title and Author of Thesis, etc.)

1. MM Yusof (2025) Validating the HOPT-Fit Evaluation Framework for Health Information Systems via Case Studies. Book chapter from Special Topic Conference conference: Good Evaluation-Better Digital Health, 98-102. IOS Press
2. MM Yusof, Y Shimai, T Takeda (2025) Safe Medication: An Integrated Approach. Book chapter from Medical Informatics Europe: Intelligent Health Systems–from Technology to Data and Knowledge, 422-423. IOS Press
3. Rohani, N, Yusof MM. Pharmacy Information Systems Adoption: Risk and Mitigation (in Malay), 2025, Bangi: UKM Press.
4. Yusof, MM, Takeda, T, Shimai, Y, Mihara, N, Matsumura, Y (2024) Evaluating health information systems-related errors using the human, organization, process, technology-fit (HOPT-fit) framework, Health Informatics Journal, 30:2
5. Rohani, N, Yusof, MM (2023) Unintended Consequences of Pharmacy Information Systems: A Case Study, International Journal of Medical Informatics. 170, 104958.
6. Rohani, N, Yusof, MM. Evaluating unintended consequences in health information systems. Boo Chapter from Medical Informatics Europe: Challenges of Trustable AI and Added-Value on Health, 269-270. IOS Press.