Unintended Consequences of Pharmacy Information Systems

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ABSTRACT

PhIS use can lead to medication errors which pharmacists may not recognise owing to increased workload and lack of understanding about maintaining the quality of information in PhIS. The aim of this study is therefore to determine the factors influencing unintended consequences of PhIS implementation (UC-PhIS) and how this affects the quality of information in PhIS which can put patients' safety at risk. This study was performed utilising qualitative methodologies from an explanatory case study in ambulatory pharmacies in a hospital and a health clinic. Data were collected through observations, interviews, and document analysis. The ISTA-UC-HOPT proposed framework, which was built from Interactive Sociotechnical Analysis (ISTA) and Human-Organization-Process-Technology-fit (HOPT-fit) frameworks, is used in this study to investigate the sociotechnical interactions in ambulatory pharmacy dispensing services with PhIS. Within the ISTA-UC-HOPT framework, ISTA-UC components were used to identify UC-PhIS while UC-HOPT components were used for identifying the evaluation dimensions that need to be considered in mitigating and preventing UC-PhIS. A total of 28 UC-PhIS have been identified. In order to learn the key factors contributing UC-PhIS, the interrelations between all UC-PhIS are studied. The primary causes of UC-PhIS include unclear knowledge, understanding, skills and purpose of using the system, usage of hybrid paper and electronic documentations, unclear and confusing transitions, additions and duplication of tasks and roles in workflow, plus system rigidity that causes cognitive overload that leads to workarounds. Threats to information quality emerge in PhIS because of a failure to coordinate its functions, clinical tasks, and pharmacists' understanding and interpretation of PhIS use. Therefore, fostering awareness in maintaining the information quality of data recorded in PhIS and cultivating the safe use of PhIS in organizations is essential to ensure patient safety.

1. INTRODUCTION

Pharmacy Information Systems (PhIS), as one of the components of a Health Information System (HIS), has the potential to improve the quality of healthcare delivery by making transaction records from administrative, inventory, clinical order entry, medication dispensing, and administration, which are also recorded in patient health records, available and accessible. (Dyb & Warth 2019; Kazemi et al. 2016; Sittig et al. 2020; Yasemi et al. 2018). While having the records easily accessible may enhance healthcare delivery, it also has been linked to various sociotechnical challenges that not only limits its potential (Alanazi et al. 2018; Azza et al. 2016; Eikey et al. 2019), but also introducing new errors (Alanazi et al. 2018; Nanji et al. 2014; Nelson et al. 2017; Yasemi et al. 2018) and user dissatisfaction that may leads to unsafe use of HIS (Lizawati et al. 2016) which may cause unintended consequences (UC) to healthcare delivery (Agrawal 2016; Dyb & Warth 2019; Eikey et al. 2019; Khlie & Abouabdellah 2016; Sittig et al. 2020). This study is thus aimed to assess the factors that influence the unintended consequences of PhIS (UC-PhIS) and how this affects information quality in PhIS, which might put patient safety at risk from user perspectives in facilities implementing Pharmacy-Based PhIS (PhIS-PB).

2. METHODOLOGY

Explanatory case studies are the preferred qualitative research strategy that can help in answering the factors that may lead to UC-PhIS in ambulatory pharmacy dispensing services. This type of study may examine the reasons and significance of PhIS implementation and the

occurrence of UC in the workflow and processes (Armstrong et al. 2019; Baxter & Jack 2008; Kaplan 2016; Kaplan & Maxwell 2005). This study includes four phases: (1) problem statement identification, (2) conceptual framework development, (3) data collection in the study sites, and (4) data analysis. The data collection process from multiple sources has taken place in ambulatory pharmacy at Hospital T and Clinic R for one month from mid-November to mid-December 2020, comprising observations, interviews and document analysis. This study adheres to the principles of the Helsinki Declaration (Korstjens & Moser 2017; World Medical Association 2013) and the Malaysian Guidelines on Good Clinical Practice (National Pharmaceutical Regulatory Agency 2018).

3. RESULTS

The challenges and issues that both ambulatory pharmacies in this study faced in implementation of PhIS are largely the same but their reaction towards those challenges might differ. Hence, this study may also enlighten the success factors of PhIS implementation in these pharmacies, as they have now achieved full utilisation of PhIS, in addition to identifying the UCs that are still present or already resolved as utilisation progresses (Table 1). This study attempts to unravel the factors that led to the emergence of UC-PhIS using the ISTA-UC-HOPT proposed framework. The ISTA-UC component of the ISTA-UC-HOPT framework has aided the identification of UC-PhIS, while the UC-HOPT component has contributed in focusing on the aspects that must be addressed in UC-PhIS mitigation and preventive planning.

4. CONCLUSION

Applying ISTA-UC-HOPT proposed framework in understanding and examining UC-PhIS in the ambulatory pharmacy dispensing services facilitated the finding of 28 UC-PhIS. the primary factors contributing to UC-PhIS are users' lack of information, comprehension, abilities, and grasp of the system's purpose, paper persistence, ambiguous and unclear shifting of tasks and roles within the workflows, and system rigidity causes cognitive overload, prompting users to devise a variety of non-standardized workarounds, which may result in different new errors. Furthermore, threats to PhIS information quality occur as a consequence of the quality information received and recorded in PhIS, resulting in erroneous functionalities and information in PhIS, which forcing users to devise and employ workarounds to overcome or prevent difficulties that also contributing to the occurrence of various type of errors. It is thus a shared duty of the entire organisation to maintain the quality of information captured in PhIS which must begin by raising awareness and nurturing safe use of PhIS to ensure patient safety.

The study's limitations are the short research period, and its limited scope and number of ambulatory pharmacies involved. Therefore, this study may not be able to characterise the UC-PhIS that happens at all pharmacies that utilise PhIS, nor does it give an overall assessment of PhIS capabilities. This is an area where further study might be conducted. Despite this, the UC-PhIS and mitigation suggestions developed from this study are relevant to all facilities that use PhIS. There is still a need for additional quantitative investigations to establish the real prevalence and impact of UC-PhIS and its impact on patient safety and professional practises. Findings on possible risks in connection with the usage of PhIS must also be validated (and further expanded) by additional research encompassing different types of facilities and varying levels of PhIS adoption.

Table 1 ISTA-UC-HOPT analysis for UC-PhIS

X = need fit , - = not applicable

ISTA-UC Interaction (Factors influencing UC)		UC-PhIS	HOPT-fit relationship						
			System Quality – Clinical Workflow	System Use – System Quality	System Use – Information Quality	Organization Structure - Quality System	Organization Structure - Clinical Workflow	Systems Use - Organizational Structure	Systems Use – Clinical Workflow
1a - HIS disrupts current workflow and practice.	1a	The implementation of PhIS disrupts an already overburdened workflow, delaying the delivery of services to patients.	X	-	-	-	-	-	-
1b - HIS increases workload by changing work tasks and roles in current practice.	1b1	Additional PhIS management (clinical and technical) responsibilities and tasks.	X	-	-	-	-	-	-
	1b2	Hidden and ambiguous changes, transitions and overlaps of roles, responsibilities, and task expectations across processes.	X	-	-	-	X	-	-
	1b3	The difficulty of adopting PhIS into existing workflows and additional workloads creates negative perceptions and feelings among users.	-	X	-	-	-	-	-
1c - HIS interferes current practice's communication and information transfer.	1c	The usage of PhIS introduces a new medium of information flow that goes unnoticed, exposing gaps in communication and patient information transfer.	X	-	-	-	X	-	-
1d - HIS requires users to have knowledge and skills to use and manage it.	1d	Knowledge and skills of using PhIS are constraints for the use of PhIS as intended.	-	X	-	-	-	-	-
2a - HIS ability to integrate with existing infrastructure.	2a1	PhIS unable to integrate with patient health records in clinics and wards because it still relies on paper documentation.	X	-	-	X	-	-	X
	2a2	Physical infrastructure such as workspace area and layout do not support tasks with the use of PhIS in workflows.	-	-	-	-	X	-	-
2c - Availability of organizational infrastructure to support the use of HIS	2c	The lack of technical hardware (such as computers and printers) makes it difficult to use PhIS as intended.	-	-	-	-	-	X	-

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ISTA-UC Interaction (Factors influencing UC)		UC-PhIS	System Quality – Clinical Workflow	System Use – System Quality	System Use – Information Quality	Organization Structure - Quality System	Organization Structure - Clinical Workflow	Systems Use - Organizational Structure	Systems Use – Clinical Workflow
3a - HIS interfaces are incompatible with the way the practise functions, and thus place a cognitive load on the user.	3a1	PhIS interface design overwhelm its functionality causing cognitive burden to users	-	X	-	-	-	-	-
	3a2	Structured and multi-step PhIS interfaces might interrupt users' focus and overburden their cognitive abilities.	-	X	-	-	-	-	-
	3a3	The rigidity of PhIS functions and machine rules, which are difficult to grasp by users, might lead to errors that the users are unaware of.	-	X	-	-	-	-	-
3b - HIS function is not interpreted and understood in line with the existing task and workflow.	3b1	PhIS functions and features can be translated and re-interpreted differently according to the objective and purpose of the social system use of PhIS.	X	X	-	-	-	-	X
	3b2	Recording of information on PhIS is not effectively performed which results in erroneous functionalities and information in PhIS.	X	X	X	-	-	-	X
	3b3	Users devise and employ workarounds to overcome or prevent difficulties that impair their work.	X	X	X	-	-	-	X
3c – HIS functions are not well adapted with communication and information transfer in practice	3c1	Patients' medication supply information is still primarily based on paper documentation.	X	X	-	-	-	-	X
	3c2	Additional information about patients' medications that was available on paper prescriptions but not recorded in PhIS	X	X	X	-	-	-	X
3d - Emergence of new types of errors	3d	Human errors, user interactions with PhIS, and the quality of the information received and recorded in PhIS contribute to the occurrence of new type of errors.	-	X	X	-	-	-	-

to be continued…

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ISTA-UC Interaction (Factors influencing UC)		UC-PhIS	System Quality – Clinical Workflow	System Use – System Quality	System Use – Information Quality	Organization Structure - Quality System	Organization Structure - Clinical Workflow	Systems Use - Organizational Structure	Systems Use – Clinical Workflow
4a - Changes in current practice	4a1	The way pharmacists perform their work has altered with the usage of PhIS.	-	-	X	-	-	-	X
	4a2	The quality of interactions with patients suffers when users interact more with PhIS.	X	X	-	-	-	-	-
	4a3	Certain PhIS functions are not used as intended by users.	X	X	-	-	-	-	-
	4a4	The implementation of PhIS has increased the emphasis on quality measurement.	X	-	X	-	X	-	-
4b - Change of HIS information content	4b1	Inadequate master data management in PhIS can affect the usability of PhIS functions.	-	X	X	X	-	-	-
	4b2	Erroneous patient information in PhIS is unrecognisable and cannot be clearly detected.	-	X	X	-	-	-	-
4c - Changes in communication and information transfer	4c1	There is a critical need for more comprehensive patient and prescription information before data entry is done in PhIS.	-	-	X	-	X	-	-
	4c2	More communication with patients and prescribers is required to acquire further information.	X	-	X	-	-	-	-
4d - Overdependence on HIS	4d	Dependence on default values, along with task automation, makes users easily overlooked the information displayed during data entry.	-	X	X	-	-	-	-
4e - Changes in users' awareness	4e	Users are becoming more aware of the need of maintaining the integrity of prescription information in PhIS, as well as the privacy and confidentiality of patient information.	-	X	X	-	-	-	-
		Total	**14**	**17**	**12**	**2**	**5**	**1**	**7**

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