Evaluating Unintended Consequences in Health Information Systems

Nurkhadija ROHANI[a] and Maryati Mohd YUSOF[b,1]

[a]*Pharmaceutical Policy & Strategic Planning Division, Ministry of Health, MALAYSIA*
[b]*Faculty of Info. Sc. and Technology, Universiti Kebangsaan Malaysia, MALAYSIA*

Abstract. The use of health information systems (HIS) and complex sociotechnical interactions can generate dangerous unintended consequences (UC). The evaluation of such interactions can provide an understanding of the root causes of UC. This paper reviews the interactions that lead to UC and its contributing factors.

Keywords: error, evaluation, framework, health information systems, patient safety, process, socio-technical, unintended consequences

1. Introduction

Health information systems (HIS) can improve healthcare quality [1,2]. However, HIS have various sociotechnical (social and technical) challenges limiting their potential and introducing new errors that may cause unintended consequences (UC). Healthcare providers can effectively understand their causes by recognising HIS-UC to mitigate them. This paper reviews HIS-UC factors and their complex interactions based on the Interactive Sociotechnical Analysis (ISTA) [3] and Human-Organization-Process-Technology-fit (HOPT-fit) frameworks [4].

2. Methods

We review the literature on UC issues arising from HIS implementation to determine the influencing factors. HIS problems are identified, classified, and summarised based on four ISTA interactions and mapped into HOPT factors in HIS.

3. Results

We identify 16 factors that influence UC in HIS from user perspectives and categorised them based on four selected ISTA interactions: (1) new HIS changes in the existing social system, (2) technical and physical infrastructures mediating HIS use, (3) the social system mediating HIS use and (4) the HIS-in-use changes in the social system. We also deduced the socio-technical dimensions for each UC (Table 1).

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[1] Corresponding author; Maryati.Yusof@ukm.edu.my

Table 1. ISTA-UC-HOPT-fit framework interactions

■ X = need fit, Y = evaluation dimension involved, — = not applicable		HOPT Dimension				
Interactions	**Factors Influencing UC**	Org Structure	Workflow	System Use	Syst Quality	Info Quality
ISTA 1: New HIS changes in the existing social system	1a - HIS disrupts current workflow and practice	-	Y	-	Y	-
	1b - HIS increases workload by changing current tasks and roles	Y	Y	Y	Y	-
	1c - HIS interferes with communication and information transfers	Y	Y	-	Y	-
	1d - HIS requires users to have sufficient knowledge and skills	-	-	Y	Y	-
ISTA 2: Infrastructures mediating HIS use	2a - HIS ability to integrate with existing infrastructure	Y	Y	Y	Y	-
	2b - Ability to provide technical support for HIS use	Y	-	-	Y	-
	2c - Availability of organisational infrastructure to support HIS use	Y	-	Y	-	-
ISTA 3: Social system mediating HIS use	3a - Incompatible HIS interfaces with practice add cognitive load	-	-	Y	Y	-
	3b - HIS functions are not interpreted according to the process	-	Y	Y	Y	Y
	3c - HIS functions are not well-adapted to communication and information transfers	-	Y	Y	Y	Y
	3d - Emergence of new types of errors	-	-	Y	Y	Y
ISTA 4: HIS-in-use changes in social system	4a - Changes in current practice	Y	Y	Y	Y	Y
	4b - Changes in HIS information content	Y	-	Y	Y	Y
	4c - Changes in communication and information transfers	Y	Y	Y	Y	Y
	4d - Overdependence on HIS	-	-	Y	Y	Y
	4e - Changes in users' awareness	-	-	Y	Y	Y
	Total	8	8	13	15	8

4. Discussion and conclusion

HIS use disrupts workflows (UC-1a), communication patterns and information transfers (UC-1c), confusing roles/responsibilities and unclear expectations (UC-1b) in the social system. HIS also transforms the physical and technical infrastructures (UC-2a) that require alignment with clinical workflows to support HIS use in the social system. However, multiple UCs can occur if the HIS functions (system quality) misaligned with the workflows (UC-3b) and communication and information transfers (UC-3c). HIS-UCs result from complex sociotechnical interactions that are difficult to understand. Therefore, evaluators can analyse them structurally to understand the interactions that can trigger HIS-UC for improvements and mitigation purposes.

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