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An importance-performance analysis of hospital information system attributes: A nurses' perspective

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ABSTRACT

Purpose: Health workers have numerous concerns about hospital IS (HIS) usage. Addressing these concerns requires understanding the system attributes most important to their satisfaction and productivity. Following a recent HIS implementation, our objective was to identify priorities for managerial intervention based on user evaluations of the performance of the HIS attributes as well as the relative importance of these attributes to user satisfaction and productivity outcomes.
Procedures: We collected data along a set of attributes representing system quality, data quality, information quality, and service quality from 154 nurse users. Their quantitative responses were analysed using the partial least squares approach followed by an importance-performance analysis. Qualitative responses were analysed using thematic analysis to triangulate and supplement the quantitative findings.
Main findings: Two system quality attributes (responsiveness and ease of learning), one information quality attribute (detail), one service quality attribute (sufficient support), and three data quality attributes (records complete, accurate and never missing) were identified as high priorities for intervention.
Conclusions: Our application of importance-performance analysis is unique in HIS evaluation and we have illustrated its utility for identifying those system attributes for which underperformance is not acceptable to users and therefore should be high priorities for intervention.

1. Introduction

Information systems (IS) have the potential to address numerous problems in healthcare delivery, patient safety, and clinical practice. This may be especially so if IS can be successfully implemented at the point of care [11,17]. Unfortunately, health workers have numerous concerns about IS usage and its implications for their work [5–7,37,50,59,58]. Problems with health workers' acceptance and satisfaction are now regarded among the most significant barriers to the diffusion of IS within health settings [15,34,53]. Tracking the needs of health workers and understanding the attributes of an IS that are most important to their satisfaction and productivity have thus become important components within health IS evaluation and research [4].

An IS user's evaluation of system attributes can influence their affective satisfaction and in turn their usage behaviours [19]. More satisfied users have been associated with deeper levels of engagement with a system's functionality [3,31,35], which is important to achieving higher-order benefits from IS implementations [20]. In the hospital context, nurses comprise the largest group of workers and, as generators and users of health information, need to interact frequently with hospital IS systems [61]. Therefore, improving nurses' satisfaction with hospital IS (HIS) and ensuring that HIS embed attributes necessary for nurse productivity are critical issues for hospital administrators and HIS providers. However, there are few studies in the hospital context that examine how multiple IS system attributes correlate with both user satisfaction and productivity outcomes for nurses (see [12,29]). Past studies have also not adequately examined the relative importance of different HIS attributes to nurse-user outcomes in a manner that distinguishes between those attributes for which underperformance is acceptable to nurse users, those attributes where high performance must be maintained, and those attributes that must be prioritized for intervention. One recent attempt to prioritise HIS attributes from the nursing perspective used a fuzzy analytic hierarchy approach [36]. However, this approach is based on a very small sample size and does not identify priorities with reference to a criterion variable. Without understanding the system attributes most important to users' satisfaction and productivity, efforts to improve HIS performance cannot be effectively prioritized. Consequently, there is

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risk that the intended impacts of HIS on nursing outcomes will be compromised.

The purpose of this study is therefore to identify priorities for managerial intervention by determining which attributes of an integrated hospital information system (HIS) are most important to the satisfaction and productivity of nurses who use the system in day-to-day clinical practice. Our study is undertaken within an importance-performance analysis (IPA) framework [42]. We utilize both quantitative and qualitative data collected from a public hospital in South Africa to understand nurses' evaluations of the *performance* of the hospital information system along the identified attributes, and the relative *importance* of these attributes to nurses' satisfaction with the system and its impacts on their productivity. Our results identify those system attributes requiring the most immediate attention, which can help health care administrators to direct scarce resources in a manner that reduces the risks of system failure, user frustrations and resentment.

2. Conceptual background

The attribute-level performance of an IS has long been recognized as fundamental to user satisfaction and IS success outcomes (e.g. [9,19,33,62]. The DeLone and McLean model of IS success provides a particularly useful organizing framework for understanding system attributes relevant to users. According to this model, attributes along dimensions of technical system quality, stored data quality, information output quality, and support service quality are important to a user's evaluation of a system [19,20,51]. Application of the DeLone and McLean model to HIS research and evaluation has been advocated (e.g. [54,12,13], and found useful in past studies of nurse users [48,49,40]. We therefore draw on the DeLone and McLean [20] IS success model as the theoretical underpinning from which to conceptualize a set of system attributes along which nurse users are expected to evaluate an HIS. Such evaluations are expected to influence two outcome variables, namely user satisfaction and productivity.

2.1. User satisfaction and productivity

User satisfaction is the affective response or attitude of a user towards a specific information system application [67]. Low levels of user satisfaction can reflect as resentment, frustration and tension that lead to inefficiencies in system usage [14] whilst high levels of satisfaction can promote not just 'better' IS usage but also influence the quality of a user's work life [2]. User satisfaction has been identified and empirically supported as a relevant indicator of health IS acceptance [30,65], and should be an important component of any HIS evaluation [2].

A user's evaluation of the benefits of IS use to his or her job performance and task productivity is another important component of their post-usage response [55,62,64]. Such evaluation is particularly important in the HIS context where evidence of productivity impacts has been mixed [12]. Some studies suggest that HIS improves productivity by providing health workers with more time for interacting with patients and engaging in direct patient care [38,46,52,60]. However, other evidence suggests that HIS systems are often accompanied by burdens of data entry, make routine tasks more difficult, interfere with workflow, and have a negative effect on time spent with patients [7,34,37,50,53].

According to the IS success model, HIS attributes reflecting system quality, data quality, information quality, and service quality are important predictors of these user satisfaction and productivity outcomes.

2.2. HIS attributes

System quality is a user's experience of the system from a technical, design and operational perspective [22]. This is reflected in a user's evaluation of system attributes such as ease of use, reliability and response time. These attributes have been found important to healthcare IT acceptance in a number of contexts [6,11,27,32,37,63]. Slow response time and difficulties in HIS use can result in severe dissatisfaction and eventually lead to the shutdown of an HIS system [57].

Data quality exists when the data records stored within a system are considered complete and correct [22]. Improving the availability, completeness and accuracy of electronic records is one of the primary motivations for the introduction of IT systems within healthcare settings. Correctness and integrity of an HIS database is thus a key user requirement essential to the realization of HIS benefits [16,47].

Information quality refers to the content and format of the system's outputs so as to ensure they are usable, sufficiently detailed, meaningful, easy to read and understand, and therefore helpful for task completion and decision making [21,45,22]. Health workers expect HIS to increase the availability of quality information to empower them to do a better job in diagnosis, treatment, and delivery of care [63,47,36]. Nurses' perceptions of information output quality are therefore important in the evaluation of HIS systems [48].

Service quality refers to the availability and responsiveness of support provided to users of the system as well as training opportunities [20]. Gruber et al. [24] systematic review identified user support as highly important for the success of clinical IS implementations, while others show user support as reducing user resistance [28]. A longitudinal study found that training and user support are among the most important factors contributing to nurses' acceptance of an IS in both early and later stages of implementation [39].

Having conceptualized the HIS attributes that can potentially impact on user satisfaction and productivity, we proceed in the next section to describe the study's research methods. We outline our application of importance-performance analysis to determine which HIS attributes are most important to the satisfaction and productivity of nurse users within the context of a public hospital in South Africa.

3. Methods

3.1. Study context

The empirical setting for our study is a public hospital in South Africa. The hospital has regional hospital status and had approximately 570 beds at the time of data collection with a staff complement of about 2200. The hospital services include general surgery, orthopaedics, ENT, ophthalmology, general medicine, radiotherapy and oncology, coronary care, high care, obstetrics/maternity gynaecology, paediatrics, as well as a number of support services including inter-alia radiology, laboratory, social work, and physiotherapy services. The hospital sits in the middle of a larger public hospital network consisting of district hospitals and clinics that refer into the hospital. The hospital acquired its first HIS in 1989, and eleven months preceding our study upgraded to a system that provided full electronic medical record functionality with additional modules for other clinical, administrative, ancillary, and financial applications.

Our data collection took place during transition from the new system's shakedown phase to the onward and upward phase [41]. During this period, monitoring and evaluation of system perfor-