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Reviewing Challenges in Specifying Interoperability Requirement in Procurement of Health Information Systems

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Abstract Procurement of health information systems (HIS) is a complex and critical task that requires early identification of interoperability requirements. However, specifying adequate requirements is often associated with several challenges. We examined relevant peer-reviewed literature and public documents (policy documents, annual reports, and newspapers) to summarize existing challenges in specifying interoperability requirement during procurement of HISs. In this study, 32 public documents and 2343 peer-reviewed articles were found using Google search engine, Springer, PubMed and ScienceDirect. Collected data were analyzed using a thematic coding schema. Our result shows that challenges related to describing the needs properly, conflicting needs and knowledge gaps are shared between most articles. Further research in the direction of developing a model that can bridge knowledge gaps, facilitate interdisciplinary collaboration, and help to avoid fuzzy requirements is needed.

Keywords. Interoperability, procurement, healthcare, health information system, requirement specification, challenges

1. Introduction

Ambiguous or incompatible standards [1], programming errors and different host system configurations [2] are four examples of underlying causes behind interoperability issues [1,3]. If these issues are not dealt with correctly, they can result in loss of data, unreliable operation, low maintainability, and unpredictable performance [3]. In terms of procurement and implementation of health information systems (HIS), missing or insufficient information may jeopardize patient safety [1]. For example, in 2010, the US Food and Drug Administration received information on 260 incidents, including 44 injuries and six deaths, caused by errors in HIS [4]. To avoid endangering patient safety, procurement managers and authorities should support interoperability by specifying

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adequate requirements during the initial planning phase of the procurement process [5]. The purpose of requirement specifications is to communicate the needs to the market and ensure the purchase of interoperable solutions by demanding adequate standards, software, middleware, and other components [6,7]. Since the quality of the interoperability requirements specification affects the entire procurement process and the outcome of the implementation phase, it is of utmost importance to perform this task with high precision [8].

Procurement of HISs, such as electronic health records and remote patient monitoring systems, is a time-consuming and complex process [7]. Rarely does a single supplier deliver all services requested in the requirements specification; usually several actors need to be consulted [5]. Such conglomerates of health services illustrate the complexity of HIS procurements and the challenge of specifying concrete requirements. Together with insufficient technical expertise among procurement managers and conflicting needs, this may lead to inadequate specifications, prolonged procurement processes, increased costs, and purchases that do not yield the desired value [2, 5, 7, 9]. Despite several regulations, guidelines, recommendations, and frameworks that aim to facilitate procurements [1,11,12], several challenges remain; need analysis, lack of interoperability and standardizations [5]. Given the significant failure rate of HISs [2], including the vast National Program for IT (NPfIT) in the United Kingdom initiated in 2002 [13], efforts are required to improve the outcome from interoperability initiatives and projects within healthcare.

This paper aims to review current challenges in specifying interoperability requirements during HIS procurement processes. Challenges will be mapped, and potential solutions will be discussed. The following research question was developed; What challenges are typically faced in the process of specifying interoperability requirements during HIS procurements?

2. Methods

This study utilized a 6-level model to define interoperability and employed a thematic analysis approach, as described by Braun and Clarke [14], to analyze peer-reviewed literature and documents related to HIS procurements. Thematic analysis can be used as a method in qualitative research for identifying, analyzing, and reporting patterns within data [14]. Thematic analysis was adapted for this study and included four of six steps described by [14]: (1) Reading through relevant literature and documents and noting down ideas and interesting aspects of the data. Highlighting potential patterns and relevant segments of data directly in the text in regard to an interoperability model that encompasses device, network, syntactical, semantic, cross-platform and cross-domain interoperability [15]; (2) Organizing data into meaningful groups and creating codes relevant to the research question; (3) Collating codes and assigning them a theme. Assigning similar codes a common, non-overlapping theme, where a theme was defined as challenges that could impede interoperability requirements specifications and hamper HIS procurements; (4) Producing the report [14]. Two types of documents were used in this study, public documents (policy documents, annual reports, newspapers) and peer reviewed articles. Public documents were found using the Google search engine, whereas Springer, PubMed Central and ScienceDirect were used to search for peer-reviewed articles. Search terms included: procurement, requirement, specification, health information, system, and were combined using the Boolean operator AND. A total of

2343 unique articles and 32 public documents were found. The search was conducted between September and November 2022, and the selected sources spanned a period from 2002 to 2022, with the majority published between 2010 and 2022. Documents were assessed according to authenticity, credibility, accuracy, and representativeness [16], whereas the peer-reviewed articles were screened for title and abstract. For all documents and articles, final inclusion was based on following inclusion criteria: written in English language; describes or reports challenges in HIS procurements; describes challenges in specifying interoperability requirements. Documents or articles focusing on procurement of hardware or procurements in other fields than healthcare were excluded. A total of 152 articles passed the screening process.

Table 1. An excerpt from the coding scheme developed during the thematic analysis.

Data extracted	Coded for	Assigned theme
“[...] functional specifications should be based on local needs [...]. [...] hospital representatives stated that the difficulty [...] was the fact that every organizational [...] needs differed significantly”[17].	Different needs	Different needs, conflicting requirements
“[...] requirements specification [...] reveals challenges with fuzzy requirements in tender announcements”[6].	Ambiguous requirements	Difficult to specify concrete requirements or describe the needs properly

3. Results

From the mapping procedure, we identified six common challenges (Table 2) that can be traced to at least two separate sources and are attributed to both suppliers and procurers.

Table 2. Themes describing challenges in specifying interoperability requirements in HIS procurements.

Challenge \ Source	[17]	[5], [10]	[9]	[6]	[18]	[19]	[8]	[20]	[11]	[7]
Different needs, conflicting requirements	x	x	-	-	x	-	-	-	-	x
Lack of technical expertise/knowledge gaps	x	x	-	-	-	-	-	x	x	x
Difficult to specify concrete requirements or describe the needs properly	x	x	-	x	x	x	-	x	x	-
Changing, incomplete or inconsistent requirements	x	-	x	-	-	x	-	x	-	-
Specifying requirements before announcing tender/up front	-	-	-	-	x	x	x	-	x	-
Lack of collaboration or communication among stakeholders	x	-	-	-	-	-	-	x	x	-

4. Discussion

This study complements previous studies (Table 2) by focusing on challenges in specifying interoperability requirements during HIS procurements. We have mapped and summarized prevalent challenges that both procurers and suppliers face during the

requirement specification process. The result shows six challenges that are shared between at least two separate sources. Lack of technical expertise/knowledge gaps, and difficulties in specifying concrete requirements/describe the need properly, were the two challenges that were shared among most of the documents.

Even though the European Commission provides recommendations and guidelines on how to specify technical requirements [21], our results shows that several challenges remain. These challenges need to be addressed since the ability to specify adequate requirements will become increasingly important as organizations more frequently purchase externally developed software as standardized software packages [6]. Furthermore, increasingly complex software systems and data privacy concerns, increase the demand for transparency and well-defined interoperability requirements [22,23]. Since a lack of transparency may lower end user acceptance [22] and impede interoperability, we suggest that patients, clinicians, and managers all engage in the requirement specification process and that transparency is added to the list of requirements. This is also motivated by the fact that inadequate end user engagement and deficient transparency were two underlying causes that lead to dismantling of one of the world's largest civil information technology programme, NPfIT [13].

However, the requirements specification process is complex and requires economical, technical, juridical, and ethical competence and involves multiple conflicting needs. We believe that involving end users in this process could enhance transparency, communication, and trust between stakeholders. This should be especially important in projects where top-down decisions are made by authorities, such as in the NPfIT [13]. However, adding additional actors to the process, who do not necessarily possess the right competence or expertise, requires strategies to bridge potential knowledge gaps and facilitate interdisciplinary collaboration. Johansson and Lahtinen [6] discussed that a new framework could potentially help to avoid fuzzy and inadequate requirements. Uyarra et al [20] further discussed the advantages of specifying requirements in terms of outcomes or performance and suggest that this encourages innovation and supports the tendering. Our result is in line with previous research, and we encourage the development of a model that can bridge knowledge gaps and facilitate the communication and interdisciplinary collaborations.

5. Conclusions

Specifying adequate interoperability requirements in procurement of HISs is a challenging yet important task. We advocate the development of a model that could address the challenges presented in [Table 2](#). The model should help to ensure compliance and conformance with current regulations and help to avoid fuzzy requirements.

We have not covered every single challenge in this study, but rather focused on providing an overview over prevalent challenges related to interoperability requirements that can guide future research. More research in the direction of designing a model or a framework is needed.

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