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How and in what Contexts Does Networked Health IT Improve Patient Safety? Elicitation of Theories from the Literature

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Abstract

Healthcare systems worldwide are investing in networked health IT systems that link healthcare providers across multiple organisations. Much of the policy arguments in favour of such investment rely on the assumption that networked health IT will lead to improved patient safety. As part of the first stage of a realist review to determine how and in what contexts networked, inter-organisational health IT does lead to improved patient safety, we elicited stakeholders' theories from the literature that reveal possible answers to this question. A key mechanism appears to be that the information provided supports improved decision making. Greatest benefits are likely to be found in relation to medication information, in scenarios where the patient is less able to provide accurate information about their medications themselves. However, access and use of this information depends on ease of access, clinicians' perception of the likelihood that the desired information will be available, and clinicians' trust in the information.

Keywords:

Health Information Technology; Health Information Exchange; Patient Safety.

Introduction

Healthcare systems worldwide are investing in networked health IT (HIT) systems that link healthcare providers across multiple organisations. For example, large-scale shared electronic health record projects have been undertaken in the United Kingdom (UK), the United States (US), Canada, Australia, Sweden, Estonia, Singapore, and Hong Kong [1; 2]. Much of the policy arguments in favour of such investment rely on the belief that networked, inter-organisational HIT will lead to improved patient safety [3-7], defined by the World Health Organisation as 'the prevention of errors and adverse events to patients associated with healthcare' [8].

How networked, inter-organisational HIT will lead to such improvements is rarely explicated in the policy literature, beyond the assumption that if clinicians have access to more information they will access and use that information, which in turn will result in better decisions and safer patient care. For example, in 2012 the Department of Health in England published a document entitled 'The Power of Information: Putting all of us in control of the health and care information we need', which set out a ten-year framework for transforming information for health and care and relies on the notion that 'not sharing information has the potential to do more harm than sharing it' [3]. Similarly, a report by the US Department of Health suggests that health information exchange (HIE) can improve safety 'by improving the timeliness and completeness of important patient health information' [5].

At present, there is a lack of evidence to support these claims [1]. Others have previously noted that networked, inter-organisational HIT is a complex intervention [9], meaning that it is aimed at producing change in the delivery and organisation of healthcare services and comprises a number of separate components that may act both independently and interdependently [10; 11]. These components are not only technological but also organisational and social, and they can all impact the extent to which the technology is successfully introduced and subsequent process and patient outcomes. It could be argued that networked, inter-organisational HIT is more complicated than a complex intervention because it spans several settings, with distinct organisational and social cultures and norms in each one. Previous research has revealed that there is significant variation in the use of information provided by networked, inter-organisational HIT, in terms of the amount and type of information that is accessed [9]. Given the complexity of the intervention, such variation is to be expected and raises the question: how and in what contexts does networked, inter-organisational HIT lead to improved patient safety?

We are currently undertaking a review of the literature with the purpose of answering this question. Using the methodology of realist reviews [12; 13], we will elicit, test, and ultimately refine theories on this topic. In this paper, we report on findings from the first stage of the review, the theory elicitation stage. These theories will be tested, using evidence from empirical studies, in subsequent stages of the review.

Methods

Realist review is an approach to synthesising evidence that represents a divergence from traditional systematic review methodology. Realist reviews identify theories of how an intervention is intended to work, for whom, and in what circumstances, and then test and refine those theories through consideration of primary studies [12]. For realists, interventions themselves do not produce outcomes. Rather, interventions offer resources; outcomes depend on how recipients respond to those resources, which is highly dependent on context. Realist theories, referred to as Context Mechanism Outcome (CMO) configurations, explain how different contexts trigger particular mechanisms (the reasoning and responses of recipients) which, in turn, give rise to a particular pattern of outcomes, where C + M = O. For example, from a realist perspective, networked, inter-organisational HIT in and of itself will not result in

improved patient safety. Rather, it is how clinicians respond to and make use of (or not) the resources that networked, inter-organisational HIT provides that will determine the impact on patient safety and how they will respond is likely to vary according to context, such that a doctor in a busy emergency department may respond differently than a nurse in an outpatient clinic. Realist approaches have much to offer the health informatics community, providing a means to not only determine if HIT interventions provide benefit in terms of outcomes, but to understand why and in what contexts such benefits may occur [14].

A realist review involves several stages. An important initial stage in a realist review is 'theory elicitation', where reviewers explore the literature with the explicit purpose of identifying theories [13]. It is only once the theories have been identified that identification of primary studies takes place. Searching should be purposive and iterative, driven not by the intervention but by the theories. This can provide particular benefit when undertaking a review on a topic where there is limited evidence, as is the case with networked, inter-organisational HIT, because the reviewer can draw on evidence from other domains where the intervention is different but the underlying theory remains the same. For example, networked IT systems to support the exchange of data between organisations have been introduced in a range of industries, such as government, manufacturing, and banking, for the purpose of process improvement, which may be based on similar theories of how networked, inter-organisational IT can lead to benefit [15].

Here we report findings from the theory elicitation stage of the review. Three main searches were undertaken for this purpose, one focusing on government policies and official reports, one focusing on opinion leaders in the area of HIT and patient safety, and one focusing on academic and practitioner literature concerned with networked, inter-organisational HIT and patient safety.

Search Strategy

Searches were conducted using synonyms for HIT, e.g. medical records, combined with synonyms for networked IT, e.g. computer networks; Health Information Exchange (HIE), defined as "the electronic movement of health-related information among organizations according to nationally recognized standards" [16]; and interoperability, defined as "the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged" [17]. In some searches, these were combined with synonyms for patient safety, e.g. adverse events, errors. These searches were conducted in February and March 2018 on the following databases: Medline (1946 to present), Embase (1996 to present), and Health Management Information Consortium (1983 to present). Full details of planned searches are available via PROSPERO (CRD42017073004).

Inclusion Criteria

Records were first screened based on title and abstract and then, where available, full papers of potentially relevant records were retrieved and screened. We aimed to identify papers that described stakeholders' theories about how and in what circumstances introduction and use of networked, inter-organisational HIT leads to improved patient safety. We did not restrict our attention to a particular form of networked, inter-organisational HIT such as HIE. No restrictions were placed on the type of healthcare setting.

Data Extraction, Analysis, and Synthesis

To provide an overview of the relevant articles, a short description of each was presented and summarised in a table format. Furthermore, we abstracted out any theories or assumptions, or fragments of theories, concerning the mechanisms through which networked, inter-organisational HIT improves patient safety and/or the contexts in which this may occur. Given the focus of this phase of the review on eliciting theories rather than testing them, when considering empirical studies we focused on the discussion sections, in an attempt to identify authors' theories about why networked, inter-organisational HIT did or did not result in the intended outcomes. In an attempt to construct initial theories, similar theories or theory fragments were grouped together.

Results

The searches reported here identified 375 records, of which 34 records were found relevant. For two of these, only abstracts were available, leaving 32 articles. Stakeholders' theories are likely to be found in editorials, letters, commentaries, and news articles and so these are often the focus of the theory elicitation stage of a realist review [13]. This was the case with our review; the majority of publications were editorials [18], letters to the editor [19-22], commentaries [23-25], and news articles [26]. However, the publications also included original research studies that sought the opinions of HIT policy and opinion leaders [27] and clinicians [28; 29], reports on experiences and lessons learned from the introduction of networked, inter-organisational HIT [30-33], and two systematic reviews [1; 34]. The publications covered a range of networked HIT, including shared EHRs [1; 18; 22-24] and networked picture archiving and communications systems [19].

The included articles discussed barriers to the introduction of networked, inter-organisational HIT – e.g. patient consent to sharing, cost, incompatibility of systems, information held within paper records – as well as drivers for it, such as financial incentives and patient expectations [1; 15; 18-20; 24; 25; 29; 31-35]. However, our concern was not with what constrains or leads to the introduction of networked, inter-organisational HIT but, once it is in place, the contextual factors that support and constrain its use and subsequent impact.

While some articles considered potential risks to patient safety that may be introduced by use of networked, inter-organisational HIT [22; 31], largely the articles reflected the same belief in the potential for improved patient safety that is promoted within the policy arena. Similar to the policy literature, how this would be achieved was often not explicated. For example, an interview study with Canadian HIT policy and opinion leaders reported that:

'clinical data sharing across the continuum of care was believed to be critical for improving safety and effectiveness, especially electronic prescribing and drug management in the near term.' [27]

Only one of the articles referred to a theoretical model that might explain the impact of networked, inter-organisational HIT. Bowden & Coiera [1], in their systematic review of the impact of accessing primary care records during unscheduled care, refer to information value theory [36], which would suggest that networked, inter-organisational HIT can only have impacts on care when the information it provides to clinicians triggers a change in a decision that has the potential for a better (higher value) outcome.

Despite the lack of explicit theory within the remaining articles, we were able to identify two key mechanisms through which authors anticipated that networked, inter-organisational HIT

would lead to improved patient safety: through clinicians making use of the information provided by networked, inter-organisational HIT to inform their decisions about patient care and through clinicians making use of networked, inter-organisational HIT to better coordinate patient care. We consider these two mechanisms in further detail below.

Improved Decision Making

A key anticipated mechanism is that clinicians will respond to the provision of accurate patient information by using that information in their decision making, resulting in improved decision making – although what is meant by 'improved' is rarely articulated – and consequently increased patient safety. For example, Alvarez [23] states:

'providing access to reliable electronic patient encounter data will result in improved diagnostic capability for providers and consequently more appropriate treatment.' (p.34)

A context where networked, inter-organisational HIT was considered to be particularly beneficial for decision making was the emergency department [1; 37; 38], due to the lack of up-to-date medical records at the point of care [31].

In terms of the information to be accessed, a patient's medication history was considered to be particularly important [23; 29; 31]. This was especially the case for patients with mental health issues, where information regarding mental health medications was perceived not only to be critical for decision making but often difficult to obtain accurately from patients [31]. Similarly, information on medications for elderly patients was seen as important, again due to anticipated difficulties in obtaining accurate information from the patient themselves. However, what information will be accessed is likely to depend on the stage in the patient journey, with information on medications, allergies, and diagnoses being the focus during triage and immediate treatment, while access to the full patient record is potentially useful later in the patient's care [1].

Other contextual factors that appear to determine whether information will be accessed and used include the ease of accessing patient information and the clinician's perception of the likelihood that the desired information will be available [31]. Where ease of access is not achieved, this may be overcome by having other staff, such as those in training, searching for information. Related to ease of access is the extent to which the networked HIT is integrated into existing workflows [26; 31]. To use the information, clinicians have to be confident that the information is accurate and up to date [22; 31; 34].

Experience of individuals may also influence the likelihood of clinicians accessing information via networked, inter-organisational HIT, with those with experience of using networked HIT typically being more positive than those without [34]. The benefits to be obtained may also vary according to levels of experience and specialism. For example, Alvarez [23] suggests that sharing of radiology images will benefit smaller hospitals by providing them with timely access to high-quality interpretations by radiology specialists.

Improved Coordination of Care

When reviewing the literature retrieved using the search term 'interoperability', an additional mechanism was identified, whereby the ability to share information provided by networked, inter-organisational HIT is used as a means of communication, leading to improved patient safety through increased coordination of care. While we were only able to elicit theory fragments, we report it here because it represents an alternative theory to the one concerning improved decision making that underlies much of the policy literature.

The e-Health Stakeholder group, a multidisciplinary group established in 2012 with the aim of discussing and contributing to the development of HIT policy at EU level, published a report entitled 'Perspectives and Recommendations on Interoperability' [2]. The report suggests that faster access to patient health records not only enables better decision making but also improved care coordination between multiple clinicians. Because of the fragmented nature of healthcare, where a patient's journey can involve multiple clinicians, there is the potential for miscommunication or error, with communication breakdown or failures in healthcare being one of the most frequent causes of adverse events [30; 39]. Networked, inter-organisational HIT can facilitate communication between clinicians working in different organisations through, for example, the transfer of hospital discharge reports to a patient's general practitioner (GP) or requests from the GP for a hospital appointment, to improve the coordination of care [30].

Beyond the scenarios described above, we were unable to elicit much from the literature regarding the contexts in which this mechanism would be triggered. However, in contrast to the decision making mechanism described above, it appears that this mechanism has less relevance to unplanned care and greater relevance to longer term care, such as palliative care and management of long term conditions such as diabetes [30]. We can also anticipate that some of the contextual factors identified in relation to the decision making mechanism, regarding ease of access of information and trust in that information, also apply here, in order for the clinician receiving the information to incorporate it into care planning for the patient.

Discussion

We have undertaken the first part of a realist review to identify stakeholders' theories regarding how and in what contexts networked, inter-organisational HIT may result in improved patient safety. The findings reveal two possible mechanisms through which improved patient safety may be achieved, one concerned with decision making and one concerned with care coordination, the relevance of which depends on the care context. Drawing together the theory fragments from the literature, two initial theories, formulated as CMO configurations, are presented in Table 1. Given realist evaluation's concern with identifying what works, for whom, in what circumstances, these theories describe what is needed to produce a positive outcome. The implication is that, in the absence of the necessary contextual factors, the mechanism that produces the desired outcome will not be triggered.

Recommendations for Future Work

Evaluation of complex interventions requires a strong theoretical foundation [40]. Bowden & Coiera [1] argue that future evaluations of networked, inter-organisational HIT need to based on appropriate theory, something that is absent in previous studies. We would agree with this and add that, ideally, not only the evaluation but also the introduction of networked, inter-organisational HIT, and HIT more generally, should be based on appropriate theory that explicates how the intended benefits are expected to be achieved. Doing so provides a way for knowledge, in terms of what works and how, to cumulate; if we become explicit about the theories that underlie the introduction of HIT, we can then test those theories, using the refined theories to inform future implementations.

Table 1 – Initial theories

Context		Mechanism: Resource	Mechanism: Response		Outcome
Emergency care Patient is unable to provide accurate medication information Information is easy to access, accurate and up to date	+	Access to medication information	Clinicians access medication information and, trusting that information, use it to inform their decision making	=	Improved decision making Reduced medication errors Increased patient safety
Long term care provided by clinicians spread across multiple organisations Information is easy to access, accurate and up to date	+	Ability to share information	On receiving information, clinicians access it and, trusting that information, incorporate it into their care planning for the patient	=	Improved coordination of care Increased patient safety

Strengths and Limitations

A strength of this work is that we have demonstrated how, when the introduction of HIT is not based on explicit theory concerning how the intended benefits will be achieved, the theory elicitation stage of a realist review provides a means of unearthing stakeholders' theories. The resulting theories can be tested and refined through the use of primary studies, as we will do, or they can be tested and refined through the collection of empirical data [41].

Nonetheless, what is presented here is only the first stage of a realist review and so we can make no claims about the truth of the theories that we have elicited from the literature. However, while the initial theories do not necessarily reflect our views, they do reflect commonly held views in one or more academic and practitioner communities.

Conclusions

Worldwide, there are efforts to introduce networked, inter-organisational HIT. While such HIT promises many benefits in terms of patient safety, these are not always achieved. We have undertaken a realist review to identify stakeholders' theories regarding how and in what contexts networked, inter-organisational HIT may result in improved patient safety. One of the key mechanisms identified in the literature is that access to 'additional' information available through networked inter-organisational IT systems can support enhanced decision making. This mechanism was more likely to yield benefits in relation to medication information, particularly in scenarios where the patient is less capable to provide accurate information themselves. However, different factors can determine the clinician's decision to access and use these systems, such as ease of accessibility, perceived usefulness of the information provided, and their trust that the information is available, accurate, and up-to-date.

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