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# The effects of interoperable information technology networks on patient safety: a realist synthesis

*Justin Keen, Maysam Abdulwahid, Natalie King, Judy Wright, Rebecca Randell, Peter Gardner, Justin Waring, Roberta Longo, Silviya Nikolova, Claire Sloan and Joanne Greenhalgh*





# The effects of interoperable information technology networks on patient safety: a realist synthesis

Justin Keen ,<sup>1\*</sup> Maysam Abdulwahid ,<sup>1</sup> Natalie King ,<sup>1</sup>  
Judy Wright ,<sup>1</sup> Rebecca Randell ,<sup>2</sup> Peter Gardner ,<sup>3</sup>  
Justin Waring ,<sup>4</sup> Roberta Longo ,<sup>1</sup> Silviya Nikolova ,<sup>2</sup>  
Claire Sloan <sup>1</sup> and Joanne Greenhalgh <sup>5</sup>

<sup>1</sup>Leeds Institute of Health Sciences, University of Leeds, Leeds, UK

<sup>2</sup>School of Healthcare, University of Leeds, Leeds, UK

<sup>3</sup>School of Psychology, University of Leeds, Leeds, UK

<sup>4</sup>Health Services Management Centre, University of Birmingham, Birmingham, UK

<sup>5</sup>School of Sociology and Social Policy, University of Leeds, Leeds, UK

\*Corresponding author

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# Abstract

## The effects of interoperable information technology networks on patient safety: a realist synthesis

Justin Keen<sup>1\*</sup>, Maysam Abdulwahid<sup>1</sup>, Natalie King<sup>1</sup>, Judy Wright<sup>1</sup>, Rebecca Randell<sup>2</sup>, Peter Gardner<sup>3</sup>, Justin Waring<sup>4</sup>, Roberta Longo<sup>1</sup>, Silviya Nikolova<sup>2</sup>, Claire Sloan<sup>1</sup> and Joanne Greenhalgh<sup>5</sup>

<sup>1</sup>Leeds Institute of Health Sciences, University of Leeds, Leeds, UK

<sup>2</sup>School of Healthcare, University of Leeds, Leeds, UK

<sup>3</sup>School of Psychology, University of Leeds, Leeds, UK

<sup>4</sup>Health Services Management Centre, University of Birmingham, Birmingham, UK

<sup>5</sup>School of Sociology and Social Policy, University of Leeds, Leeds, UK

\*Corresponding author [j.keen@leeds.ac.uk](mailto:j.keen@leeds.ac.uk)

**Background:** Interoperable networks connect information technology systems of different organisations, allowing professionals in one organisation to access patient data held in another one. Health policy-makers in many countries believe that they will improve the co-ordination of services and, hence, the quality of services and patient safety. To the best of our knowledge, there have not been any previous systematic reviews of the effects of these networks on patient safety.

**Objectives:** The aim of the study was to establish how, why and in what circumstances interoperable information technology networks improved patient safety, failed to do so or increased safety risks. The objectives of the study were to (1) identify programme theories and prioritise theories to review; (2) search systematically for evidence to test the theories; (3) undertake quality appraisal, and use included texts to support, refine or reject programme theories; (4) synthesise the findings; and (5) disseminate the findings to a range of audiences.

**Design:** Realist synthesis, including consultation with stakeholders in nominal groups and semistructured interviews.

**Settings and participants:** Following a stakeholder prioritisation process, several domains were reviewed: older people living at home requiring co-ordinated care, at-risk children living at home and medicines reconciliation services for any patients living at home. The effects of networks on services in health economies were also investigated.

**Intervention:** An interoperable network that linked at least two organisations, including a maximum of one hospital, in a city or region.

**Outcomes:** Increase, reduction or no change in patients' risks, such as a change in the risk of taking an inappropriate medication.

**Results:** We did not find any detailed accounts of the ways in which interoperable networks are intended to work and improve patient safety. Theory fragments were identified and used to develop programme and mid-range theories. There is good evidence that there are problems with the co-ordination of services in each of the domains studied. The implicit hypothesis about interoperable networks is that they help to solve co-ordination problems, but evidence across the domains showed that professionals found interoperable networks difficult to use. There is insufficient evidence about the effectiveness of interoperable networks to allow us to establish how and why they affect patient safety.

## ABSTRACT

**Limitations:** The lack of evidence about patient-specific measures of effectiveness meant that we were not able to determine 'what works', nor any variations in what works, when interoperable networks are deployed and used by health and social care professionals.

**Conclusions:** There is a dearth of evidence about the effects of interoperable networks on patient safety. It is not clear if the networks are associated with safer treatment and care, have no effects or increase clinical risks.

**Future work:** Possible future research includes primary studies of the effectiveness of interoperable networks, of economies of scope and scale and, more generally, on the value of information infrastructures.

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## List of abbreviations

CPOE	computerised physician order entry	MeSH	medical subject heading
EHR	electronic health record	PPI	patient and public involvement
e-SSA	electronic version of single shared assessment	PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
GP	general practitioner	RAMESES	Realist And Meta-narrative Evidence Syntheses: Evolving Standards
HIE	health information exchange		
HIT	health information technology		
IT	information technology		



## Plain English summary

Many countries, including England, are investing money in information technology networks. The hope is that these networks will help to improve the quality and safety of patient care. Many patients are treated by professionals from different organisations, and each organisation holds its own – partial – records. In some localities in England, professionals cannot access the records held in other organisations. Increasingly, however, localities are implementing digital networks that allow them to access all of their patients' records, wherever they are held. It is not known, however, if the networks actually lead to improvements in treatment and care. We undertook a systematic literature review, using an established method called realist synthesis, to find out whether or not the networks help to improve patient safety.

We conducted literature searches for three problems that the networks might help to solve: (1) co-ordinating services for older people living at home, (2) ensuring that older people who are prescribed medicines by more than one organisation take the right ones and (3) preventing children who are considered as being at risk coming to harm. We found good evidence in all three searches that there are problems with the co-ordination of services. Similarly, we found evidence in all three searches that professionals find networks difficult to use.

Our main search finding was that there is very little evidence about the effects of interoperable networks on patient safety. This means that it is not possible to say whether the networks improve patient safety or, indeed, if they undermine it. NHS managers and professionals should be aware of the lack of evidence and take steps to monitor the effectiveness of their own local projects. There is also a need for research that establishes the cost-effectiveness of interoperable networks.



# Scientific summary

## Background

Many people who live in their own homes and have a number of health problems need support from a range of health and social care professionals. These include general (or family) practitioners, community nurses, therapists, social workers, and hospital-based doctors, nurses and other professionals. There is good evidence that treatment and care is often fragmented, and increases patients' safety risks. Policy-makers and opinion leaders argue that information technology networks that link organisation systems – often referred to as interoperable networks – can help to overcome fragmentation and support effective co-ordination of services and, thus, ensure safer treatment and care.

The networks might support safer services in two main ways. First, health and care professionals can use the networks to communicate securely with one another and to actively co-ordinate a patient's treatment and care. The value of this function might be particularly evident at transition points (e.g. in a health emergency or at the point of leaving hospital to return home). Second, different services have historically held their own records, and information about a patient's treatment and care held in one service could not be accessed by professionals working in others. The networks can be designed to enable professionals to search for and locate information wherever it is held, and use the additional information to provide better and safer treatment and care.

To the best of our knowledge, there have not, to date, been any systematic reviews of the effects of cross-organisational interoperable networks on patient safety. We conducted a realist synthesis, that sought to both describe and explain the effects of interoperable networks on patient safety.

## Aim and objectives

The aim of the study was to establish how and why interoperable networks improved patient safety, failed to do so or increased safety risks. The objectives of the study were to:

- identify initial programme theories and prioritise theories to review
- search systematically for evidence to test the theories
- undertake quality appraisal, and use included texts to support, refine or reject programme theories
- synthesise the findings
- disseminate the findings to a range of audiences.

## Design

We undertook a realist synthesis. As with all realist syntheses, a key feature of the design was a comparison of the intended with the actual effects of an intervention. The comparison provided a basis for explaining how the intervention worked and why it was effective (or ineffective) in practice. The intervention of interest was interoperable networks that linked organisations across a health and social care economy. The outcomes were changes in patients' clinical risks (e.g. improvement in medication reconciliation error rates).

Information about the intended effects of interoperable networks on patient safety was identified in statements in policy documents, opinion leader articles and other sources. These were used to develop programme theories, which together represented both how and why the networks were intended to

work. We then conducted nominal group meetings with policy-makers and with NHS information technology leads, and telephone interviews with front-line clinicians, to elicit their interpretations of the theories and to establish their priorities for review. The main programme theory selected for detailed study focused on specific effects on the decisions and actions of professionals, and the consequences for patient safety. We also developed a mid-range theory to be used as a source of independent judgement criteria in the evaluation phase of the synthesis.

A case study design was used to co-ordinate literature searches for empirical evidence about the actual effects of interoperable networks. Searches were undertaken in four domains:

1. older people living in their own homes who are in receipt of two or more services from different organisations
2. older people living in their own homes who have been prescribed medications from two or more organisations
3. children who are at risk of harm
4. economies of scope and scale of interoperable networks across health and social care organisations in a health economy.

A leading programme theory was tested and revised in each of the first three domains (within-domain evaluation). The designs of the three searches were very similar, allowing us to compare and contrast findings across domains (cross-domain evaluation). The fourth domain was different in kind from the first three. It was designed to evaluate an alternative programme theory based on the argument that information technology networks can generate 'global' effects across all users. The literature searches were, accordingly, distinct from those used in the first three domains. The common and contrasting findings were then further reviewed against the mid-range theory, enabling us to assess the extent to which the revised programme theory might be generalised to other information technologies and settings.

## Patient and public involvement

The patient and public involvement group met three times during the study and contributed to its design and conduct on each occasion. At the first meeting, we presented the early findings of our theory development searches and the nominal group meetings. The patient and public involvement group provided valuable comments, in particular helping us to prioritise which populations and settings we should focus on. It was their comments, taken in tandem with the views of the nominal groups, that led us to focus on services for frail older people living at home (later broadened, pragmatically, to older people in general). They also noted the importance of medication reconciliation, and expressed the view that the next most important population to study would be at-risk children. We acted on all three of these comments.

At the second meeting, we presented the interim findings of the first two sets of searches, which were on the co-ordination of services for older people and on medication reconciliation. The group gave their comments on, and interpretation of, those findings. At the third meeting the group commented on drafts of the Discussion and Conclusions chapter and the Plain English summary.

## Results

In the theory development phase of the synthesis, we did not find any detailed accounts of the ways in which interoperable networks are intended to change the behaviour of professionals and, by extension, improve patient safety. There were many statements to the effect that treatment and care would be safer, but the majority did not attempt to explain in any detail how or why the improvements would be achieved. We were, however able to identify a substantial number of theory fragments, and we used

these to develop initial rough programme theories. We were also able to identify a mid-range theory that framed (provided a broad theoretical framework for) the interpretation of the evidence about the programme theories. The mid-range theory was institutional, emphasising that technology developments and working practices shape one another over time.

### ***The co-ordination of services for older people***

We found substantial evidence about the nature and extent of care co-ordination problems. Most of the problems were essentially social or cultural. For example, there were several evidenced-based reports of difficulties due to different health-care professionals having incompatible working assumptions about the kinds of support that older people needed. There was no obvious role for interoperable networks in solving most of these problems. There was one exception, which concerned difficulties associated with information-seeking and retrieval. The problems were attributed to a combination of interprofessional issues not directly related to technology, as well as to characteristics of the networks (such as multiple log-ons) and the difficulty of locating patient information held on other organisations' servers. We did not find any countervailing studies that reported 'seamless' use of interoperable networks.

There was limited and weak evidence about the effectiveness of interoperable networks in reducing older people's risks. The evidence was for limited networks, typically involving a single application (such as a shared assessment process), and based on the subjective views of users. We did not find any quantitative patient-focused measures of effectiveness.

### ***The co-ordination of medication reconciliation***

We found limited empirical evidence that there is a problem with the process of conducting medication reconciliation. The available evidence suggested that medication reconciliation problems could be due to responsibility for reconciliation not being clear on the ground and could fall between professionals (principally pharmacists, doctors and nurses).

Another search investigated the nature of problems encountered in reconciliation when using interoperable networks. We found one observational study, and seven further 'offline' simulation studies, about the nature of clinicians' cognitive processes and the error rates associated with them. These studies suggested that errors could occur in both types of reconciliation. There was less field-based evidence about users' experiences in this domain than about those in services for older people or in child protection services.

A search focusing on evidence about changes in patient outcomes produced mixed results. Some articles indicated that the use of an interoperable network was associated with a measurable reduction in reconciliation errors. Others reported problems with using systems that resulted in interoperable networks having no effects on reconciliation error rates.

### ***Child protection***

We found evidence of co-ordination problems in child protection services. There is a debate in the academic literature about the nature of those problems. In the context of this synthesis, the key difference is that some commentators interpret the problems in mechanistic terms as communication failures, whereas others argue that they reflect deeper interprofessional and interorganisational problems.

There was some evidence that users find interoperable networks difficult to use, but this was relatively less than the evidence we found for the co-ordination of services for older people. We did not find any evidence about the effectiveness of interoperable networks, defined as changes in children's risks of harm.

### ***Economies of scope and scale***

We did not find any evidence of effects of interoperable networks on health economies.

## Limitations

The study had four main limitations. First, we found little evidence of outcome changes. We were not, therefore, able to determine 'what works', nor any variations in what works, when interoperable networks are deployed and used. This point is linked to the second limitation, which is that we used a case study method to evaluate interoperable networks in the three domains, and in terms of economies of scope and scale. Taking the two together, we can say that we have been able to address broad questions about the nature of the co-ordination problems in the chosen domains and practical experiences of using interoperable networks. We were not, however, able to produce fine-grained evidence that would allow us to evaluate our programme theories in detail. Third, we developed and used a mid-range theory. The theory provided an independent statement against which the relevance of articles could be judged. A disadvantage of the mid-range theory, we have found, is that it has risked locking us into the assumptions underpinning that theory. It would have taken a great deal of time and intellectual effort to move to another theoretical framework. We were able to use the mid-range theory to interpret our data, but in principle another framework might do equally well and we have not tested alternative theories for their 'fit' with the data. Fourth, we deliberately biased our choice of domains in favour of services for which we were most likely to find evidence of effects. We therefore have to be cautious about generalising from our findings to other domains.

## Conclusions

The conclusions from the realist synthesis are that there is:

- good evidence that there are problems with the co-ordination of services in each of the three domains studied
- evidence across the domains that professionals have found interoperable networks difficult to use
- no evidence of economies of scope and scale across health economies
- insufficient evidence about the effectiveness of interoperable networks to allow us to establish how and why they affect patient safety.

### *Future work*

There are three implications for practice:

1. Practitioners, including informatics and information leads, should note the lack of evidence about the effectiveness of interoperable networks and take steps to monitor the effects of local programmes themselves.
2. Practitioners should take note of the negative evidence about users' experiences of using interoperable networks.
3. Practitioners should be aware of the extent to which institutional arrangements and, in particular, the challenges of working across professional and organisational boundaries influence the deployment and use of interoperable networks.

The priorities for future research are as follows:

- Primary empirical studies of the effectiveness of interoperable networks in health and social care.
- Primary empirical studies of economies of scope and scale associated with interoperable networks in health and social care.
- In the course of this synthesis we came across a literature on patients' access to their records via interoperable networks. A synthesis focusing on patient portals would complement the synthesis reported here.
- More detailed guidance on the design and conduct of realist syntheses, updating current Realist And Meta-narrative Evidence Syntheses: Evolving Standards guidance.



## Study registration

This study is registered as PROSPERO CRD42017073004.

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# Chapter 1 Introduction

Just 25 years ago, most commentators assumed that health services were generally safe. Then, in 2000, the Institute of Medicine in the USA published a report on patient safety: *To Err is Human: Building a Safer Health System*.<sup>1</sup> The evidence presented in the report suggested that rates of adverse events – events that resulted in harm to patients – were far higher than anyone had realised. It proved to be a landmark report, not just in the USA but around the world. Ever since, policy-makers around the world have been acutely aware that treatment and care need to be safer.

The NHS in England has committed considerable resources to improving patient safety in the intervening 20 years. Overall, however, the rate of adverse events remains high and it is widely accepted that there is still considerable scope for improvement.<sup>2</sup> A range of interventions have been proposed by policy-makers, including quality improvement initiatives, the use of performance targets and comparative audits. A series of government policies and official reports published over the last 20 years have argued that health information technologies (HITs) can also improve patient safety.<sup>3-5</sup> This report investigates this argument. We have undertaken a realist synthesis of evidence about an important class of HITs, namely interoperable networks. These are networks that link the information technology (IT) systems of different organisations in a health economy, so that a professional based in one organisation can access data about a patient held in another organisation during the course of treatment and care. There is a continuum of technical solutions. At one end is a network that allows a user to access a remote patient database using a separate log-in, so that the user has to accept the layout and content of that database. At the other end is an integrated solution in which a user logs on once and sees a patient record that has a single consistent layout and for which data from all sources are easily accessed.

## The effects of health information technologies on patient safety

When we bid for this evidence synthesis, we were aware of two systematic reviews that usefully summarised what we knew about HITs and patient safety, and helped us to pinpoint what we did not. Black and colleagues<sup>6</sup> undertook a ‘review of reviews’ of a number of HITs that have been available for many years, including telehealth, electronic health records (EHRs) (used within organisations), decision support systems and hospital e-prescribing systems. Black and colleagues<sup>6</sup> focused initially on experimental and quasi-experimental studies, but then broadened their searches to include a selection of observational studies of implementation. The majority of reported studies were conducted in hospital settings, with the main exception being studies of telehealth applications. Some of the studies reported positive results, notably for electronic medicines reconciliation, whereas others found mixed and negative results, including for telehealth. The authors commented on the poor overall quality of the literature and, in particular, on the small numbers of high-quality randomised controlled trials in the domain.

Second, Brenner and colleagues<sup>7</sup> identified 31 systematic reviews that focused on HITs and patient safety. The authors<sup>7</sup> reported on a range of systems, including computerised physician order entry (CPOE), order entry alerts (e.g. for contraindicated drugs), EHRs, clinical decision support systems, electronic medicines reconciliation and electronic clinical pathways software. They used a broad definition of patient safety, and the end-point measures included mortality, adverse drug events and infection rates. Twenty-five out of 69 included studies reported a statistically significant positive effect on the patient safety measure assessed. Overall, however, the authors concluded that, ‘many areas of health IT application remain understudied and the majority of studies have non-significant or mixed findings’.<sup>7</sup>

These reviews led us to identify two significant gaps in the applied health research literature. First, we did not find any systematic reviews of the effects of interoperable networks on patient safety outside hospitals. There was evidence about telehealth, but a large England-based trial showed that telehealth was not cost-effective and systematic reviews of international evidence were, at best, inconclusive.

There was no case for another systematic review. The one published review that shed light on interoperable networks focused on effects on resource use rather than on patient safety.<sup>8</sup>

This state of affairs was a surprise, given that government policies in many countries had promoted investments in interoperable networks – or, to use the preferred US term, health information exchanges (HIEs) – for some years. In particular, the Barack Obama administration in the USA had allocated US\$35B to HIT investments from 2009. A substantial proportion of the money was to be spent on information exchanges, linking hitherto separate IT systems in hospitals, family physicians' offices, pharmacies and elsewhere. The benefits claimed initially included improvements in patient safety, cost savings and productivity improvements.

Information technology policies in England had also promoted investments in interoperable networks from 2015 onwards, although the central monies allocated were initially modest.<sup>9</sup> We were also aware of developments on the ground in a number of health economies. For example, health and social care organisations in the city of Leeds had been developing an IT platform, or information infrastructure, linking their various systems together for a number of years. Nurses, doctors and other professionals working in one organisation could already access patients' records held in others' systems. There was a gap, then, between investments in this sort of development and the evidence about their value, particularly in relation to patient safety.

The second gap concerned the 'how and why' of the deployment and use of HITs. We were struck by the effectiveness evidence: why was it so mixed and why were effect sizes so modest? Mobile phones and other consumer technologies have transformed the way we search for information, shop and communicate with one another. Why were no similar effects found in health and social care settings? We did not expect effectiveness studies to answer these questions, but we were aware of other literatures that might help us to do so. For example, a comprehensive review of evidence from the field of human-computer interactions revealed that, in contrast with applied health research, there was a long history of empirical studies stretching back to the 1980s. The review suggested that health professionals often found systems difficult to access and use. A range of problems was cited, including poor interface designs and the unreliability of hardware.<sup>10</sup> There was, again, more evidence about hospital than extra-hospital systems, but some evidence about the latter was presented. Similarly, sociological studies reported problems with integrating IT systems into routine clinical practice.<sup>11-13</sup>

These literatures were consistent with reports that HITs could increase patients' risks. A 2011 Institute of Medicine report neatly summarised the problem:

*... some case reports suggest that poorly designed health IT can create new hazards in the already complex delivery of care. Although the magnitude of the risk associated with health IT is not known, some examples illustrate the concerns. Dosing errors, failure to detect life-threatening illnesses, and delaying treatment due to poor human-computer interactions or loss of data have led to serious injury and death.*

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## A realist synthesis

Putting these lines of argument together, we decided to focus on interoperable networks that link organisations across health economies, and their effects on patient safety. Furthermore, we agreed with the Institute of Medicine that there were risks, as well as benefits, associated with HITs. It would therefore be important to go further than identifying the effects associated with interoperable networks, and explain how and why the networks produced these effects.

We needed, then, to identify an evidence synthesis method that would allow us to investigate the 'how and why' of interoperable networks, as well as their effects on patient safety. We would also need to be able to assimilate both narrative and quantitative evidence into the synthesis. Pope and colleagues<sup>15</sup> have reviewed the methods that are available for the synthesis of 'mixed' health evidence, including narrative reviews and thematic analyses. Pope and colleagues<sup>15</sup> emphasise that each method has strengths and weaknesses, and that each one is better suited to some topics and research questions than others. Following Pope and colleagues' analysis,<sup>15</sup> and drawing on our own experience, we judged that a realist synthesis would be appropriate. It would allow us to identify how and why interoperable networks led to particular outcomes, in our case how and why they led to changes in patient safety. As we show in *Chapters 2 and 3*, we took the caution about the weaknesses of the method seriously and actively sought to mitigate them in this review.

## Aims and objectives

The aim of the study was to establish how and why networked, interorganisational HIT services improve patient safety, fail to do so or increase safety risks. We undertook a realist synthesis. The method involved identifying (1) programme theories that capture the chains of reasoning that lead from an intervention to its use and subsequent effects, and (2) reasons why the intended improvements are, or are not, achieved in practice, or indeed increase safety risks.

The objectives of the study were to:

- identify initial programme theories and prioritise theories to review
- search systematically for evidence to test the theories
- undertake quality appraisal, and use included texts to support, refine or reject programme theories
- synthesise the findings
- disseminate the findings to a range of audiences.

## Protocol change

One change was made to the protocol for this evidence synthesis. The intention was to run three nominal groups to consult with policy-makers, senior informatics managers and front-line clinicians in the theory development stage. We were able to organise the first two nominal groups but not the third, principally because front-line staff were not able to obtain permission for time off to attend the initial meeting. We used a different method, eliciting the views of seven health and social care professionals based in two localities in the north of England in semistructured telephone interviews. This method is described in *Chapter 3*.

## Structure of this report

*Chapter 2* provides an overview of the study design of the realist synthesis and shows how we made key decisions about the design. *Chapter 3* describes our literature review, nominal group and interview methods. *Chapter 4* sets out the findings of the theory development phase of the synthesis. The next four chapters present evidence search findings. *Chapter 5* presents the findings for the co-ordination of services for older people. *Chapter 6* presents the findings for searches on medication reconciliation undertaken in the course of care of older people. *Chapter 7* presents the co-ordination of child protection services. *Chapter 8* presents the evidence about economies of scope and scale resulting from the deployment and use of networked HITs. In *Chapter 9* overall synthesis of the findings is presented and discussed, and the conclusions and recommendations are listed.



# Chapter 2 Study design

## Introduction

This chapter sets out the study design for the realist synthesis. The next section (see *Theory development and programme theories*) outlines the key features of a 'standard' realist syntheses, reported in many published accounts. Core elements of our study design are consistent with those accounts. We then note the diversity of study designs and methods reported in the literature.<sup>16</sup> Realist syntheses have common characteristics, notably in the development and testing of programme theories that investigate the relationships between interventions and outcomes. However, they also vary in the ways in which theories are developed and in which they are tested, and teams therefore need to make choices about their synthesis designs. The last section (see *Mid-range theory*) sets out the choices that we made and the ways in which they influenced our study design. The synthesis is registered with PROSPERO CRD42017073004.

## Theory development and programme theories

The realist synthesis review method was first described in detail by Pawson in *Evidence-Based Policy*<sup>17</sup> in 2006. The first stage, which we refer to as theory development in this report, involves the development of a programme theory.<sup>18,19</sup> A programme theory is a representation of the way in which an intervention is intended to work. It typically involves a sequence of decisions and actions that lead to a defined outcome, underpinned by reasoning about how those decisions and actions follow one another. A number of programme theories may initially be developed, reflecting different ways in which an intervention might lead to an outcome. Sources of programme theories can include government and other policy documents, and accounts by opinion leaders in journal editorials and elsewhere. It has become usual, in the last few years, for stakeholder consultation to be used as another source of information for developing programme theories.

Sometimes, established theories have already been published, and these can be used by the review team. On other occasions, no plausible, published sequences can be found. When this happens, review teams can instead identify potentially useful fragments, covering partial sequences of events, which are pieced together by the review team. Evidence is then identified and evaluated. This is to establish the actual sequence of events that links an intervention and an outcome, and whether or not the underlying reasoning is supported by empirical evidence. (Putting this a slightly different way, a rationalist approach to identifying an intended sequence of events is followed by empirical assessment of that sequence.)

Most realist syntheses present evidence reviews in three distinct stages (*Figure 1*). First, key concepts are identified from the review question and used to design the literature searches. Inclusion and exclusion criteria are defined and used to identify articles for full-text review. The second stage involves close scrutiny of the full text of the included articles, which are assessed for rigour and relevance, with data and relevant theory extracted. Third, the data and theory in the included articles are synthesised and compared with the initial programme theories. Any one theory might be supported, refined or rejected. Pawson points out that the conduct of realist syntheses is typically iterative. Empirical evidence might, for example, suggest that there is evidence to support a proposed sequence of events, but there may be additional steps in the sequence that were not identified in initial programme theories. As a result, evidence has not been sought for these steps, and further searches need to be designed and conducted.

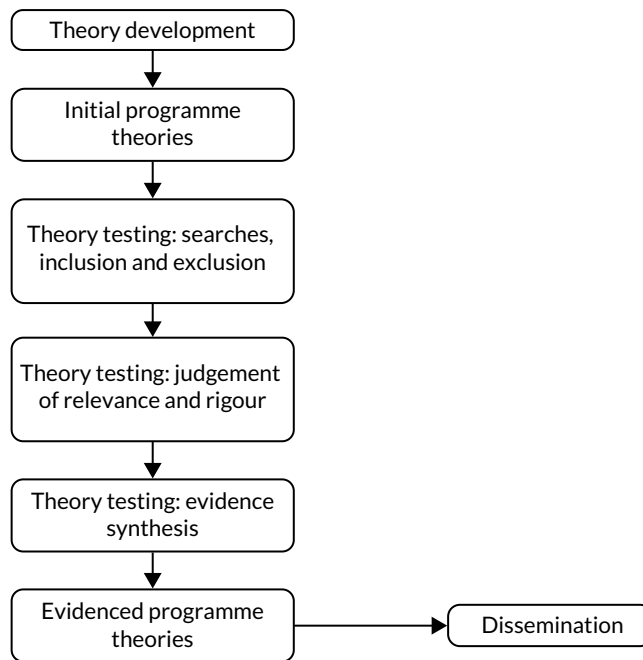


FIGURE 1 Study design.

The design of our realist synthesis is consistent with the Realist And Meta-narrative Evidence Syntheses: Evolving Standards (RAMESES) guidance. The left-hand column in *Figure 2* illustrates the flow of methods. The first stage involved developing initial programme and mid-range theories. These represented the intended changes and effects associated with the intervention (i.e. the use of interoperable networks). The methods used include literature searches and consultation with stakeholders, the latter using nominal groups and semistructured telephone interviews. The next three stages were designed to identify evidence about actual changes and effects. The evidence reviews comprised carrying out literature searches, screening reports against inclusion and exclusion criteria, assessing relevance and rigour, data extraction and synthesising evidence. The methods are described in *Chapter 3*.

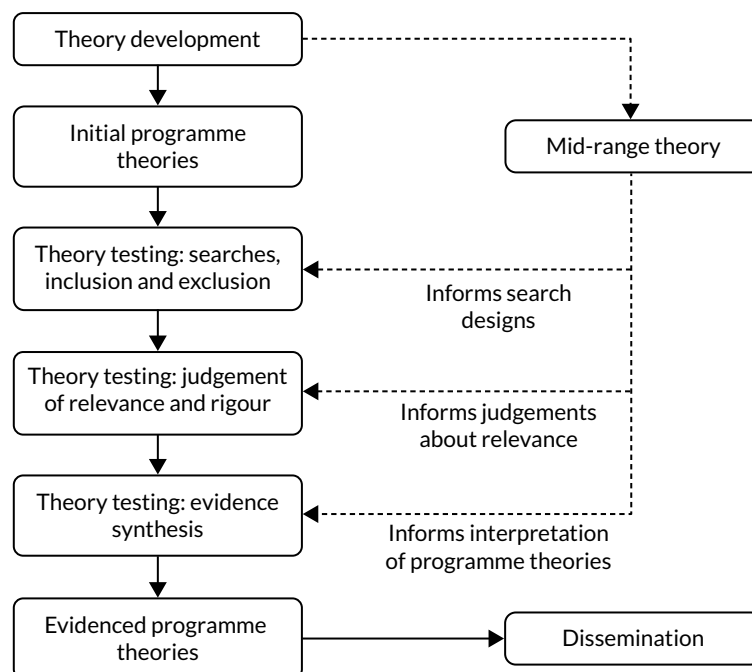


FIGURE 2 Study design, including mid-range theory.



## Mid-range theory

As we have noted, there is also variation in published study designs, particularly in relation to the role of theory. The RAMESES guidelines on the conduct and reporting of syntheses provide general, rather than prescriptive, guidance, offering flexibility to each research team.<sup>20</sup> It can be argued that this state of affairs is reasonable: it gives teams the space to develop a still-new methodology and evaluate different ways of conducting one. It also means, however, that a team undertaking a realist synthesis today has to make some choices about its preferred study design and methods.

The right-hand column in *Figure 2* represents a distinctive feature of our study design and reflects our thinking about the role of theory. Our starting point is the observation that programme theories are not neutral, for the straightforward reason that researchers from different backgrounds (psychology, sociology, geography and so on) might develop different programme theories about the same intervention. That is, they think about, or frame, their theories in different ways, reflecting the beliefs and assumptions of their host disciplines. It is therefore important, as a minimum, to know what beliefs and assumptions have framed any given programme theory.

In 2013, Pawson<sup>21</sup> noted the diversity of ways in which theories are incorporated into study designs. Our reading of the realist synthesis literature in the course of this study supports this point; we found that published accounts offer three main options. One is to use concepts derived from classical systems theories, typically referred to as context–mechanism–outcome configurations. The key idea is that the course of a given sequence of events (i.e. the events represented in a programme theory) is directly influenced by the context in which those events occur. Evidence searches might show that an intervention that works in one context may not work in another; the differences between the two can shed light on how and why the sequences of events work, or fail to do so. We decided not to use this approach, because in this study interoperable networks seemed to be the context for behaviour change across a locality. That is, it seemed that interoperable networks were both contexts and mechanisms.

The second option, which appears to be the most popular in practice, is to rely solely on programme theories; a psychological, sociological or other theory is embedded in the programme theories (implying that the nature of the theory should be stated explicitly by the research team). We decided not to rely on programme theories alone for the reason given above: we felt that it was important to make any conceptual framing of theories explicit in the study design.

The third option is for a research team to identify a relevant theory, typically referred to as a mid-range theory. The theory used might be based on the team's prior knowledge of a domain or on the initial reading in the course of the study, or a combination of the two. We decided to pursue this option. In doing so, we were able to draw on the work of authors who have identified and used mid-range theories to inform their deliberations.<sup>22–24</sup> We also drew on Pawson's<sup>17</sup> account of mid-range theories as 'reusable conceptual platforms' (they are reusable in the sense that the same underlying reasoning can underpin a number of programmes).<sup>17</sup>

The mid-range theory needed to be integrated into the study design and we were not able to find published accounts that made it clear how this could be done. We took the view that mid-range theory performs different functions (represented by the dotted lines in *Figure 2*): informing the design of searches, serving as a source of criteria for judging the relevance of articles and facilitating the synthesis of evidence. Following the synthesis of findings, the theory was used to inform the generalisation outwards from programme theories across populations, interventions or settings. Overall, it acted as a sort of 'glue', helping to bind the stages of the synthesis together.

The decision to use a mid-range theory influenced other design decisions. One decision concerned the assessment of rigour and relevance, which we discuss in *Chapters 2 and 3*. Additionally, at the start of the study, we assumed that there would be both similarities and differences in the ways in which interoperable networks influenced processes and outcomes. We were already aware of relevant literatures, including the human–computer interaction literature and the sociological literature on the development of large-scale IT systems. Our initial reading and deliberation confirmed that a theoretical framework that might account for large-scale change, spanning organisational and professional boundaries, would be appropriate. As we will see in *Chapter 4*, our mid-range theory (our reusable conceptual platform) drew principally on the literature on information infrastructures. This is an example of an institutional theory: published realist syntheses have used institutional frameworks and we followed their example in this study.<sup>25,26</sup>

Finally, the decision about mid-range theory influenced our thinking about programme theories. They are used in different ways, for example to characterise causal relationships between activities or to capture the underlying inferential logic of an intervention.<sup>27</sup> Our choice here was to develop programme theories that represented contingent sequences of concrete decisions and actions, ending in a defined outcome. In this synthesis the outcome was a change in patients' or clients' risks, consistent with arguments about outcomes made by Pawson and colleagues.<sup>28,29</sup> We sought to strengthen our confidence in findings about these contingent sequences by undertaking searches focusing on different functions of interoperable networks (e.g. supporting professionals co-ordinating care for older people and reconciling medication lists for older people) and different populations (older people, at-risk children). Comparing across functions and populations provided us with a means of identifying and interpreting any similarities and differences that we found between functions and populations.

# Chapter 3 Methods

## Introduction

In *Chapter 2* we described the overall design of the realist synthesis and explained the rationale for key design decisions. In this chapter we describe our methods. The next section introduces the literature search methods, including the common features of methods used throughout the study. The following sections set out screening and selection, and data extraction and quality appraisal. The final section describes the stakeholder consultation that we undertook in the course of the review.

## Literature search methods

We took the approach of conducting a number of literature searches throughout the review, rather than relying on a single ‘big bang’ search that could be used to address a number of questions. This allowed us to identify separate literatures that were pertinent to identifying theories and theory fragments in the theory development phase or to identifying empirical evidence in the theory testing reviews.<sup>16</sup> The following 19 information resources were searched:

1. Association for Computing Machinery (ACM)’s Digital Library (full text)
2. Agency for Healthcare Research and Quality’s PSNeT Patient Safety Network
3. Applied Social Sciences Index and Abstracts (via ProQuest)
4. Cumulative Index to Nursing and Allied Health Literature (via EBSCOhost)
5. The Cochrane Library (via Wiley Online Library), including Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, Health Technology Assessment Database
6. Criminal Justice Abstracts (via EBSCOhost)
7. EMBASE Classic and EMBASE (via Ovid)
8. Epistemonikos (Epistemonikos Foundation, Santiago, Chile)
9. Google (Google Inc., Mountain View, CA, USA)
10. Google Scholar (Google Inc., Mountain View, CA, USA)
11. Health Management Information Consortium (via Ovid)
12. Health Systems Evidence (McMaster University, Hamilton, ON, Canada)
13. Inspec (via EI Village)
14. Ovid MEDLINE®, including Epub Ahead of Print and Ovid MEDLINE® In-Process & Other Non-Indexed Citations
15. PsycINFO (via Ovid)
16. Research Papers in Economics (EconPapers; Örebro University Business School, Örebro, Sweden)
17. Scopus® (Elsevier, Amsterdam, the Netherlands)
18. Sociological Abstracts (via ProQuest)
19. Web of Science™ Core Collection (Clarivate Analytics), including Arts and Humanities Citation Index, Book Citation Index – Social Sciences and Humanities, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Sciences Citation Index, Social Sciences Citation Index and Emerging Sources Citation Index.

*Appendix 1* provides a detailed listing of databases, sources and search strategies used for each individual search.

The databases and sources used for each search were selected based on the type of study or publication being sought (e.g. policy document, systematic review) and the question posed for each search (e.g. the nature of co-ordination problems, users’ experiences of interoperable networks). Populations, interventions,

comparators, outcomes and settings (PICOS) were identified before some of the theory development and all of the evidence searches to aid search strategy development. All of the searches were performed and peer-reviewed by information specialists (NK and JW). Search terms and synonyms were identified by the project team and from known relevant papers. Structured search strategies were developed using free-text words, synonyms and subject index terms, organised into search concepts. Further complementary searches, including forwards and backwards citation searches, were undertaken by both the information specialists and the reviewers; the team members who undertook the searches are stated in each instance.

Searches that were designed to retrieve particular study types, such as systematic reviews or narrative research articles, used one of three strategies, namely (1) database 'limit' features (e.g. systematic reviews publication type limit in Ovid MEDLINE), (2) a 'study type' search strategy developed by the University of Leeds information specialists, or (3) a published search strategy. Each of the three options was tried and tested before it was decided which was the most appropriate for each search.

### Theory development

In February and March 2018 we undertook five types of search to identify programme and mid-range theories. We aimed to find literature that, taken together, captured the sequences of events that policy-makers and other stakeholders believe link the deployment of interoperable networks to effects on patient safety. An update search for systematic reviews was conducted in July 2019 to identify any new theoretical explanations for the effectiveness or lack of effectiveness of interoperable networks on patient safety. *Appendix 1* provides a detailed listing of databases, sources and search strategies used for each search.

#### *Government policies and official reports*

We were aware at the start of the study of policies and reports that might contain programme theories or theory fragments. We collected all of the policies and reports for England and the USA that had been cited in our research proposal, plus additional reports that we were aware of, and traced further reports via references and through pragmatic Google searches.

#### *Structured subject searches*

Two searches were conducted in three health databases for studies that presented theories or theory fragments associated with terms that identified relevant HIE-type technologies and either 'patient safety' terms or 'interoperability' terms (see *Chapter 1* for definitions of HIE and interoperability).

#### *Named author searches*

Searches were undertaken to identify articles by or citing two opinion leaders, Robert Wachter (author of an influential 2016 report<sup>30</sup> on IT in the NHS in England) and David Bates (the most highly cited author in the academic health informatics literature). Slightly different search methods were used owing to the large volume of literature authored by Bates compared with that by Wachter. We searched three health databases and one multidisciplinary database (Web of Science Core Collection) for both. In addition, we identified studies by Wachter on the Agency for Healthcare Research and Quality Patient Safety Network Portal. The Bates search in Web of Science involved a further search using the 'usage count' search feature, which identifies the most prominent or popular articles by ranking those that are accessed the most. This was to ensure that we had captured and reviewed key papers by Bates that may have had valuable insights but had not been found by the standard 'Bates AND HIT terms' search. We looked at (1) articles authored by Bates mentioning HIT terms and (2) any article he authored or any article in which he was mentioned with a usage count  $\geq 20$  (at least 20 records or full-text downloads).

### **Systematic review searches**

We searched seven health databases for systematic reviews that included theories or theory fragments linking HITs, including, but not limited to, interoperable networks and patient safety. We were not at this stage, concerned with the evidence in the reviews, but rather the discussion sections that offered explanations that could help with theory development.

### **'Usage count' search**

In the Web of Science Core Collection, usage counts measure the level of interest in a specific record since a given date (e.g. 1 February 2013). This is calculated by users either downloading it into reference management tools or linking to the article's full text. The usage count demonstrates current activity and interest in a record and can help identify recently published articles that may not register using traditional citation counts, which tend to favour older publications. We searched for interoperable systems or HIEs, selecting results with a usage count of  $\geq 50$  since 2013. We also used this technique to identify key articles by Bates, which were detailed and recorded in the author searches above.

## **Evidence review**

### ***The co-ordination of services for older people living at home***

We identified three linked search questions that between them, were designed to provide evidence about the main programme theory (presented in *Figure 9*). The intuition here was that we needed to identify empirical evidence about the nature and extent of co-ordination problems. Were problems amenable to IT-based solutions or were they problems of a different kind (e.g. attributable to differences in objectives and values between the different professionals who care for older people)? If some problems were amenable, then this might help us to focus later searches. If, on the other hand, there was a mismatch between the proposed solution (interoperable networks) and the nature of co-ordination problems, we would want to investigate the reasons for the mismatch. For each search we tested subject headings and search terms iteratively until we agreed on a search strategy that identified a representative evidence base and that we were also able to screen in the time available to us. We used a modified version of the DeJean and colleagues<sup>31</sup> qualitative search filter to identify qualitative studies and our internally validated reviews of search strategies to identify systematic reviews.<sup>31</sup>

### **What is the nature and extent of care co-ordination problems for frail older people living at home?**

Five health and social science databases were searched in August 2018 for either reviews or qualitative studies describing the care co-ordination for frail older people. Engineering databases were not searched as we were not concerned with technical aspects of care co-ordination systems. We also hand-searched the Integrated Care topic page and the Integrated Care and Partnership Working reading list from The King's Fund.<sup>32</sup>

### **What are the experiences of professionals using interoperable networks in the course of care co-ordination?**

We searched initially for studies of experiences gained in the course of treating and caring for frail older people living at home. This produced a small number of papers that, on screening, seemed unlikely to shed any useful light on the question. In September 2018, we revised the search to cover services for older people, rather than focus on frail older people. At the same time, we restricted the search to review articles. Seven health, social science, engineering and multidisciplinary databases were searched.

We also undertook a forwards citation search of the four databases and search engines of Fitzpatrick and Ellingsen's<sup>10</sup> 2013 review of 25 years of computer-supported co-operative work in health care. This was in our personal library at the start of the study, and at the end of the theory development phase it was still the most relevant review that we were aware of on the topic of users' experiences.

### **Do interoperable networks improve patient safety outcomes for frail older people living at home?**

In March 2019 we conducted structured database searches in six health, social science, engineering and multidisciplinary databases to identify evaluation studies of interoperable networks or HIE and care co-ordination.

We undertook additional forwards and backwards citation searches using Google Scholar for three included studies.<sup>33-35</sup>

#### *Medicine reconciliation for older people living at home*

We identified three search questions.

### **What is the nature and extent of the medicine reconciliation problem among older people?**

In December 2018, we conducted structured database searches of three health databases and one multidisciplinary database to identify reviews or qualitative studies investigating medicine reconciliation for older people living at home. Two further searches were conducted in Google Scholar.

### **What are professionals' experiences of using interoperable networks in medicine reconciliation for frail older people?**

In November and December 2018, we searched for users' experiences of interoperable networks in medicine reconciliation processes. Our initial search and screening was not fruitful. We consulted with colleagues in the study team and, through them, with colleagues with specialist knowledge of the literatures on medicine reconciliation. This led to the pragmatic identification of a book chapter, which we used as the basis for a cluster search that identified a further two relevant articles.<sup>119,120,124</sup> Structured database searches were then designed using terms found in the two articles to identify studies of medicine reconciliation and cognitive reasoning. We ran the search in two health databases and one multidisciplinary database.

### **What are the patient outcomes of using interoperable networks in medicine reconciliation?**

In December 2018, we conducted structured database searches in four health databases and one multidisciplinary database to identify any reports of medicines reconciliation, prescription errors and HIE (or interoperable health records). The searches were not limited by study type.

#### *The co-ordination of services for at-risk children*

The searches were designed to address three questions.

### **What is the nature and extent of the co-ordination problem in services for at-risk children?**

In May 2019, we conducted structured searches of four health databases for literature reviews of care co-ordination in child protection services.

### **What are clinicians' and other professionals' experiences of using interoperable health information technology to co-ordinate the care of children at risk and what are the effects of interoperable networks on outcomes for at-risk children?**

In March 2019, we conducted searches to cover the second and third questions (i.e. to retrieve any type of study on HIE or interoperable records and child protection services). We searched four health databases, one social science database, one engineering database, one criminal justice database and one multidisciplinary database.

### ***Economies of scope and scale in health economies***

In June 2019, structured searches were conducted of three health databases, one economics database and two multidisciplinary databases to identify studies of HIE (or networked IT) and economies (or efficiencies) of scope or scale.

### **Records management and tracking**

All database search records were downloaded and stored in an EndNote library (version 9.2; Clarivate Analytics), the same library used in the theory development searches. Duplicates were removed from the EndNote library every time a new set of searches (for a new review subquestion) was added. Records were clearly labelled with the review subquestion for which they had been identified. Some records were found and screened several times for different review subquestions.

We were unable to download the results of some website and complementary searches into EndNote. In these cases, we screened the search results for potentially relevant report records during the search and manually created EndNote records from the selected results.

The details of all search activities were recorded in a summary spreadsheet, so that we had an evolving overview of the number and nature of searches that we conducted. The spreadsheet included the date of the search, the information resource, the purpose of the search and the numbers of records found.

### **Screening and study selection methods**

Inclusion and exclusion criteria were identified for screening for programme theory development and evidence reviews. The following inclusion criteria were common to all searches:

- written in the English language
- published in 2000 or later (following the publication of the Institute of Medicine's *To Err is Human: Building a Safer Health System*;<sup>1</sup> see Chapter 1).

Inclusion and exclusion criteria for the specific searches are described in the following section (see *Evidence review: the co-ordination of services for older people living at home*). Throughout the study we adopted a cautious approach to inclusion and exclusion, preferring to include or 'provisionally include' articles until we were confident about our judgements.

#### ***Theory development***

Screening was performed by three members of the review team (MA, JK and JG). Initially, 20% of the records from all the searches were double screened by two reviewers. Following this, all of the titles and abstracts were screened by one reviewer. The remaining records were categorised as clearly included or potentially included, and these were then independently assessed by a second reviewer. Any disagreements were resolved through discussion.

### **Evidence review: the co-ordination of services for older people living at home**

As noted above, the searches were designed to address three questions about the co-ordination of services for older people and the effects of interoperable networks. Screening in this and the next two sets of searches (medicine reconciliation and at-risk children) was undertaken by three members of the review team (MA, JK and JG).

### ***The nature of co-ordination problems***

We identified separate inclusion and exclusion criteria for systematic reviews and individual narrative studies. We included systematic reviews if they were:

- articles that described and explained the nature of care co-ordination problems across health and social care organisations in frail older people (later expanded to all older people)
- literature reviews of any type that searched at least two academic databases.

We excluded:

- non-peer-reviewed reviews
- studies that were condition or disease specific (as opposed to studies focusing on services for frail older people in the round).

For individual studies we included:

- narrative or mixed-method studies that described care co-ordination problems for frail older people
- studies published from at least 1 year earlier from the date of the most recent review of evidence of care co-ordination problems in elderly patients (this was identified later as 2016–present).

We excluded:

- studies that focused on single conditions or diseases
- surveys and intervention studies.

### ***Users' experiences of interoperable networks***

We included articles if they were:

- reviews or studies that included evidence about users' experiences of interoperable networks
- focused on older people or on the general adult population (i.e. did not specify an age limit)
- literature reviews of any kind, or individual observational studies.

We excluded:

- studies that described professionals' experiences of using single databases
- surveys.

### ***Patient safety outcomes***

Studied were included if they met the following criteria:

- study design – literature reviews, observational and interventional studies
- population – older people living at home
- outcomes – any measurable change in patient risk, defined in the article.

We excluded studies if they were:

- reports of tools and technologies based on single patient databases or in other settings (e.g. within-hospital networks)
- studies that did not include evidence about the effects of interoperable networks
- studies of condition- or disease-specific outcomes
- implementation studies or surveys.



## Evidence review: medication reconciliation for older people living at home

We defined medicine reconciliation as the process by which any two or more lists of medications are reconciled with one another, or two or more lists that are reconciled with an assessment of a patient, to identify the appropriate medication list. Some definitions allow for reconciliation of a single medication lists against a patient's assessed need, but in this study our interest was in the reconciliation of two or more lists, on the basis that interoperable networks might have roles in their reconciliation, not least because two or more patient records linked in the network would be available to professionals.

### *The nature and extent of medicine reconciliation problems*

We included studies that were:

- observational studies that explored the nature of the medicine reconciliation problem (independent of any given technology)
- focused on services for frail older people (later expanded to adult populations) living at home
- literature reviews or single observational studies.

We excluded:

- studies that focused solely on IT-related problems, or were studies of technologies, including applications, for single users
- studies evaluating the impact of medicine reconciliation on patient outcomes
- quantitative studies of patient-related risk factors for medication discrepancies
- studies based in other settings (e.g. hospitals or care homes)
- surveys.

### *Users' experiences of interoperable networks*

We included studies that:

- explored networked IT-supported medicine reconciliation across health and social care organisations
- described the cognitive process of professionals (pharmacists, doctors, nurses) in medicine reconciliation
- explored these processes in the context of services for older people living at home (later expanded to the adult population).

We excluded:

- studies of medicine reconciliation in single organisations
- studies of medicine reconciliation for patients who were not living at home (e.g. in a care home)
- surveys.

### *Patient safety outcomes*

Our inclusion criteria were:

- study design – literature reviews, observational and interventional studies
- population/setting – older people living at home who may have experienced a care transition (e.g. from hospital back home)
- intervention – interoperable networks
- outcomes – any measurable change in patient risk, defined in the article.

We excluded:

- studies that reported on tools and technologies based on single patient databases or in other settings (e.g. within-hospital networks)
- studies that did not include evidence about the effects of interoperable networks
- studies of condition- or disease-specific outcomes
- surveys.

## Evidence review: the co-ordination of services for at-risk children

As with earlier searches, we undertook searches to establish the nature and extent of co-ordination problems, users' experiences and outcomes.

### *The nature and extent of co-ordination problems*

We included studies that met the following criteria:

- literature reviews (of any kind)
- studies that described care co-ordination problems for at-risk children living at home.

We excluded studies if they:

- discussed children receiving routine services, including children in accident and emergency departments who were not deemed to be at risk
- described only IT-related problems
- were experimental studies of individual patient records systems or IT applications
- were quantitative studies of patient-related risk factors.

### *Users' experiences of interoperable networks and patient safety outcomes*

Inclusion and exclusion criteria were developed for both questions. We included studies if they satisfied the following criteria:

- described users' experience of interoperable networks or patient safety outcomes (with outcomes defined in the articles)
- included at-risk children (aged < 18 years) living in their own home.

Excluded were studies that:

- focused on children living in settings other than their own home (e.g. in institutional care)
- described professionals' experiences of using single patient databases.

## Economies of scope and scale in health economies

One member of the team (SN) screened all of the abstracts, and two members of the team (SN and JK) read seven of the full-text articles and together made the final selection. Data extraction and quality appraisal methods were not required, as there were no relevant full-text papers to synthesise.

### *Inclusion and exclusion criteria*

We included studies that satisfied the following criteria:

- Interoperable networks that linked two or more organisations outside (but possibly including) hospitals in a health economy.
- Interoperable networks supported direct treatment and care.
- Studies that included empirical evidence about the added value of interoperable networks, as measured by economies of scope and scale.

We excluded studies if they:

- described hospital-only IT systems
- described systems that did not link two or more distinct organisations in a health economy
- focused on IT systems that supported secondary uses of data (e.g. for service planning, research).

## Data extraction and quality assessment

### Theory development

For each included article, we recorded the details of studies (authors, publication year) and text that described potential programme theories or theory fragments. As can be seen in *Chapter 4*, we did not find any complete programme theories, but we identified a substantial number of theory fragments. As noted in *Chapter 2*, we were looking for theory fragments, and so either copied all of the relevant text, which might be a few sentences, or recorded the location of larger sections of text for later analysis. Similar fragments that dealt with a particular topic, such as users' experiences of interoperable networks, were grouped together. The groups of fragments were then pieced together so that initial programme theories could be developed both in text form and as visual representations. When possible the representations were annotated with claims about the reasons why programmes succeeded or failed in practice. The programme theories were used as the basis for consultation with three groups of stakeholders: (1) policy-makers, (2) senior IT managers and (3) front-line clinicians.

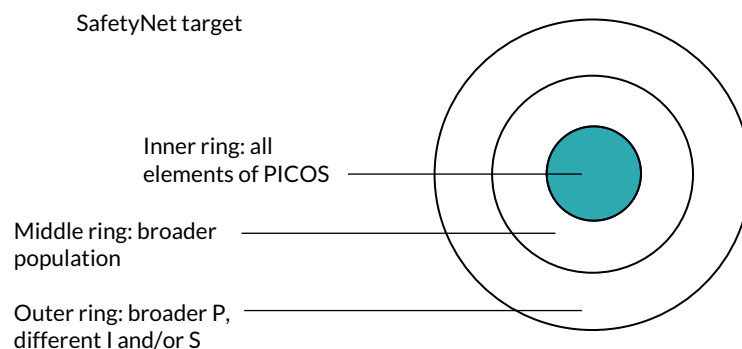
We undertook two broad types of evidence search. One focused on components of programme theories (e.g. users' experiences of using interoperable networks) and the other focused on evidence of the outcome (which in this review was a change in patients' risks of harm). For the former, data extracted included the study identifiers (author, publication year and country), information about study methods (the methods used and the numbers and types of participants), the evidence itself and information about the theoretical approach used. In this study, most of the evidence identified was narrative and extracted wholesale from papers (i.e. it was not summarised before synthesis), in part to retain the relationship between data and theoretical frameworks. Data extraction was undertaken by one researcher and checked by a second researcher (one MA, JG or JK).

For evidence about outcomes, a customised data extraction spreadsheet was designed for the recording of study identifiers, objectives, settings and a description of the intervention. Information that allowed us to judge the rigour of the study, including study design, participants, duration and theoretical framework, was also extracted. Finally, we extracted the findings of the study in terms of safety-related outcomes in quantitative studies, and quotations and comments in narrative studies. Critical Appraisal Skills Programme quality assessment checklists were used to appraise the rigour of systematic reviews and narrative and cohort studies.

### Rigour and relevance

Most published accounts of realist syntheses include the assessment of the rigour and relevance of included articles. Rigour is concerned with the technical quality of the methods used in an article. In realist syntheses and any other review method that incorporates a range of experimental and observational methods, the approach is to judge technical quality against accepted standards appropriate for the methods used. In this review, we drew on the approaches used by other teams.<sup>36,37</sup>

One consequence of the decision to use a mid-range theory (see *Chapter 2*) was in the ways in which judgements were made about the relevance of articles. Clear accounts of judgements about relevance are less common than those of judgements about rigour, but our approach was similar to that taken by Greenhalgh and colleagues<sup>38</sup> in their review of patient-reported outcome measures. We took the view that the judgement criteria should be independent of, not derived from, the articles being assessed, and of the methods used to identify and assess them. We extended the method by developing a pragmatic 'target' akin to an archery target (*Figure 3*). Articles that clearly met the inclusion criteria were placed in the bullseye. Those that met most of the criteria, but not the population (e.g. all adults, rather than older people) criteria, were placed in the next ring. Articles that did not strictly meet the population, intervention or setting criteria, but were nevertheless deemed potentially relevant, were placed in the third ring. The use of the two outer rings is consistent with the view in realist syntheses that evidence can be included as long as it sheds useful light on a programme theory (i.e. articles were included if they shed light on the processes that linked an intervention and an outcome).



**FIGURE 3** Relevance ‘target’ diagram. I, interventions; P, populations; PICOS, populations, interventions, comparators, outcomes and settings; S, settings.

The ‘target’ was not used in the theory development searches. These were satisficing searches, which means that we did not conduct exhaustive searches, but rather we made practical judgements about the points for which we had identified sufficient evidence to answer the search question.

## Stakeholder consultation

Alongside gathering literature to inform theory development, we consulted with stakeholders.

### Nominal groups

We originally intended to use nominal groups with representatives of three groups of people: (1) policy-makers, (2) senior IT managers and (3) front-line clinicians. In the event, we ran nominal groups with the first two and conducted semistructured telephone interviews with front-line clinicians. The telephone interviews are described below (see *Telephone interviews*).

The nominal group technique involves an initial meeting with stakeholders at which a topic of interest is discussed and initial agreement or consensus is reached. The extent of agreement is then tested in one or two rounds of electronic consultation, typically e-mail or web based. Nominal groups were appropriate in this study because the underlying mechanisms linking interoperable networks and patient safety are poorly understood. We developed initial visual representations of programme theories, supported by text. Participants were sent the visual representations and text in advance of the meeting (see *Appendix 2*). The first meeting was with three senior NHS IT managers, all of whom were responsible for interoperable networks. It was held in May 2018 and was audio-recorded. At the meeting participants were asked to:

- comment critically, on the basis of their knowledge and experience, on the initial programme theories
- develop and then prioritise theories, or particular sequences of decisions and action within theories, for detailed study.

The prioritisation took account of the types of networked health and care systems that the participants were responsible for. That is, they were encouraged to identify questions that they were asking about their own networks (e.g. concerning the functions that appeared to be most closely associated with safety risks or improvements).

The second meeting was held with five managers from NHS Digital and NHS England in June 2018, and was also audio-recorded. As with the first group the participants were sent the initial programme theories in advance and were asked to comment critically on them, and to prioritise theories, or elements of theories, for detailed study.

In July 2019, both groups were sent a paper that summarised the findings of the evidence searches and the implications for our programme and mid-range theories (see *Appendix 3*).

### **Telephone interviews**

It was not possible, in practice, to convene a nominal group of front-line clinicians. We spoke to a number of clinicians who explained that it was very difficult to obtain permission for time away from clinical duties. We consulted with our Steering Group, who advised us to conduct interviews instead. We obtained ethics approval to include a short topic guide for the telephone interviews (see *Appendix 4*). In common with the nominal group meetings, we sent the initial programme theories and supporting text in advance, and asked the clinicians to comment critically on the proposed programme theories and to prioritise the theories that they would like us to test. Potential interviewees were approached in two ways: via a short article in the Clinical Human Factors Group's newsletter (circulated in October 2018) and through personal contacts in two cities that had interoperable networks routinely used by clinical staff. Seven interviews were conducted in November 2018.

### **Analysis**

The nominal group meetings and interviews were audio-recorded and transcribed. Open coding was used to identify broad themes, on the basis that we were interested in insights into our programme theories, rather than the meaning inherent in anyone's comments. Implications for our programme theories were identified pragmatically by members of the study team (MA and JK). The outputs of the nominal groups were summarised, and possible implications were noted and shared with the patient and public involvement (PPI) panel and the Steering Group. The comments of the nominal groups, PPI panel and Steering Group were all taken into account when refining the initial programme theories. The interview programme was undertaken later; the study team used the interviews to feed into thinking about the framing of the programme and mid-range theories.



# Chapter 4 Theory development

## Introduction

This chapter presents the findings of the systematic and grey literature searches undertaken to support the development of programme and mid-range theories. The searches identified 1302 records to be screened, of which 46 were included in the synthesis [see the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram<sup>39</sup> in *Figure 4*].

## Government policies and official reports

We were aware of a number of relevant government policies and official reports at the start of the study (these are recorded as being in our personal library in *Chapter 3*). These were reviewed first for statements about the nature and role of interoperable networks, or patient safety or, ideally, both together. We identified additional documents via two routes: (1) references made to them in our initial reading and (2) informal means (e.g. in conversations with colleagues and in incidental 'finds' in the course of other searches). These additional documents were not identified in formally structured searches and were therefore added to our personal library as we came across them.

At this early stage, we included any relevant statements irrespective of the settings described, and so included statements about hospital IT systems as well as interorganisational networks. For reasons of

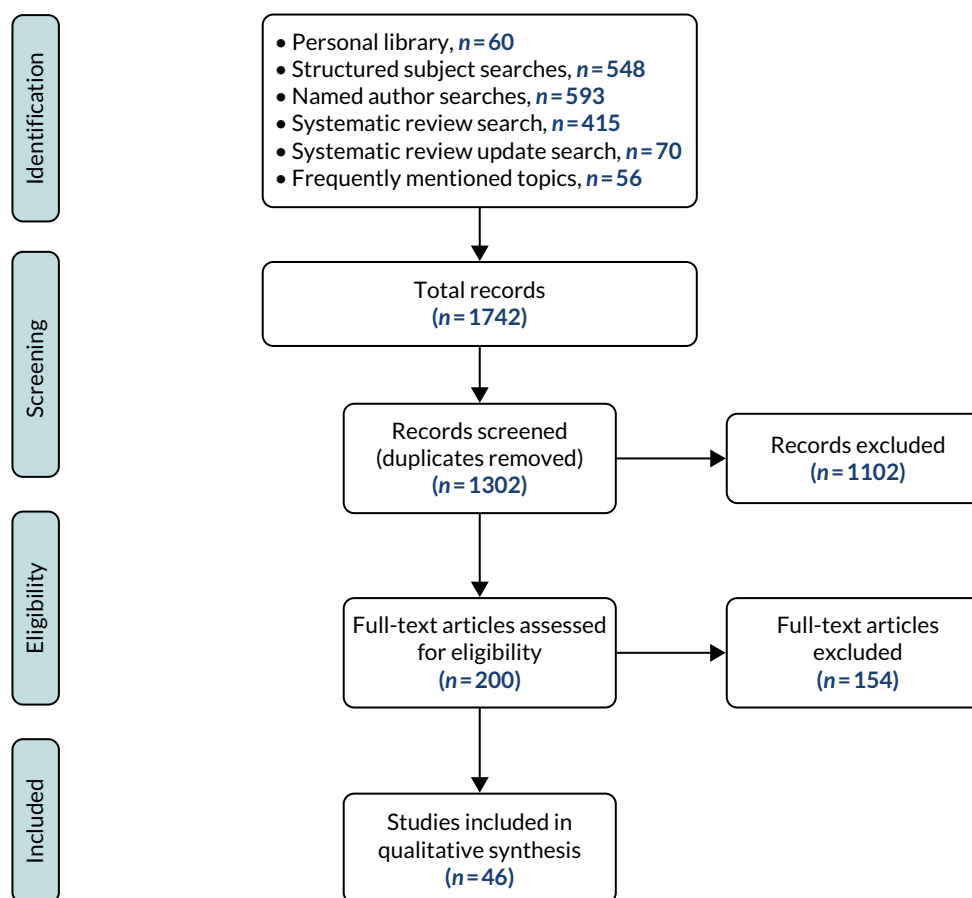


FIGURE 4 Theory development PRISMA flow diagram.

time, we did, however, focus on documents about the NHS in England and national health-care policies in the USA. Interoperable networks have been an important element of current IT policies in England in the last 5 years and attracted considerable federal investment in the USA after 2009.

Taking US policies first, we noted in *Chapter 1* that the Institute of Medicine published *To Err is Human: Building a Safer Health System* in 2000.<sup>1</sup> The report focused principally on ways in which the overall design of a health-care system makes errors and adverse events more or less likely. The report took a measured view of the role of HITs in helping to improve system design and hence patient safety. On the one hand, it observed that all technologies introduce new risks and hence the possibility of harm to patients. On the other, it recognised that technologies have the potential to support better clinical processes and decision-making. It recommended that research was needed to establish where and how that potential could be realised. The report provided us with a very simple initial programme theory: the deployment of HITs might lead to safer care or might increase patients' risks, or both (*Figure 5*).

A great deal has been written about the HIT policies during the era of US President Barack Obama. We reviewed a substantial number of reports but did not find any detailed accounts of 'how and why' interoperable networks were expected to improve patient safety. Rather, the reports commented on ongoing problems with achieving interoperable networks. Typical of the documents we reviewed is an Institute of Medicine report<sup>14</sup> that stated that:

*Lack of interoperability is a barrier to improving clinical decisions and patient safety, as it can limit data available for clinical decision making.*

*Republished with permission of The National Academies Press, from the Institute of Medicine.<sup>14</sup> Health IT and Patient Safety: Building Safer Systems for Better Care. Washington, DC: The National Academies Press; 2011; permission conveyed through Copyright Clearance Center, Inc.*

The report referred to the role of human-computer interaction and its impact on clinical working practices:

*The process of implementing software is critical to optimizing value and mitigating patient safety risks. A constant, ongoing commitment to safety - from acquisition to implementation and maintenance - is needed to achieve safer, more effective care.*

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Similarly, a 2016 report for the Office of the National Coordinator for Health Information Technology, *Report of the Evidence on Health IT Safety and Interventions*,<sup>40</sup> argued that:

*Interoperable health information exchange (HIE) . . . can improve . . . safety by improving the timelines and completeness of important patient health information.*

*Graber and colleagues, p. 11.<sup>40</sup> Reproduced with permission from HealthIT.gov (www.healthit.gov; accessed 30 March 2020)*

The report then went on to argue that interoperability was desirable, but that a number of hurdles still had to be overcome, including a lack of data standards and of interfaces that avoided overloading clinicians with patient data. In practice, limited progress with implementation meant that clinicians encountered problems with access to patient data held on IT systems in other organisations.

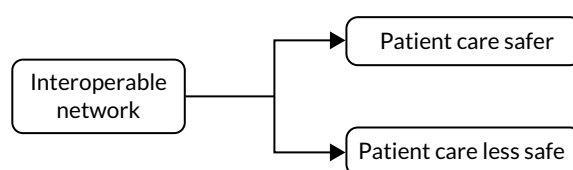


FIGURE 5 Official policy and report programme theory.



Turning to English reports and policies, the 2001 Bristol Inquiry report into the deaths of adults and children in cardiac surgical services argued that 'The need to invest in world-class IT systems must be recognised ...' (recommendation 154, p. 456; © Crown copyright).<sup>5</sup> Similarly, the 2003 Bichard<sup>41</sup> report into the murders of two girls in Soham recommended the implementation of a national IT system to monitor sex offenders. It was initially envisaged that the system would link police forces, but later iterations expanded the scope of the system to include a range of agencies. The NHS National Programme for IT was launched in parallel with these reports in 2002, with significant funding that eventually totalled > £10B. At the outset it was claimed that this would drive a transformation of NHS services, including improvements in patient safety.<sup>42</sup> None of the authors of these reports and policies elaborated on why they believed that HITs would improve safety.

The numbers of incidents and complaints remained large throughout the 2000s. The problems were highlighted most dramatically by the scandal at Mid Staffordshire NHS Foundation Trust.<sup>43</sup> Sir Robert Francis' second report on the trust in 2013 made a number of recommendations about HITs, including that all provider organisations should:

... *develop and maintain systems which give them:*

- *effective real-time information on the performance of each of their services against patient safety and minimum quality standards*
- *effective real-time information of the performance of each of their consultants and specialist teams in relation to mortality, morbidity, outcome and patient satisfaction.*

*Francis, Recommendation 262.<sup>43</sup> © Crown copyright. Contains public sector information licensed under the Open Government Licence v3.0*

These recommendations were accepted by the government in its formal response to the report in November 2013.<sup>44</sup> The government also commissioned a report from the respected US clinician and analyst Donald Berwick.<sup>45</sup> The Berwick report also identified a potential role for HITs:

*Most health care organisations at present have very little capacity to analyse, monitor, or learn from safety and quality information. This gap is costly, and should be closed.*

*Berwick, p. 27.<sup>45</sup> © Crown copyright. Contains public sector information licensed under the Open Government Licence v3.0*

Again, the statements in the reports were general. They did not specify how HITs would improve patient safety, or the clinical settings in which the improvements were most likely to be achieved.

A number of HIT policies that included relevant statements were published from 2012 onwards. *The Power of Information: Putting All of Us in Control of the Health and Care Information We Need* was published in 2012.<sup>3</sup> It set out a 10-year framework for information and IT investments in the NHS in England. The report stated that current information systems were disjointed and that paper records could get lost. It gave examples of services that could be improved if professionals had access to information from other organisations:

*The Accident and Emergency doctor does not always have the information needed, such as details of important allergies or information about vulnerable children at risk, to be able to treat the sick person in front of them safely. On discharge to a care home, the busy care worker has inconsistent paper medication records to interpret.*

*Department of Health and Social Care, p. 4<sup>3</sup> © Crown copyright. Contains public sector information licensed under the Open Government Licence v3.0*

The report<sup>3</sup> also made the first explicit statement that we found about the value of interoperable networks in the NHS, particularly for people with complex care needs:

*Connected information and new technology can help health care professionals to make informed decisions and provide safe patient care through faster access to test results in hospitals or by ensuring a care worker gives the right medicines to the right person in a care home.*

*Department of Health and Social Care.<sup>3</sup> Contains public sector information licensed under the Open Government Licence v3.0*

The policy also argued that failing to share information had the potential to do more harm than sharing it.

NHS Digital is responsible for two clinical safety standards, which were first published in 2013.<sup>46,47</sup> They mark a departure from earlier English policies in echoing *To Err Is Human*<sup>1</sup> and emphasising both the risks and the benefits associated with HITs:

*[HITs] ... can deliver substantial benefits to NHS patients through the timely provision of complete and correct information to those healthcare professionals that are responsible for administering care. However, it must be recognised that failure, design flaws or incorrect use of such systems has the potential to cause harm ...*

*NHS Digital.<sup>46,47</sup> Contains public sector information licensed under the Open Government Licence v3.0*

The next policy document was *Personalised Health and Care 2020: Patient, Carers and Service User Vision*, published in 2014.<sup>4</sup> It pledged an 'information revolution', with the aim of putting people first and providing what it called 'transparent' care. It observed that most hospital information systems could not be accessed by care professionals outside hospitals, including those in nursing homes and hospices. It identified the lack of interoperability as a major problem.<sup>4</sup> The policy also noted a number of barriers to the more effective use of HITs, including lack of consideration of the clinician's working practices in their design.

*Making IT Work: Harnessing the Power of Health Information Technology to Improve Care in England – Report of the National Advisory Group on Health Information Technology in England*,<sup>30</sup> often called the Wachter Report after the chairperson of the group, was published in 2016.<sup>30</sup> It made recommendations about many aspects of HITs, including education and training. One of them was that the NHS should:

*... ensure interoperability as a core characteristic of NHS Digital ecosystem – to support clinical care and to promote innovation and research.*

*National Advisory Group on Health Information Technology in England.<sup>30</sup> © Crown copyright*

The report suggested that the end goal of interoperability is not solely exchanging digital data, but enabling integrated workflow, service redesign and clinical decision support. There were, further, general statements about how digital systems could improve patient care. Implicitly, at least, the statements assumed that patient information would be widely available, presumably via interoperable networks:

*We cannot emphasise enough that the purpose here is not to computerise ... The purpose is to radically improve the chances that important information will be available when and where it is needed, because no health system or clinician can perform at the top of their potential if it is not ...*

*National Advisory Group on Health Information Technology in England.<sup>30</sup> © Crown copyright*

The most recent policy document is *The Future of Healthcare: Our Vision For Digital, Data and Technology in Health and Care*, published in 2018.<sup>48</sup> It picked up, and greatly expanded on, the interoperability

theme in *Personalised Health and Care*<sup>4</sup> and *Making IT Work*.<sup>30</sup> In a section headed 'Infrastructure', it states that:

*The ability to share records between hospitals, GPs [general practitioners], community pharmacies and care providers is inconsistent and people are frequently discharged from hospital without sufficient or accurate information about their care needs.*

*Department of Health and Social Care, Section 1.<sup>48</sup> Contains public sector information licensed under the Open Government Licence v3.0*

The policy emphasises the extent to which successful deployment of interoperable networks will require NHS organisations and suppliers to adhere to common data and technical standards, and meet users' needs. Once again, however, there is no account of the ways in which networks will improve patient safety (or other desired outcome). As things stand, therefore, it seems reasonable to summarise the official reports and policies by saying that, (1) interoperability has become increasingly important in the last 5 years, but (2) they do not spell out in any detail how they, or HITs more generally, might improve patient safety. Figure 5 therefore represents current thinking, as represented in the documents discussed in this section.

## Structured subject searches

We tested a number of search terms, and combinations of terms, and found that two terms that described our technology of interest produced distinct and useful results. These terms were HIE and 'interoperability', which we discuss in turn.

We came to understand, through these searches, that the term HIE is used in two ways in the literature. The first of these is general in nature, particularly in the USA, where it is used as a shorthand for the major Obama-era IT investment programme. One reason to use HIE as a search term was, indeed, to identify articles discussing that programme. The second is more technical, and refers to the ability to move data between any two or more IT systems. HIE's are therefore necessary for interoperability, which we discussed in *Chapter 1*, which refers both to technology and to the use of data. Put another way, interoperability is a broader term than HIE.

### Health information exchange structured subject search

We did not find any articles that set out a detailed programme theory. We therefore sought to identify theory fragments and identified three types of fragment in 13 articles<sup>49-61</sup> (*Table 1*). The first type concerned the value of HIE, one centred on access to remotely held patient data. HIE could provide health-care professionals with a more comprehensive view of a patient's information and thereby avoid or decrease medication-related errors. In the second type, HIEs could be used to facilitate communication between professionals. This might avoid delays in clinical decisions or facilitate improved co-ordination of care.

For the third type, some articles commented on the potential risks arising from poor data quality and consequent risks to accurate diagnosis and treatment. Authors mentioned system reliability and poor user interface design, and the implications of these for patient safety. Privacy and confidentiality were also mentioned; Foley,<sup>53</sup> for example, argued that:

*Workers in hospitals or general practice surgeries might seek inappropriate access to medical records because of curiosity or malice, commercial gain, or simple errors.*

Foley<sup>53</sup>

### Interoperability structured subject search

We also used interoperability (replacing HIE) as a key search term. Seven articles were included, and these are described in this section.

TABLE 1 Health information exchange: structured database search for theory fragments

Study	Topic	Theory fragment(s)
Alvarez <sup>49</sup>	Canada Health Infoway, part of a pan-Canadian interoperable EHR solution	Discussion article. Argued that co-ordinated national EHR initiative would cost less, save lives and prevent reduce harm. It then described Infoway, a Canadian initiative intended to improve electronic access to accurate and timely health information, which would improve safety, quality, accessibility, cost-efficiency and the sustainability of the health-care system. Patient safety was described as a cornerstone of Infoway's activities
Bowden and Coiera <sup>50</sup>	Impact of accessing primary care records during unscheduled care	Review article. It concluded that: <i>no study reported on clinical outcomes or patient safety, and no economic studies of shared electronic record access during unscheduled care were available. Design factors that may affect utilization included consent and access models, shared electronic record content, and system usability and reliability</i> <sup>50</sup>
Cotter <sup>51</sup>	Benefits of HIT	Opinion article. Argued that the creation and implementation of a comprehensive clinical information system would entail many difficulties, particularly in regard to patients' privacy and control of their information, standardisation of EHRs, cost of adopting IT, unbalanced financial incentives and the varying levels of preparation across providers of care. There will also be potential effects on the physician-patient relationship
Fontaine <i>et al.</i> <sup>52</sup>	Survey of primary care practices regarding plans and motivation to invest in HIE	Primary research article. This was an original article describing the use of HIE in primary care practices in Minnesota, USA. Internal 'motivators' to use were anticipated cost savings, quality, patient safety and efficiency. The most frequently cited barriers were lack of interoperability, cost, lack of buy-in for a shared HIE vision, security and privacy, and limited technical infrastructure and support
Foley <sup>53</sup>	Confidentiality and shared clinical records	Letter. Author expressed concerns about the risks to confidentiality associated with shared patient records
Goroll <i>et al.</i> <sup>54</sup>	Experiences of Massachusetts eHealth Collaborative	Case report. The authors reported that, despite initial enthusiasm, progress with implementation was impeded by a range of challenges, including lack of technical standards, costs of converting paper to electronic records, and concerns about privacy and confidentiality
Gottlieb <i>et al.</i> <sup>55</sup>	Policy and regulatory barriers to successful clinical data exchange project in Massachusetts, USA	In this article, the authors described a number of barriers and lessons learned from piloting the use of data exchange project in emergency departments in Massachusetts, USA. This included privacy concerns, accessibility, data quality and technical issues with the software, which led to challenges in use and uptake of the project by the clinicians
Hawking <sup>56</sup>	Medicolegal issues with shared electronic records	Letter. GP voiced concerns about the use of shared EHRs in primary care, including problems with functionality and governance. He had particular concerns about data entry errors and responsibility for updating medication information in a shared record environment
Hillblom <i>et al.</i> <sup>57</sup>	Impact of HIE on pharmacy practices	Opinion article. Argued that HIEs will knit together unrelated information sources to provide health-care professionals with a more comprehensive view of a patient's medical information
Hopf <i>et al.</i> <sup>58</sup>	Health-care professionals' views on linking patient data	Systematic review. Facilitators of use of a network included having trust in the system, including in its reliability. Barriers included costs and information governance and technical issues. Possible effects on the physician-patient relationship and on workload were also identified as barriers. Health-care professionals supported the idea that an integrated system would improve patient safety

TABLE 1 Health information exchange: structured database search for theory fragments (continued)

Study	Topic	Theory fragment(s)
Ishikawa <i>et al.</i> <sup>59</sup>	Proposals for an integrated, networked EHR	Primary research article: survey. The authors argued that a system should be designed to share information among all professionals, which would promote team practices and, in turn, improve patient safety. System security and reliability were acknowledged to be risks
Traynor <sup>60</sup>	Commentary on Institute of Medicine report <sup>1</sup>	Opinion article. The author noted a lack of robust evidence that HITs can improve patient safety. There is also limited evidence about the harms resulting from HITs
Zimlichman and Bates <sup>61</sup>	National priorities in the patient safety agenda in the USA and Canada	Opinion article. Argued that harnessing HIT to promote patient safety was 'pivotal' because it extended to all providers

GP, general practitioner.

Most of the theory fragments were general in nature. The most commonly cited theory fragment concerned access to additional patient data via an interoperable network. A report commissioned by the European Union argued that access to patient records would lead to more accurate diagnosis and better-quality treatment and care delivery, as well as potential for improved patient safety through:

- improved knowledge of the patient's health, social status, family and personal history
- improved care co-ordination between health-care professionals
- more and higher-quality communication between health-care professionals and patients
- avoidance of errors, including prescribing and medication administration errors.<sup>62</sup>

Huckvale and colleagues<sup>63</sup> reviewed the role of IT systems in general in patient safety, citing roles for clinical decision support and for linking and sharing patient data. They argued that HIE would improve safety by reducing clinical errors, preventing data loss and ensuring that information was available when needed. Huckvale and colleagues<sup>63</sup> noted a 'fragmented theoretical framework', which limited the scope for the understanding of the issues involved in promoting safer care using HIE to evolve.

Some authors argued that interoperability could offer a solution to the fragmentation of health care. For example, Font and colleagues<sup>64</sup> described a number of case studies in which interoperable systems were implemented, and argued that these offered evidence of the value of those systems. Similarly, Foisey,<sup>65</sup> based in New Zealand, argued that patient journeys can involve many health-care professionals. Data exchange and easy access to complete patients' health information could reduce patients' risks. In a similar vein, Hutchison<sup>66</sup> outlined the benefits of pharmacy interoperability: the ability for physicians to securely and electronically exchange prescription information with pharmacies. It would reduce the time staff spent on filling prescriptions and would reduce medical errors. More broadly, it would allow licensed prescribers and pharmacists to access securely the drug history of any patient in an emergency, anywhere in the country.

Conversely, a family physician who also worked as a part-time emergency physician at a local hospital in the USA expressed his frustration at not being able to access the patient hospital record in his clinic and the patient's clinic record from the emergency department.<sup>67</sup> Finally, two studies identified concerns about privacy and confidentiality.<sup>68,69</sup> There were, the authors argued, important legal and ethical considerations associated with sharing patient records across different professionals and organisations.

Summing up our insights from the articles identified in the structured searches, we can say that we were cautious about excluding potentially useful observations and insights early in the synthesis but, even so, found relatively few articles that could contribute to the development of programme theories.

We found more comments on the nature of possible barriers or risks than on the nature of the processes that might be affected. We were not much further forward than we were at the end of our analysis of government policies and official reports.

### Named author searches

Robert Wachter's and David Bates' literature typically discusses HITs in general, rather than focusing on interoperable networks.

One title by Wachter, *The Digital Doctor: Hope, Hype and Harm at the Dawn of Medicine's Computer Age*, was included.<sup>70</sup> Few passages commented, directly or indirectly, on interoperable networks, but three theory fragments were identified, on information sharing in medical emergencies, the safety implications of information sharing and the design of interoperable networks. Regarding the last of these Wachter commented on Epic (Verona, WI, USA), a major US-based IT supplier:

*The company also worries about the safety implications of trying to cobble together mismatched parts, particularly in complex clinical environments like hospitals. The company is 'religious' about not mixing and matching components in areas where integration is critical to safety.*

Wachter<sup>70</sup>

More generally, Wachter was sceptical about the US Federal programme, arguing that there was little to show for an investment of almost US\$30B.

Bates is co-author of five articles that include observations about the relationship between HITs and patient safety. In a 2003 article<sup>71</sup> he argued that HITs could reduce errors resulting from inadequate access to clinical data, and could rapidly communicate important results, monitor adverse events and provide decision support. Barriers to the adoption of HITs Bates identified included cultural issues and high implementation costs. In 2007, Kaelber and Bates<sup>72</sup> suggested ways in which HITs could improve patient safety. Some ways were related to improving the processing of laboratory information, radiology information and medication information. Others were concerned with improving communication among providers, and among patients and providers and, finally, the role of HIE in public health information processing.

Panjamapirom and colleagues<sup>73</sup> were more sceptical about HITs in a 2010 article noting growing concerns about the privacy and security of personal data, and the lack of incentives for making use of data. The authors referred to problems of data ownership (i.e. who owns a patient's data) and the lack of standards and legal frameworks for the use of personal data. Similarly, Kushniruk and Bates<sup>74</sup> commented on US federal efforts to improve the safety of HITs (i.e. ensuring that HITs do not themselves increase patients' risks). They described the growing body of evidence about the unintended consequences of using HITs and consequent risks to patient safety. They produced a simple framework for thinking about improving safety, involving:

- recognition of the problem and of the role of safety and regulation influences
- usability and design considerations, which influence
- implementation issues, which influence
- post-implementation issues and error reporting.

In 2015, Bates<sup>75</sup> described a previous study on the role of EHRs in co-ordinating the care of elderly people in nursing homes. Four 'domains' were identified: (1) reconciling medication, (2) tracking laboratory tests, (3) communicating across settings and (4) managing care planning, referrals and consultations.<sup>75</sup> Finally, Rudin and colleagues<sup>76</sup> argued that HITs could be used to improve the co-ordination of treatment and care, in part by making it easier for professionals to identify and communicate with one another.

We can make similar observations about the named author search to those we made about the structured database search. There are useful theory fragments that offer more detail about risks than about clinical processes, so that the risks were presented without any useful context; and fragments were general, rather than specific, in nature.

## Systematic reviews search

By their nature, most systematic reviews focus on evidence rather than theory. However, they served three purposes in the theory development phase of the review. First, we needed to check whether or not we had missed any systematic reviews in our chosen topic area at the proposal stage, and whether or not any had been published in the period between the research award and the start of the study. Second, systematic reviews might help to identify empirical evidence that we could use in later evidence searches. Third, a systematic review might not cover exactly the same ground as ours, but might include useful interpretations of evidence that are relevant to one or more programme theories.

We did not find any systematic reviews using a realist, narrative or other method that covered the same review aims and objectives as ours. We did, however, identify reviews that covered aspects of topics that we might be interested in, for example process measures of the effects of interoperable networks.<sup>8,77-79</sup> Many reviews noted the paucity of research into the processes that led to changes in quality of care and patient safety.

Four reviews<sup>78,80-82</sup> were included on the basis that they went beyond the data they presented and sought to explain how and why clinical processes were influenced by interoperable networks and had subsequent effects on patient safety. Bassi and colleagues<sup>78</sup> presented a general sequence of events in medicine management: obtain medication information (from a computer system), compare medications, clarify discrepancies and then, in parallel, communicate medication information to relevant clinical colleagues and track discrepancies.

The other three reviews highlighted the importance of what they termed the unintended consequences of HITs. Back in 2004, Ash and colleagues<sup>80</sup> presented two categories of such consequences, errors associated with entering and retrieving information, and errors associated with communication and co-ordination. An example of the former might occur if interfaces are not suitable for working environments in which professionals are regularly interrupted. An example of the second might occur if the HIT itself leads to 'cognitive overload', perhaps by overemphasising the need for structured and 'complete' information entry or retrieval.

Zheng and colleagues<sup>81</sup> published a review in 2016 of the unintended consequences of interoperable networks and observed that:

*... a widely held consensus has been reached that unintended adverse consequences brought by health IT implementation are almost inevitable, even if their effects may be temporary and the magnitude of the impact may be small.*<sup>81</sup>

*Zheng and colleagues<sup>81</sup>*

They did not, however, provide any detail about the processes that might be involved in producing unintended consequences, and noted that more research was needed into 'root causes and remedies'. Similarly, Jones and colleagues<sup>82</sup> found that hospital IT systems reduced medication management errors and, conversely, that 'alert fatigue' and 'incongruent workflows' were barriers to the successful use of systems. The authors also observed that:

*... the health IT literature is expanding rapidly but failing to produce a commensurate amount of useful knowledge ...*

*Jones and colleagues<sup>82</sup>*

In addition, they stated that:

*... insufficient reporting of implementation and context of use makes it impossible to determine why some health IT implementations are successful and others are not.*

*Jones and colleagues<sup>82</sup>*

The pattern that emerges is one of relatively little detailed information about clinical working practices, but rather more about the unintended consequences of deploying interoperable networks.

### Usage count search

Usage count searches limit search results to articles in the academic literature that are most frequently accessed and downloaded. We identified two articles that included theory fragments. Kalra and colleagues<sup>83</sup> presented the outcomes of three workshops held with domain experts on interoperable networks in the USA and Europe. The main action suggested was to urgently ensure access to high-quality interoperable information resources that:

*... (1) provide clinical context, (2) be mapped to interoperability standards for EHR data, (3) be linked to well specified multi-lingual terminology value sets, and (4) be derived from high quality ontologies.*

*Kalra and colleagues<sup>83</sup>*

That is, the paper argued that the fundamental computing issues involved were far from straightforward, and a number of problems had to be solved if sophisticated interoperable networks were to become a reality.

Adjerid and colleagues<sup>84</sup> evaluated the impact of privacy regulation on the development of interoperable networks, comparing legislative frameworks and consent policies in different US states. The authors argued that networks could foster the co-ordination of patient care across the fragmented US health-care system, but that evidence suggested that the uptake of interoperable networks depended on frameworks and policies. The more the policies incentivised citizens, the more the networks were likely to be used.

Although this search resulted in a small number of included articles, it reminded us of some of the wider issues that interoperable networks raise. Once again, however, there was little detail about the effects of networks on clinical working practices and, hence, on patient safety.

### Initial programme theories and nominal groups

All five searches described in the previous sections were undertaken in the first 2 months of the study. In month 4 we prepared materials outlining the initial programme theories for the two nominal group meetings (see *Appendix 2*). One of the programme theory diagrams is reproduced for convenience in *Figure 6*, and *Table 2* summarises some of our thinking about patient safety. The diagrams and text could be described, in accordance with Shearn and colleagues,<sup>23</sup> as initial rough programme theories.

*Figure 6* and *Table 2* capture two key, early, lines of thinking. The first was that we represented clinical working practices in simple terms, reflecting the lack of detailed theories resulting from any of the searches. The second was that we noted articles that resonated with two of the themes in our proposal – the possible effects of deployment on the use of networks, and privacy and confidentiality – but decided not to pursue either theme. We decided against studying deployment on pragmatic grounds: the lack of detail about programme theories of professionals' working practices would have required us to speculate about the effects of deployment on them. This seemed to us to be a risky strategy. We decided against focusing on privacy and confidentiality because we had established, in during another study that one of the authors (JK) was involved in [URL: <https://gow.epsrc.ukri.org/NGBOViewGrant.aspx?GrantRef=EP/N013980/1>



## SafetyNet: initial programme theories

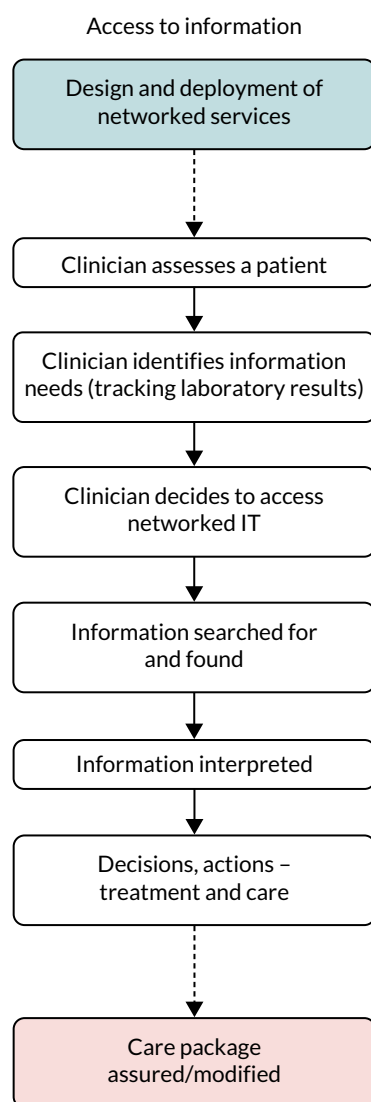


FIGURE 6 One of the initial programme theories presented to nominal groups.

TABLE 2 Table presented to nominal groups

Theme	Key feature	Example	Managing or avoiding risk
Co-ordination	Clinicians use records and networks to co-ordinate with one another	Community nurse reviews elderly person's care package, contacts services that have not been attending	Managing
Non-standard patterns of care/alerts	Systems provide data to alert clinicians	Safeguarding	Managing
Reconciliation	Clinicians access data from 'remote' systems	Medicines reconciliation	Managing and avoiding
Design to eliminate risks	'Whole-system' approach to the role of networked IT services	Comprehensive redesign of services	Avoiding

(accessed 25 February 2020)], that there was a limited empirical literature in relation to HITs in general, and none that we could find in relation to interoperable networks. We judged that we would find it difficult to link elements of programme theories on privacy and confidentiality to elements representing clinical working practices.

Table 2 draws on one of the publications in our personal library, Vincent and Amalberti's<sup>85</sup> three-way classification of approaches to managing risks in health-care systems: embracing, managing and avoiding risks. We focused on the last two of these, describing them in the following way in the text provided to the nominal groups:

*[Managing risks] . . . involves actively managing patients' risks. The key idea here is that much health and social care is inherently uncertain, so that it's never going to be possible to know when any particular patient falls ill, or deteriorates. The appropriate response is to set the care system up so that clinicians can respond to patients' problems as they arise.*

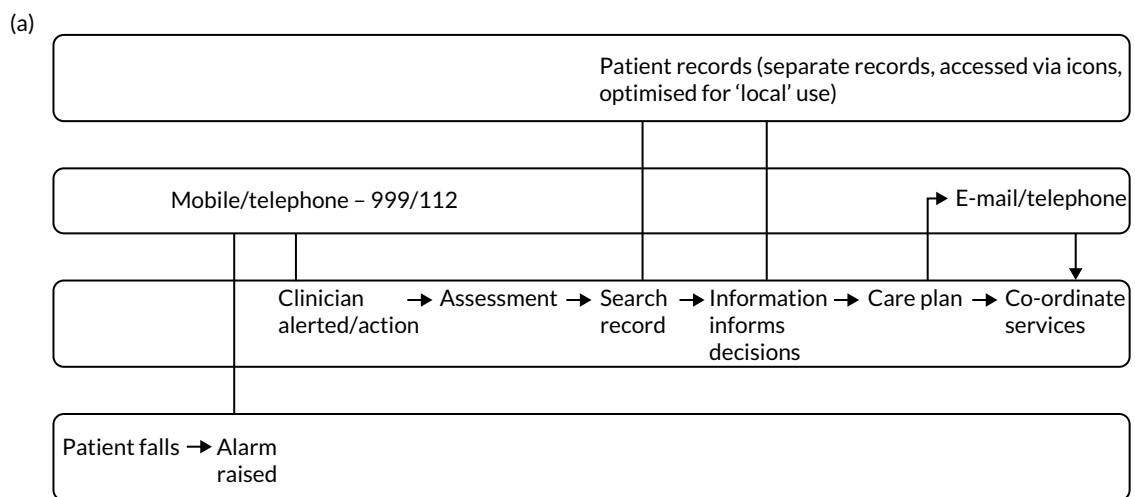
*The [avoiding risks] approach involves eliminating risks. The Virginia Mason model, currently being piloted in five English NHS hospitals, is an example of this approach ([improvement.nhs.uk/resources/virginia-mason-institute/](http://improvement.nhs.uk/resources/virginia-mason-institute/)). The starting point is that, although some aspects of care are inherently uncertain, much can be done to eliminate uncertainty for many patients. Our question is, do you think that networked IT services can be designed and deployed in support of an inherently safer care system?*

*By way of illustration, medicines reconciliation can be interpreted as an example of this approach (as well as of actively managing risks). By providing the means to check current medications, and contraindicated medication, IT systems can be part of a comprehensive approach to eliminating patients' risks.*

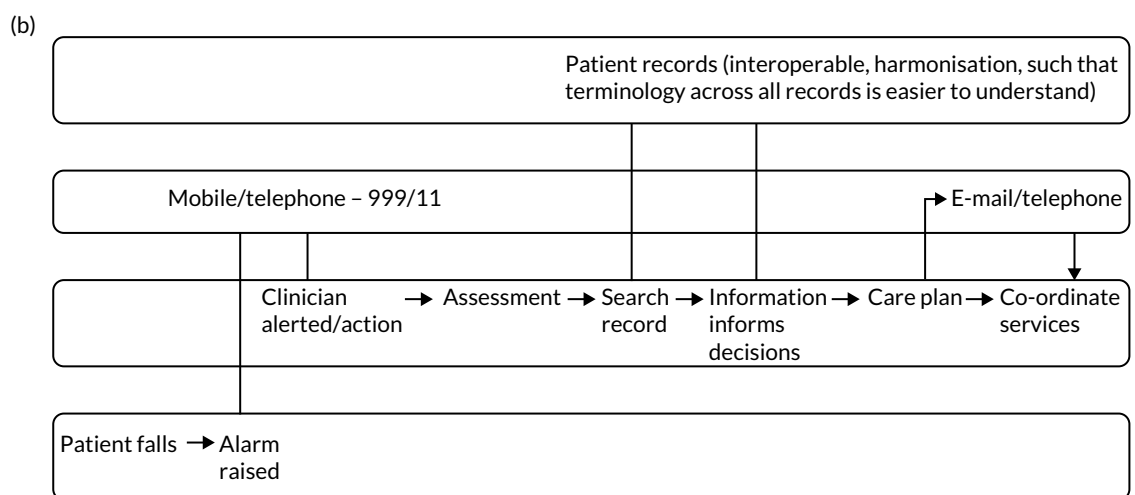
The nominal groups did not offer detailed comments on our initial rough theories, but instead provided four key insights. First, the health and social care IT managers stressed that very few localities in England could currently provide health and social care staff with 'seamless' or 'click through' access to patients' records held by several organisations (general practices, community NHS services, social services and so on). Indeed, most of the leading localities offered access to records on an organisation-by-organisation basis, typically by clicking on an icon to access each one. Systems were designed this way at least in part because doctors (in particular) could not be persuaded to do more than access patients' remote records on a tactical basis, when they really needed information. There was little incentive to provide more integrated solutions. Thus, although it would be theoretically interesting to focus searches on fully (semantically) interoperable solutions, the results would not reflect current realities on the ground, and the value to the staff who procured, built and maintained networks would be limited. Second, although the initial programme theories were of some interest, there was a more specific challenge, namely to establish the value of interoperable networks. It would be helpful to know how and why interoperable networks worked, but it was more important to identify and, ideally, quantify the outcomes associated with their deployment. Third, the meetings confirmed the intuition, arising from the initial searches, that those responsible for IT systems did not themselves think through the ways in which systems might influence patient safety. Fourth, and finally, we asked about the patient groups or services that we should focus on. At both meetings, the suggestions included services for a frail elderly person living at home who has a fall (or some other event), an adult with mental health problems who needs urgent treatment and care, and an at-risk child who attends a general practice or an urgent care service.

## Revised programme theories 1

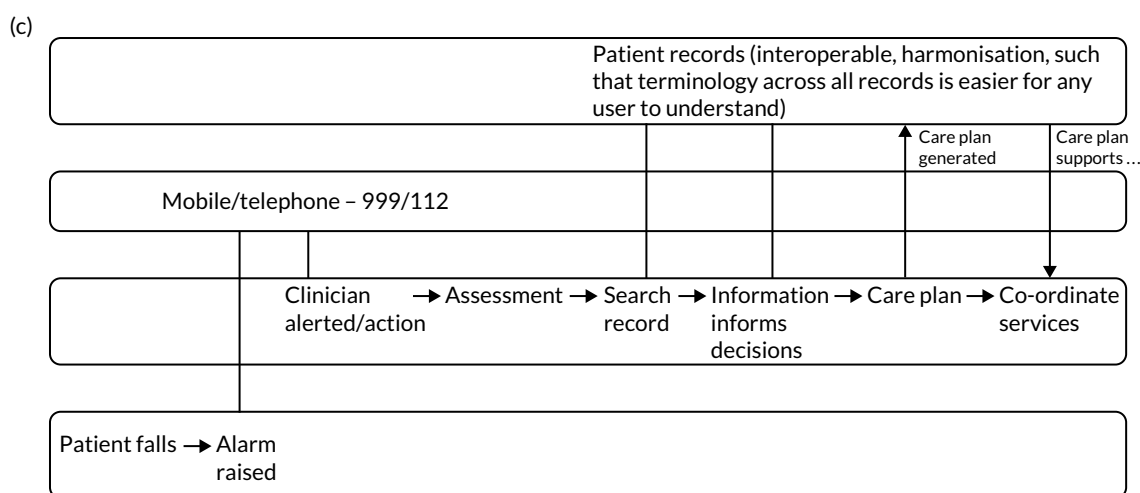
We used the nominal groups' observations to revise the initial programme theories. The changes were reflected in papers prepared for the first Steering Group and PPI panel meetings, both held in June 2018. Figure 7 was our attempt to represent the insights gained from the nominal group meetings, with each band representing events unfolding over time in a different domain: patient records systems, the



Draft programme theory 1: access to 'separate' records/embracing clinical risks



Draft programme theory 2: access to integrated records, semantic harmonisation/managing clinical risks



Draft programme theory 3: access to integrated records, semantic harmonisation, care planning/managing clinical risks

FIGURE 7 Programme theories presented to the PPI panel. (a) Draft programme theory 1; (b) draft programme theory 2; and (c) draft programme theory 3.

technologies professionals use to initiate an encounter with a patient, clinical actions and patient experiences. The comments at both meetings suggested that although the representations had some merit they were simply too abstract to be of real value; we determined to rethink them rather than revise them.

We also asked the PPI panel for guidance on the population(s) that we should focus on in our literature searches, setting out some of the suggestions made by the nominal groups to 'seed' the discussion. The panel gave us clear steers. Support was strongest for focusing on the support of frail older people, including people with dementia. More generally, it was suggested that we focus on people who need support from a number of health and social care services, and who may not be able to organise that support for themselves. Other possible groups mentioned included children who are safeguarding risks and patients who take a number of medications (polypharmacy). Broadly, then, the PPI panel supported the nominal groups' suggestions.

### Revised programme theories 2

Following the PPI and Steering Group meetings, we sought to think in different ways about programme theories. Our first output is in *Figure 8*, which illustrates ways in which care processes, which are not represented, could go wrong. Although this did not, in itself, represent a plausible programme theory, it did help to consolidate our thinking about many of the theory fragments that we had identified in the literature searches. This led us on to *Figure 9*, which is in effect an amalgamation of, and simplification of, *Figures 6* and *8*. *Figure 9* was the main programme theory that we used to guide our evidence searches, reported in the next four chapters.

We draw attention to three features of the main programme theory in *Figure 9*. First, in representing the intended effects we assume that an interoperable network is available for use. We were not concerned in this review with the implementation of a network or with the details of its architecture. The programme theory focused, instead, on the use of networks, and the decisions and actions that might follow. Second, *Figure 9* focuses on access to information held on other organisations' systems, but we were interested in evidence about any possible function of an interoperable network, which (on the basis of our theory fragments) included communicating with colleagues in other organisations and comparing (reconciling) information about a patient held on two or more systems. Third, we clarified our thinking about the outcomes of interest in the synthesis. In the early months, we used the umbrella term 'patient safety' in our discussions, but realised that this was too broad a description of an end point in a programme theory. We settled on 'changes in patients' risks' as the end point of each theory.

Finally, in this section, we also settled on the domains of interest for our evidence searches. These closely followed the advice we received from the nominal groups and PPI panel, as shown in *Table 3*.

### Second programme theory and mid-range theory

In our proposal we identified a distinct economic programme theory concerning economies of scope and scale. We hypothesised that there might be 'global' effects associated with the deployment of an interoperable network when the costs and benefits were distributed across the network and, hence, across a health economy. This contrasts with the more individualistic programme theory in *Figure 9*. Our searches and consultation had not given us any reason to either include or exclude this theory; we retained it for the evidence searches and discuss the results in *Chapter 8*.

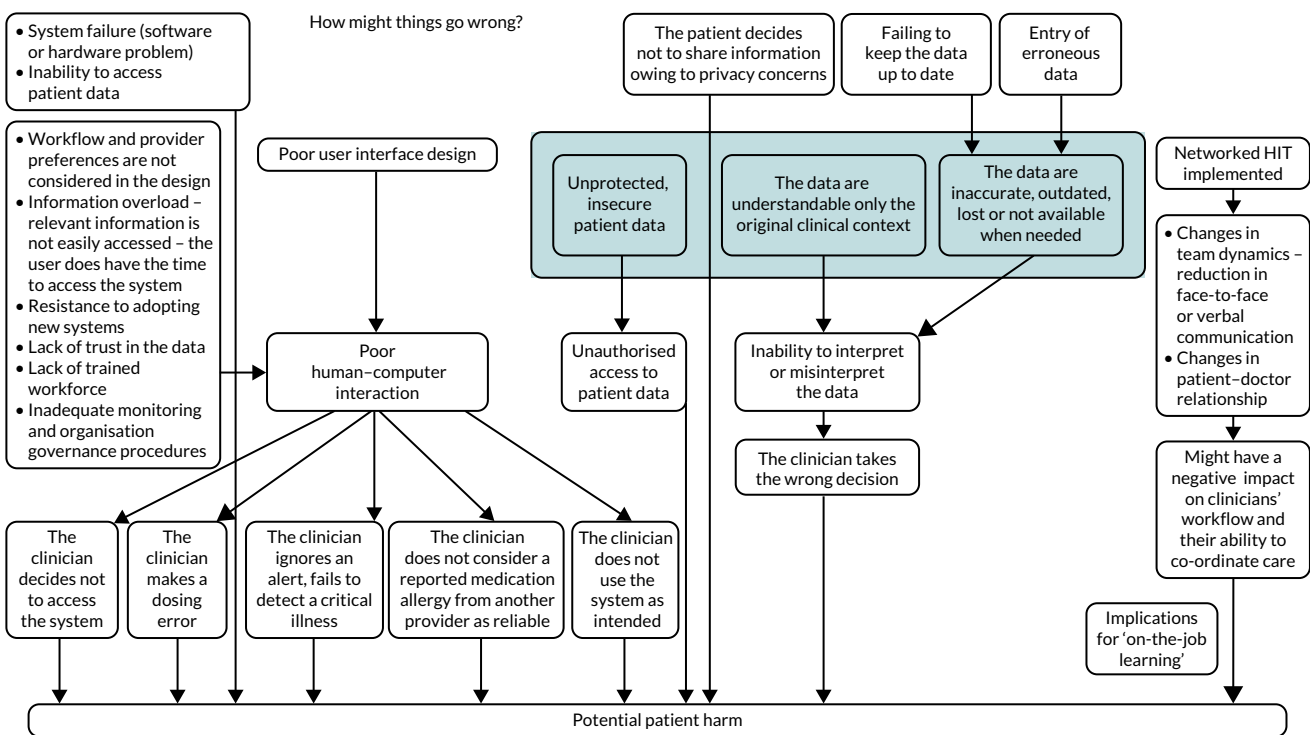


FIGURE 8 How might things go wrong?

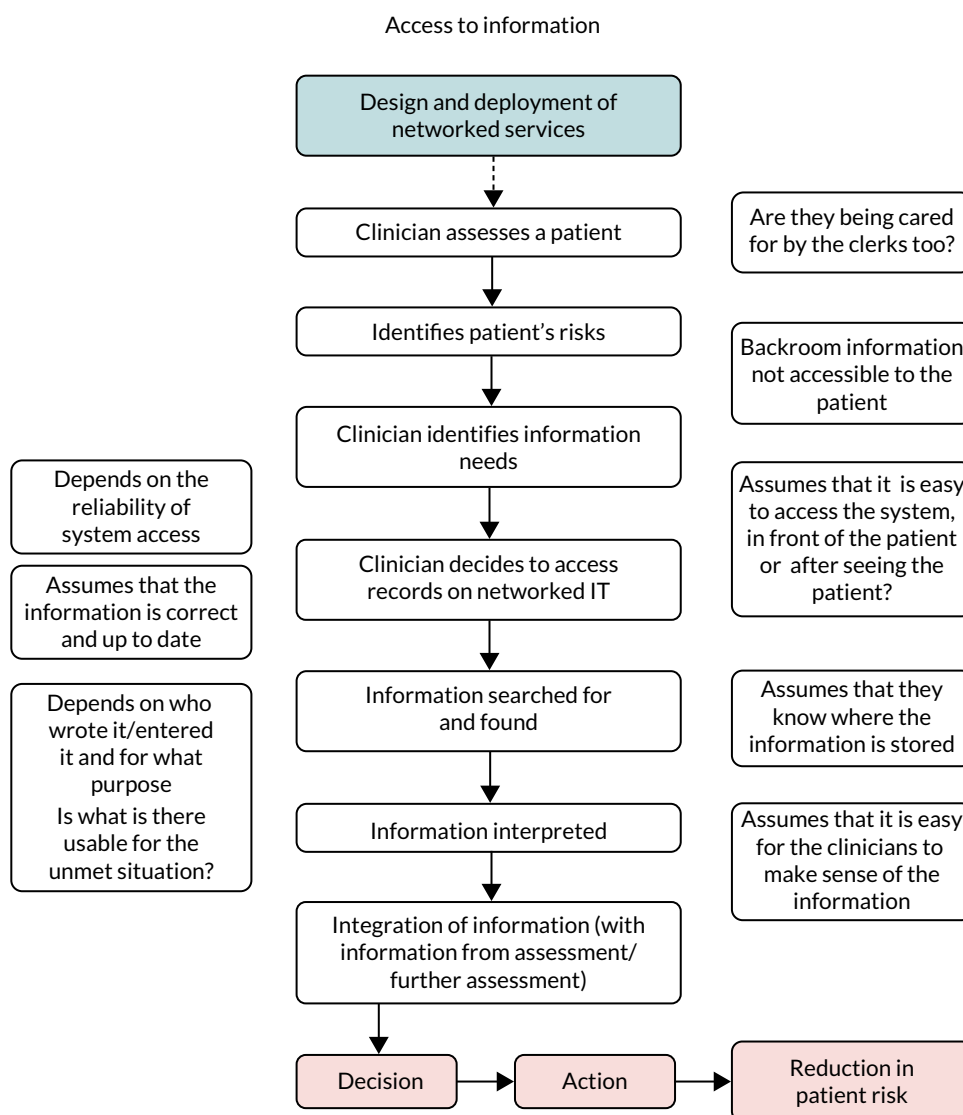


FIGURE 9 Main programme theory.

TABLE 3 Populations and topics for three sets of literature reviews: month 7

Population	Topic	Interoperability	Main programme theory
Frail older people	Co-ordination of care	Functional	Access to information
Frail older people	Medicine reconciliation	Functional or semantic	Medicine reconciliation
At-risk children	Co-ordination of child protection	Semantic	Access to information and communication

As we noted in *Chapter 2*, we developed a mid-range theory, as well as programme theories. The general form of the mid-range theory was identified at the end of the theory development phase of the study. Given the study protocol, and the steers from the nominal groups, the theory selected needed to address the issues associated with large-scale networks, spanning organisational and professional boundaries to shed light on the relationships between interorganisational networks and changes in clinicians' working practices; and to have a solid evidence base. This ruled out a number of frameworks that have been found to be useful in other settings. This included normalisation process theory, which is well suited to studies of interventions in single settings (as opposed to studies of interventions

spanning many settings).<sup>86</sup> Other sociological and sociotechnical theories have been used fruitfully over the last two decades, but they tend to focus more on implementation failures than on successes, and our concern here was to explain, if possible, both successes and failures. One framework that does this, and meets the three listed criteria, is a sociotechnical theory concerned with the development of information infrastructures.<sup>87</sup> The initial form of the mid-range theory was as follows:

- Older people with complex needs are supported by care professionals who have different backgrounds and training, and who often work in different organisations. Networked IT systems are embryonic information infrastructures that over time are likely to become more interoperable (in the sense that an engineer would use this term). Information infrastructures span a number of professionals and organisations. The long-run intention is that professionals will integrate the use of the IT systems into their work so that the systems effectively become invisible. Professionals will not think about if or how to use them; they will be just part of 'the way we do things here'.
- When infrastructures become invisible, they contribute to overcoming co-ordination challenges that naturally arise in these institutional arrangements. The resulting improvements in the effectiveness of co-ordination will, in turn, lead to reductions in patients' risks.
- This positive account is qualified by evidence about the practical difficulties that professionals can face when using IT systems. Far from becoming invisible, and part of usual working practices, the systems can be difficult to use. The difficulties can stem from poor-quality interfaces and the fact that IT systems can create additional work compared with paper systems, notably in the time it can take to input data.

## Interview programme findings

The interview programme with front-line health and social care professionals who were using interoperable networks was undertaken in November 2018, after the initial programme and mid-range theories had been settled. The interviews could not, therefore, influence the development of the theories. As we noted in *Chapter 3*, however, following consultation with our Steering Group we decided that consultation with professionals was important for two reasons. First, any insights generated could still be used, notably in helping us to frame our thinking about the evidence we found. Second, there was still time to modify our search plans if the professionals highlighted an important issue that we had not thought of or had undervalued earlier in the study.

A community nurse, a general practitioner (GP), a social worker, two pharmacists and two physiotherapists were interviewed. Professionals valued their local interoperable networks. In both localities, the networks could be described as functionally or partially interoperable, allowing access to patient information held in other organisations' systems, each accessed via a separate web page. Interviewees stressed the value of access to a 'wealth' of data, which allowed some of the professionals to 'follow their stories in detail'. Some were able to log on to other systems easily (e.g. just by clicking on an icon) and to keep two or more systems open at the same time on separate web pages (on a laptop or tablet). They could check current medications (which was particularly helpful to pharmacists, but was also useful for other professionals), access information about a recent hospital stay, look up who is visiting whom at home and check whether or not a particular patient is on a waiting list for a hospital appointment.

Some interviewees contrasted these facilities with the situation a few years earlier, when they would have had to call a general practice or hospital to request information. If they needed to know what was written in patient notes, they would have had to wait to receive a fax. The overall sense was that the networks reduced patients' risks; even if professionals had access to incomplete information, they had better, more readily available information than would have been the case in the past and were, therefore, more likely to make better decisions. Two of the interviewees noted that it was possible to post alerts on their network; for example, new information about an at-risk child could be placed on that child's home screen and the information would appear to anyone who accessed that child's records.

At the same time, more mixed experiences were reported. Several interviewees lamented that they did not have access to mental health services' systems. Some professionals did not have access to particular information they needed and so could end up repeating tests, which they felt did not promote patient safety.

Some interviewees also reported multiple, 'clunky' log-ons. Different professionals had different permissions, and some could access remote systems more easily than others. There was a view that networks were designed more around the needs of GPs than those of other professionals; for example, procedure or diagnostic codes for important and frequently occurring issues were not available to nurses and therapists (e.g. for pressure ulcers). GPs were able to choose which IT systems they used in their practices, which created issues for professionals in other organisations, as they might have access to one system but not to the other. When other professionals did not have access, they still had to telephone practices for information about a patient they were visiting that day.

Nurses and therapists took longer to complete assessments than they had done when paper assessment forms were used. One estimate was 60–70 minutes via a network, compared with 40 minutes using paper assessment forms. Standardised forms, which had to be completed in an order determined by the network managers, increased time costs. Social workers could refer someone to an NHS service, but they had no way of finding out, via the local network, whether or not an NHS colleague had actually followed up. Discharge letters often did not include full details of medications prescribed at hospital discharge, so that pharmacists had to call the hospital for more information. On one of the networks, take-out medication information was not uploaded until midnight on the day of discharge, which could exacerbate the problem of medicine reconciliation post discharge.

Finally, it was suggested that the networks were part of a larger HIT ecosystem. The combination of the networks, e-mail, Skype™ (Microsoft Corporation, Redmond, WA, USA) and other HIT services meant that co-ordinating treatment and care was easier than in the past. The fact that some of these services were separate from one another was not a problem. Several interviewees did, however, agree with the suggestion that semantic or seamless interoperability was desirable and might, in principle, make treatment and care safer.

The interviews confirmed views expressed in the nominal groups and by our PPI panel, not least about the combination of the potential of and the risks associated with interoperable networks and about the importance of medicine reconciliation. They did not change our views about our programme and mid-range theories.

### **Nominal group feedback**

We sent the two nominal groups a summary of our findings in July 2019 (see *Appendix 3*). The response from the groups was brief. The groups were surprised and disappointed that the available evidence was so limited. They did not have anything to add to these comments.

### **Systematic review update**

We updated the systematic review search in July 2019 to identify any new (evidence-based) theory fragments that might influence our thinking about our programme or mid-range theories and to check if any new reviews had been published in our domain. None of the reviews was included. We note, however, that two reviews gave us a little more confidence in our findings. The first was by Bowden and Coiera,<sup>50</sup> who reviewed evidence about the use of primary care records, shared with local hospitals, during episodes



of unscheduled care. We had found this study before, but re-read it in the light of our own results. Bowden and Coiera,<sup>50</sup> like us, found little high-quality evidence and concluded that:

*[Shared EHRs] should in principle be capable of improving the efficiency, quality and safety of unscheduled care, but at present the evidence for such benefits is weak, largely because it has not been sought.*

*Bowden and Coiera<sup>50</sup>*

We had not previously identified Devine and colleagues' review,<sup>88</sup> even though it was published in 2017. They focused on evidence about the rates of deployment and use of interoperable networks up to 2015. They concluded that the availability of networks had increased substantially, particularly in the 10 years prior to 2015. The functionality of those systems had improved in that period, in that users had access to more services (e.g. to laboratory test results), to remotely held patient records and to secure communication with clinical colleagues. They also observed, however, that there was little evidence that localities, both in the post-Obama administration environment in the USA and in other countries, had developed semantically interoperable networks. As we will see in later chapters, all of the evidence we found was about what one might term 'basic' functionality in the interoperable networks studied.

## Commentary

This chapter has set out the process of developing programme and mid-range theories. We were struck by the absence of theories that directly linked interoperable networks, and indeed HITs in general, to patient safety. As a result, we had to work harder than we expected to develop the theories ourselves. These theories did, however, provide a basis for the evidence searches that are described in *Chapter 3* and, hence, the evidence presented in the next four chapters.



# Chapter 5 The co-ordination of services for older people

## Introduction

This chapter presents the findings of the first evidence review described in *Chapter 3*. The next section discusses the nature of problems with the co-ordination of services for older people and, by extension, whether or not any of them might benefit from the deployment of interoperable networks. The following sections focus on users' experiences of interoperable networks and on evidence about the outcomes associated with the deployment of such networks.

### *What are the problems with the co-ordination of services?*

The searches identified 619 records for screening, 10 of which were eligible for inclusion (*Figure 10*).

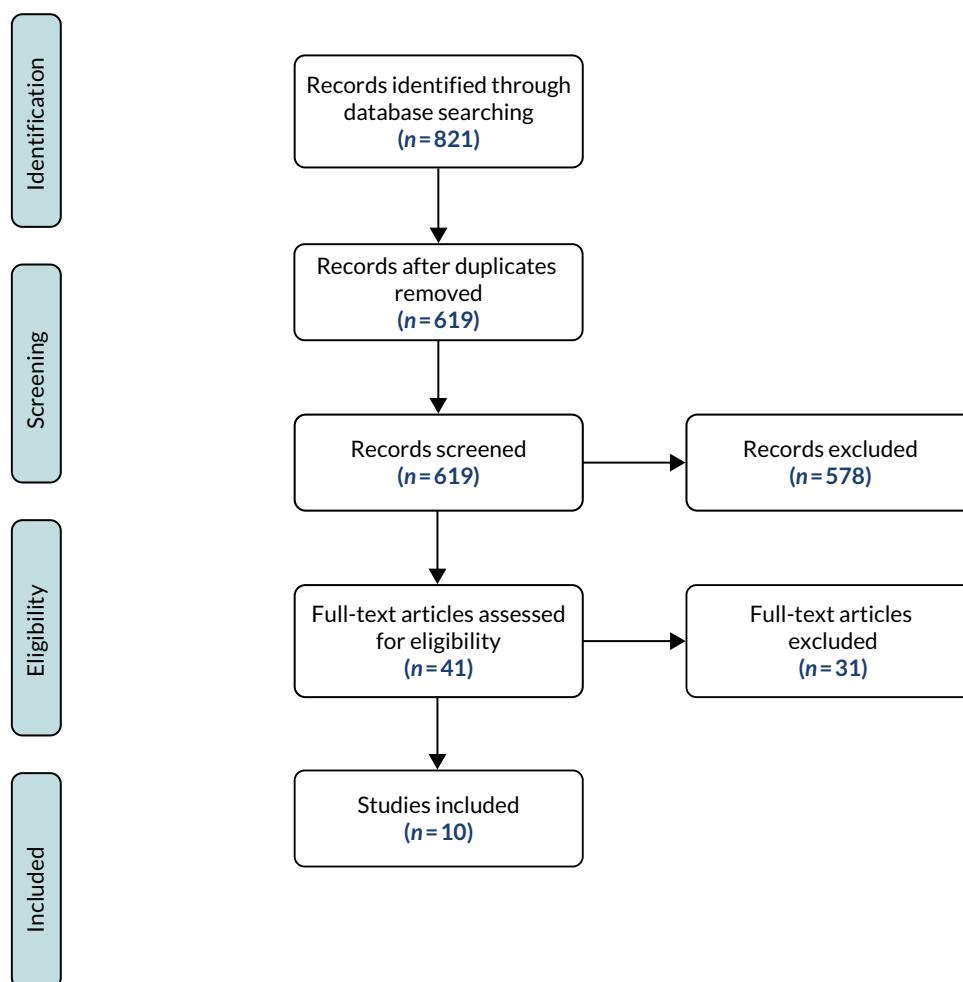


FIGURE 10 A PRISMA flow diagram: care co-ordination – nature of the problem.

## The nature of co-ordination problems

This section presents summaries of five review articles (*Table 4*) and of primary research articles published after the reviews and the results of hand-searching The King's Fund reports, which yielded two further references. We highlight two broad themes: one is the nature of co-ordination problems in general and the other is a particular problem, namely communication between professionals.

### Review articles

Auschra<sup>89</sup> undertook a review of barriers to the integration of care in interorganisational settings.<sup>89</sup> She argued that health care is delivered to many people by a number of professionals at any one time, and that integrated care is desirable as it leads to better outcomes. Similarly, Auschra<sup>89</sup> identified a number of barriers to integration. The strongest evidence (i.e. the largest number of papers) was about problems arising from the differences in the professional backgrounds of care providers, problems with leadership across professional and organisational boundaries and the conflicting goals of those providing care. There was also evidence suggesting problems due to lack of trust and shared understanding between professionals.

Auschra<sup>89</sup> also found evidence that a lack of communication and a failure to share information between professionals were barriers to integration. Confidentiality concerns were mentioned in relation to the latter. A lack of IT standards and the consequent inability to share information were also found to be barriers to integrated care.

Threapleton and colleagues<sup>90</sup> reviewed evidence about integrated care for elderly people. The authors identified eight 'components' of integrated services: (1) care continuity, (2) the policy context, (3) shared values and goals, (4) person-centred care, (5) multidisciplinary teams, (6) effective communication, (7) case management and (8) needs assessment. The study cites evidence of co-ordination problems between primary and secondary health services, and health and social care services. Threapleton and colleagues<sup>90</sup> argued that some of the prerequisites for integrated care are functional (e.g. funding, having multidisciplinary teams, having effective communication between service managers and between care providers) and others are more concerned with social and cultural issues (e.g. leadership, common values, problems posed by risk-averse or permission-based cultures).

Communication was one of the components of integrated care. Threapleton and colleagues<sup>90</sup> cited evidence about the value of different modes of communication, including team meetings. They also cited papers that found evidence of a role for integrated electronic record management, suggesting that a common database (i.e. shared patient records helping the flow and exchange of information) was also deemed desirable.

Allen and colleagues<sup>91</sup> reviewed evidence about care integration and the experiences of older people in the transition from hospital to home. They focused on the co-ordination of hospital and home-based services on the basis that problems with home-based services can affect decisions about an older person leaving hospital. The authors found evidence of inconsistent co-ordination of services. They suggested that this could be because the organisation was fragmented and/or because some services were not available in a given locality. They noted evidence of conflicting messages about care plans from different providers and practical difficulties at home (e.g. with personal hygiene, and with shopping, cleaning and other household tasks). Older people and their carers wanted information about their health problems, care plans or details of self-care, including how to access community services, but this was typically limited.

Allen and colleagues<sup>91</sup> presented what they termed a social constructivist account of communication as embedded in the processes of patients and carers negotiating with community-based providers, and of providers negotiating with one another. Communication problems were evident in many of the papers that the authors cited. To take just one example, failure to discuss an older person's needs could translate into missed opportunities to meet those needs, and to enable an older person to live independently.

TABLE 4 Nature of co-ordination problems: review articles

Study	Country	Method	Topic	Data type	Rigour	Relevance	Processes	Outcomes/errors
Auschra <sup>89</sup>		Systematic review	Barriers to integrated care	Qualitative	1	1	Range of interpersonal and institutional issues	
Threapleton <i>et al.</i> <sup>90</sup>		Scoping review	Barriers to and facilitators of co-ordination	Quantitative (E & O) and qualitative	2	1	Organisational and cultural features of co-ordination	
Allen <i>et al.</i> <sup>91</sup>		Narrative review	Transition from hospital to home	Qualitative	1	1	Negotiation and navigation of service user independence	
Kirst <i>et al.</i> <sup>92</sup>		Realist review	Conditions for effective team integration	Quantitative (E & O) and qualitative	1	1	Service use, patient and provider experience	Patient health status
Hudson <i>et al.</i> <sup>93</sup>		Narrative review	Transition from hospital to home	Quantitative (O) and qualitative	2	3	Range of organisational and interprofessional issues	Re-admission rates, user satisfaction with transition
Goodwin <i>et al.</i> <sup>94</sup>	Seven countries	Synthesis of case study evidence	Models of integrated care	Qualitative	2	1	Range, including flexibility of team working, effective communication, focus on users' needs	Effective integration associated with improved user satisfaction
Goodwin <i>et al.</i> <sup>95</sup>	England	Multisite case study	Evaluation of care co-ordination programmes	Qualitative	2	1	Range, including organisational models, team cultures, engagement	

E, experimental study; O, observational study.

Kirst and colleagues<sup>92</sup> undertook a realist review of the implementation of integrated care programmes for older people with complex needs. They identified evidence that supported two inter-related context-mechanism outcome configurations. The first concerned trust in multidisciplinary team relationships. Programmes were successful when cross-sector multidisciplinary teams that spanned different organisations trusted each other, were clear about their roles and could rely on each other to perform their roles. These teams collaborated closely, communicated effectively and shared knowledge about their work and patient information effectively, which allowed for continuity of care and better co-ordination of care. They also identified what they described as contextual factors that helped to build trust. These included team collaboration, leadership, and an organisational culture that encouraged team participation.

The second context mechanism outcome configuration emphasised provider commitment to, and understanding of, an intervention. The contextual factors that influenced provider commitment included strong leadership and strong organisational culture, provider expertise and training, provider incentives, flexibility in implementation (to respond to patients' needs) and time to build infrastructure. The last of these included building relationships across organisations and establishing management information systems.

Kirst and colleagues<sup>92</sup> did not emphasise communication to the same extent as the first three reviews. It is, however, strongly implied in both configurations that teams cannot build relationships, or arrive at a shared understanding of an intervention, without effective communication. The authors were less sure about the role of HITs, finding that common IT solutions across partnering organisations facilitated effective team communication and collaboration, but that this was not a necessary condition for successful co-ordination.

Hudson and colleagues<sup>93</sup> reviewed evidence about transitions in (what they termed) wicked environments for people aged  $\geq 65$  years (a broader group than in the other reviews). The authors identified six challenges that involved community-based services: (1) communication between professionals, and between professionals, patients and carers; (2) interprofessional relationships, including power differentials; (3) the primacy of the medical model; (4) role confusion, due in part to professionals not understanding one another's roles and working circumstances; (5) having sufficient resources available to provide services; and (6) leadership. Again, communication is one of the themes the authors identified. This included evidence of colleagues failing to send information to one another and of a patient's social history not being valued by medically qualified professionals involved in their care.

### ***The King's Fund publications***

The King's Fund has published a series of reports on the co-ordination of care for both older people and other groups that stretches back more than 10 years. We screened report titles and abstracts for relevance and then assessed 19 full texts. Two reports were included.<sup>94,95</sup> Given the evidence found in the five systematic reviews<sup>89-93</sup> reported above, our focus here was evidence about the role of interoperable networks, or HITs more generally, to compensate for the relative lack of focus on this in the reviews.

The first report,<sup>95</sup> published in 2013, was a comparative analysis of five UK-based case studies of care co-ordination programmes for people with long-term and complex chronic conditions. The report did not focus on a specific age group, but sections did discuss evidence of problems with the co-ordination of care for older people. The authors concluded that care co-ordination is a multifactorial problem. They created a framework that included > 30 characteristics of successful approaches to care co-ordination. The characteristics were divided into four 'levels' (system, organisational, clinical and professional, and service integration), with change needed at all four levels for effective co-ordination. System-level characteristics included universal health coverage, community- or primary care-led health care, emphasis on long-term and chronic conditions, and development of workforce skills in teamwork

and care co-ordination. Integrated EHRs were reported to be facilitators of care co-ordination, along with strong leadership, common values and a shared mission, aligned finance and governance structures, and a focus on continuous quality measurement and improvement. Shared clinical records were also mentioned in the context of clinical and professional services. At the service integration level, multidisciplinary teamwork and the development on interprofessional networks were deemed important, as were co-location of services and shared accountability.

The second report<sup>94</sup> was a synthesis of evidence from seven international case studies, from a number of countries, of integrated health and social care programmes for elderly patients with complex health needs. The authors collected key documents and conducted key informant interviews, evaluating the case studies against criteria identified in the previous report.<sup>95</sup> With regard to information management, the authors found that none of the case study programmes had developed fully shared electronic patient records that were accessible by all professionals involved in patient care. The authors<sup>94</sup> concluded that the case studies showed that it was possible to deliver integrated care using older technologies, such as telephone and fax. Greater use of shared EHRs was potentially an important enabler of integrated care but did not appear to be a necessary condition for it.

### Post-review individual studies

This search was designed to identify papers that had been published after the review by Threapleton and colleagues.<sup>90</sup> Three papers were included after full-text screening. These are summarised in *Table 5*.

Hainstock and colleagues<sup>96</sup> conducted interviews with family caregivers of older people to explore the challenges and needs of older patients when they transfer from one care environment to another. They interviewed 16 caregivers recruited from a 'diverse health region' in western Canada. During the transition of care, participants noted that communication between health-care professionals was problematic, and that it was complicating information flows and related caregiving efforts. Participants additionally described a perceived lack of empathy, compassion and continuity of care. The participants described experiences of receiving services from several health and social care professionals, and how they were not always informed about who was doing what and when. Other challenges were system related, including issues with funding and transport. The article mentioned issues with information transfer and effective communication, but did not explicitly mention interoperable networks.

Jeffs and colleagues<sup>97</sup> studied a transition intervention for older people with complex needs in Canada. They used a modified Delphi consensus technique, asking 23 panellists (clinicians, managers and caregivers) to rank intervention components and contextual factors identified in an earlier realist review.<sup>99</sup> The results

TABLE 5 Nature of the care co-ordination problem: summary of primary research articles

Study	Theme	Focus
Hainstock <i>et al.</i> <sup>96</sup>	Information-seeking and knowledge gaps, navigating roles, regulations and procedures (staff turnover, lack of continuity of care), advocacy	How family caregivers navigate and make sense of the transition from home care to residential care for a family member
Jeffs <i>et al.</i> <sup>97</sup>	Components of successful nurse-led care transitions	Nurse-led care transition intervention
Larsen <i>et al.</i> <sup>98</sup>	To collaborate is to feel trust or mistrust between health-care providers  To collaborate is to have a sense of security or insecurity	Interprofessional collaboration

suggested that patient involvement and engagement in transitions was ranked highest, followed by improving communication, professional practices and strategic leadership. The facilitation of information transfer, enhancement of clinical information systems and use of integrated person-centred health records was ranked eighth by the panel.

Larsen and colleagues<sup>98</sup> conducted an interview study with health-care professionals involved in providing care for older people living at home in Sweden. The study aimed to illustrate and describe how various health-care professionals experience collaboration in caring for older people living at home. The results suggested that a combination of clinicians' personalities and professional boundaries may affect the quality of teamwork and, hence, the quality of care patients receive. The authors argued that the keys to successful collaboration were building trust and a sense of security, and not drawing boundaries between primary and specialist care.

Taking the papers as a group,<sup>96-98</sup> the main themes identified were similar to those identified in the literature reviews.

### **Commentary**

The literature reviews and other articles confirm that there is empirical evidence of co-ordination problems in the care of older people. Services are provided by people with different professional backgrounds, typically working for different organisations. Service providers have to co-ordinate their work, spanning professional and organisational boundaries, to provide integrated (or effectively co-ordinated, or person-centred) care. The evidence suggests that there is broad agreement about the nature of those problems. Reviews conducted in different academic traditions, and using different review methods, have produced broadly similar findings. The reviews indicate that this is an ongoing challenge: it is structural, it is not going to change and it is difficult. It makes sense that a great deal of work has to go into creating, and sustaining, multidisciplinary teams.

The articles<sup>89-98</sup> all stress the fundamentally social nature of team working across professional and organisational boundaries: the importance of leadership, culture, trust and other qualities of teams. They also convey the point that co-ordination problems cannot be separated from one another. That is, it is not possible to solve one issue – say, a culture that does not encourage team working – separately from others. The question that follows, for this review, is whether or not any of the themes is amenable to solutions that involve interoperable networks. Most of the themes are not, by their nature, ones that an interoperable network – however designed – can obviously help to address. Their contribution to leadership or trust problems will be indirect, at best.

Our interpretation is that there might be a role for interoperable networks in addressing communication problems, but the communication problems can be addressed only in concert with addressing other problems.

### ***Users' experiences of interoperable networks***

The searches identified 463 records to be screened, of which six<sup>100-105</sup> were eligible for inclusion (*Figure 11*). All articles included are in the outer ring of the relevance 'target' described in *Chapter 2*.

### ***Literature reviews***

We included four literature reviews and two primary research articles (*Table 6*). All four reviews<sup>100-103</sup> were general in nature, and did not focus specifically on the experiences of users in the course of the treatment and care of frail older people, or of older people more broadly. The reviews reported that there was generally little information about the nature of the interoperable networks studied, including their user interfaces.



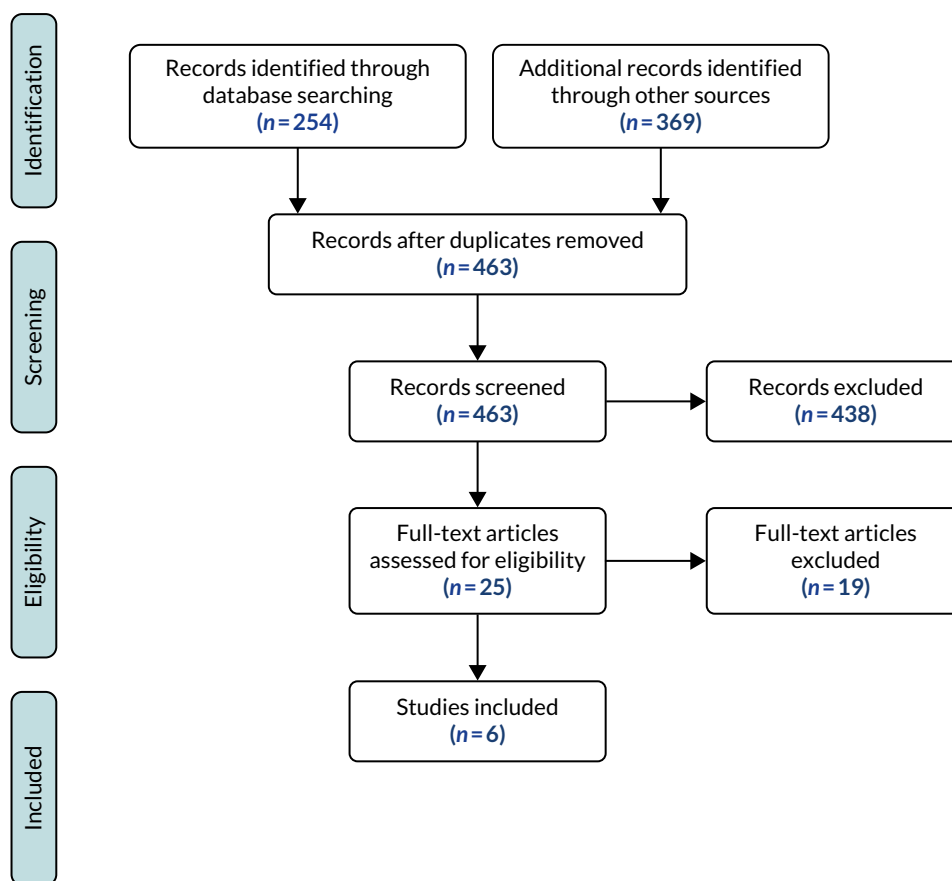


FIGURE 11 A PRISMA flow diagram: care co-ordination – users’ experiences.

TABLE 6 Co-ordination of services: users’ experiences of interoperable networks articles

Study	Country	Methods	Topic	Rigour	Relevance
Eden <i>et al.</i> <sup>100</sup>		Systematic review	HIE barriers and facilitators	1	3
Azarm-Daigle <i>et al.</i> <sup>101</sup>		Systematic review	Cross-organisational data sharing	1	2
Hoerbst and Schweitzer <sup>102</sup>		Systematic review	Critical success factors for clinical information systems in integrated care	1	2
Wu and LaRue <sup>103</sup>	USA	Systematic review	HIE barriers and facilitators	1	3
Nicolaisen and Berg <sup>104</sup>	Norway	Primary qualitative: interviews	Perceptions of messaging system	1	2
McMurray <i>et al.</i> <sup>105</sup>	Canada	Primary qualitative: ethnographic study	Impact of partial interoperability	1	1

Hoerbst and Schweitzer<sup>102</sup> undertook a review of barriers to and critical success factors of HITs in integrated care settings. They identified 43 success factors, which they classified under five headings (organisational, technical level and user-related factors, and data and functionality of an IT system). For example, in relation to organisational success, they stated that the most important factor (cited in 24 studies) was project and IT management. The second most commonly cited success factor was active user participation in training and availability for IT support. Our interest was in user experiences. The most commonly cited success factors were perceived usefulness of a system and the active involvement of clinicians in the design process (24 studies). The engagement of managers with users’ feedback or

concerns was cited in 11 studies. Less frequently cited factors included previous users' experience and readiness to use these systems (seven studies), and availability of and easy access to computers (three studies).

Most of the evidence about barriers was focused on users' working practices and on interface issues. The most cited barrier was increased clinician time spent on using IT (19 studies). Lack of involvement of clinicians in design and implementation was reported in 12 studies. Perceived negative impact of IT systems on the doctor-patient relationship was mentioned in 11 studies. The disruptive impact of systems on workflow was cited in nine studies.

Azarm-Daigle and colleagues<sup>101</sup> conducted a literature review of studies that explored cross-organisational information sharing. Most of the evidence addressed implementation challenges rather than end-user experiences, so that evidence about information sharing was indirect. The authors did, however, cite evidence that might contribute to problems with information sharing. For example, they noted gaps in understanding between IT developers and health professionals, and the misconception that technology alone could solve all problems, both which might lead to suboptimal software solutions being implemented.

Wu and LaRue<sup>103</sup> conducted a review of the barriers to and facilitators of adopting HIE in USA. They identified a number of challenges, many organisational, hindering the adoption of HIE. The review discussed five articles that focused on users' experiences. The evidence suggested that overall usage rates were very low, with physicians using HIE the least and nurses using it more frequently. HIE varied by hospital department and user role. Reasons given for low usage rates included a lack of trust in data generated in other places, the disruptive effect of HIE on workflow, the redundancy or inaccuracy of information, time constraints and costs. Health professionals also commented on the need for more user-friendly designs, for automated single log-in (to interoperable networks) and for automated notification of the availability of new patient data.

Eden and colleagues<sup>100</sup> conducted a review of barriers to and facilitators of using HIE (as distinct from Wu and LaRue's<sup>103</sup> focus on adoption). The review comprised 19 studies that used range of study designs, most of which were conducted in the USA. The most common perceived barriers to using HIE were incomplete information and the fact that the available information did not meet the needs of the users. Users were cited as saying that there was not enough information in the system to warrant use. Studies showed that users were frustrated because of the time they spent searching for information, which did not always lead to them finding anything clinically useful. Users also voiced concerns about the legality of sharing data.

The impact of HIE use on workflow was also found to be important. The review found that users struggled with separate log-ins and too many mouse clicks to get to information. In common with Wu and LaRue,<sup>103</sup> the authors<sup>100</sup> found that the role of the user affected when and how frequently they used systems, with nurses tending to use them more often than doctors. Facilitators of improving workflow included having single log-ins, training and IT support and, more generally, addressing the need for changes in working practices.

### ***User experiences of interoperable networks: single studies***

We found two studies that were not included in the four reviews reported in the last section. McMurray and colleagues<sup>105</sup> interviewed 24 health-care professionals and 19 family members and caregivers involved in the transition of older patients in Canada. There was a combination of paper and digital records, with limited interoperability between the digital records held by different organisations. The two key themes emerging from the interviews were:

1. Partial interoperability between electronic information systems has complicated, rather than eased, the ability to communicate across settings and disciplines.
2. Although some information is more accessible and communications are more streamlined, the use of parallel paper and electronic systems has increased staff administrative time.

A physician was quoted as saying:

*If the hospital doesn't send the paperwork with the patient then I'll never know the answer . . . who did you see while in hospital . . . why did you see a breathing type doctor while in hospital? . . . I don't have that ability.*

*McMurray and colleagues*<sup>105</sup>

Health professionals observed that one issue was a lack of trust that patient information would be accurate and up to date. These health professionals also raised concerns about the ease of looking for and finding information in electronic records, the structure and design of the records, and the impact on their autonomy in recording practices.

Nicolaison and Berg<sup>104</sup> evaluated a national message exchange system in a sample of hospitals and primary care centres in Norway. The findings were based on interviews and a literature review. The interviews revealed differences in system use between hospitals and primary care settings. Hospital users saw the system as an 'additional task' that was used in parallel with other modes of communication. They reported finding message structures confusing. On the other hand, GPs and other professionals in primary care used and trusted the system. It was seen as a time-saving alternative method of cross-organisational asynchronous communication.

### ***Fitzpatrick and Ellingsen forwards citation search***

We did not find any articles that met our inclusion criteria in the forwards citation search of Fitzpatrick and Ellingsen's 2013 review<sup>10</sup> of computer-supported co-operative work literature.

### **Commentary**

The evidence indicates that interoperable networks are difficult to use. We found limited evidence directly relating to the use of networks in the course of treatment and care of older people, but it seems reasonable to infer that some of the evidence in the literature reviews will include services for older people. There is a lack of studies involving direct observation of working practices; many studies were based on interviews. We did not find evidence about the use of interoperable networks when they are embedded in routine use (when implementation has been deemed a success).

Caution in interpretation of these findings is needed given that key details are missing from most reports, notably about the characteristics of the interfaces and other characteristics of interoperable networks. This said, the evidence casts doubt on the normative assumption underlying a section of the main programme theory. That is, users can access information to inform their decisions and actions.

## **The effectiveness of interoperable networks**

The searches identified 977 records for screening, of which eight<sup>33-35,79,106-109</sup> were eligible for inclusion (*Figure 12*).

### ***Main search results***

Three studies were included, all in the outer ring of the relevance 'target' described in *Chapter 2*. They used interviews as the main source of data (*Table 7*). None of the studies included quantitative data on patients' risks, but all three studies did include perceptions of outcome changes.

Vimarlund and colleagues<sup>33</sup> report a case study of Old@home, a 'virtual health record' tool in Sweden. It allowed health-care professionals making home visits to access patient information from remote records systems and record new information at the point of care. The tool also allowed different parties to view the current services for a patient and was perceived to have reduced duplication or repetition of documentation. The team both developed and evaluated the tool.

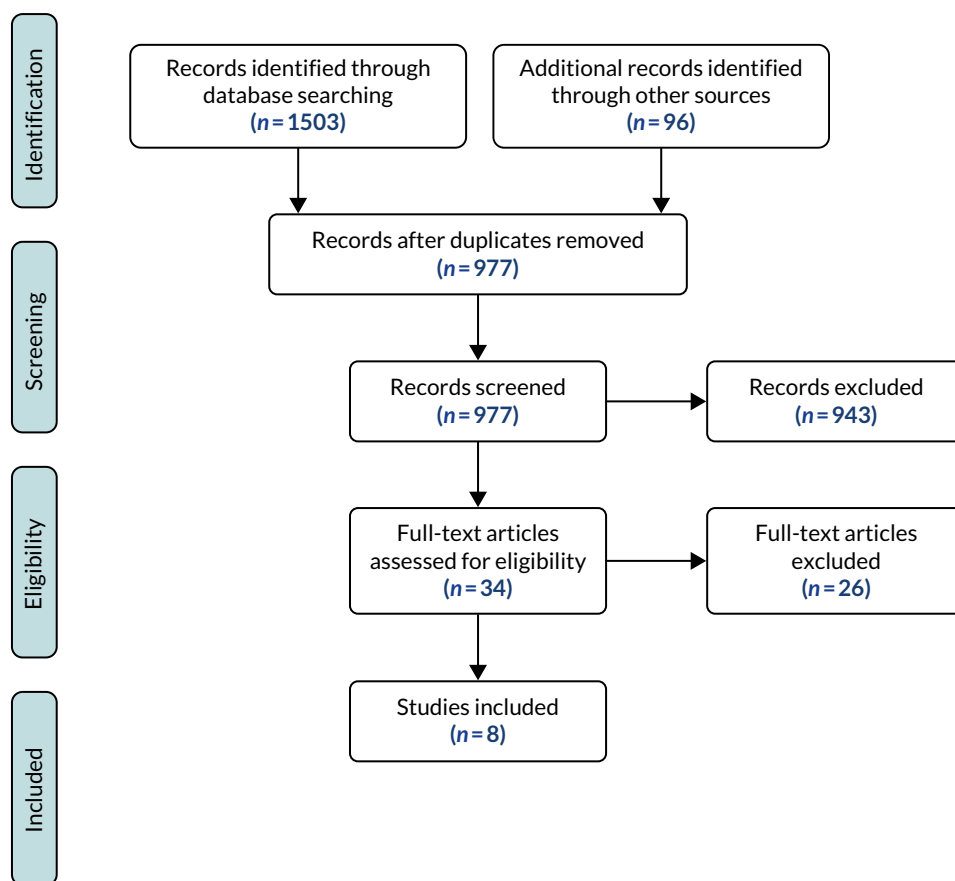


FIGURE 12 A PRISMA flow diagram: care co-ordination – outcomes.

TABLE 7 Co-ordination of services: service and patient outcomes

Study	Country	Methods	Topic	Rigour	Relevance
King <i>et al.</i> <sup>35</sup>	Scotland	Interviews	Electronic shared assessment tool	1	3
Waterson <i>et al.</i> <sup>34</sup>	England	Interviews, observations of meetings	e-health supported care pathway	2	3
Vimarlund <i>et al.</i> <sup>33</sup>	Sweden	Interviews	Virtual health record tool	3	3
Health Quality Ontario <sup>106</sup>		Systematic review	e-tools, HIE and care co-ordination	1	2
Sadoughi <i>et al.</i> <sup>107</sup>		Systematic review	HIE, quality of care	1	2
Hersh <i>et al.</i> <sup>79</sup>		Systematic review	Effectiveness of HIE	1	2
Reis <i>et al.</i> <sup>108</sup>		Review of systematic reviews	Cost-benefit of records, HIE, interoperability	1	2
Menachemi <i>et al.</i> <sup>109</sup>		Systematic review	HIE and service changes	1	2

The researchers<sup>33</sup> conducted six semistructured interviews with project stakeholders, including system users. Overall, Old@home was perceived to improve team working, reduce pressures and reduce waiting time for the delivery of services. Access to real-time information was believed to improve relationships between various health-care professionals, was considered an important factor in improving work routines and was perceived as ‘a gain in efficiency’ for health-care staff.

Participants reported struggling to get used to the new system. Once they were familiar with it, however, they believed that it improved the transparency of work activities and also served to 'reduce the constraints related to geographical locations and organizational cultural differences'.<sup>33</sup> The authors<sup>33</sup> also argued that the new tool played a role in improving teamwork.

Waterson and colleagues<sup>34</sup> reported on a 3-year project that aimed to design and implement an 'e-health-supported' care pathway for frail older patients in two NHS trusts in England.<sup>34</sup> The authors used a number of methods to collect the data, including 40 semistructured interviews with health-care professionals and observations of project meetings.

The findings were mixed. On the positive side, interviewees said that it was helpful to be able to see which other care professionals were involved in the care of patients and what the latest blood test results were. Community health-care professionals logged into the system when they received a referral for a frail older person. One nurse commented that 'You have all the jigsaw puzzle pieces together'.<sup>34</sup> Accident and emergency staff used the system to send an alert to community nurses if a known frequent attender was at the hospital. Less positively, care co-ordinators reported that the system resulted in rushed arrangements for people being cared for in their own homes.<sup>34</sup>

The system was also limited in that it did not allow nurses to access GP records. Social workers had limited access to the system. Many challenges were reported in being able to access patient information while working in the community (e.g. during home visits). Health-care professionals had to collect all of the data and then enter them into the system after they completed home visits, which increased their workload. Participants described how they worked around this and attempted to visit family practices while on the road to access the system. The paper concluded that the implementation of networked IT system was patchy and that further enhancements were needed.

King and colleagues<sup>35</sup> undertook a case study of the implementation of an electronic version of the Single Shared Assessment (e-SSA) in three different health board regions in Scotland. The authors interviewed 30 health and social care workers across three study sites. They found that staff did not actively share e-SSA forms. An interviewee commented that:

*I'd give it about 1 out of 10. I don't think it has helped in the slightest. We don't share a lot of them . . . they're probably not a particularly good assessment either. In terms of a joint document it's pretty pointless really.*

*King and colleagues<sup>35</sup>*

Health information technology infrastructure was different between health boards and local authorities. Social workers were familiar with a mobile IT device and needed training only for the new application. Health-care workers had rarely used a mobile IT device to support their work and found it challenging. The authors also reported connectivity and IT infrastructure issues when the e-SSA was used in remote and rural locations. Participants also commented that the e-SSA document was lengthy and time-consuming.<sup>35</sup>

The authors<sup>35</sup> reported on broader issues. Professional boundaries between health and social care staff was a significant theme. There was evidence that different professionals had different views, roles and expectations. Overall, the authors found that the e-SSA did not meet professionals' expectations.

### **Broader search results**

The findings of the first search, which did not yield any direct evidence of outcome changes, prompted us to undertake a broader search. We searched for reviews relating to a broader population of adults and older people (i.e. relaxing the constraint of services for older people). Five reviews<sup>79,106-109</sup> were included.

A systematic review<sup>106</sup> and meta-analysis by Health Quality Ontario examined the impact of e-tools for HIE in the context of care co-ordination for individuals with chronic disease in the community. The review comprised 11 studies. Only one, a randomised controlled trial, reported on the impact of such tools on adverse events, with no statistically significant findings. The authors concluded that 'the findings from this evidence-based analysis raise doubts about the ability of e-tools with care co-ordination capabilities to independently improve the quality of outpatient care'.<sup>106</sup>

Sadoughi *et al.*<sup>107</sup> conducted a systematic review on the impact of HIE on quality of care, cost-effectiveness and use. The authors found 32 studies that satisfied their inclusion criteria. Medical error rates were reported in three studies; two reported reductions in rates and one reported no significant change.

Hersh *et al.*<sup>79</sup> undertook a systematic review of effectiveness of HIE. They included 34 studies, but none reported patient mortality or morbidity outcomes. Most of the evidence looked at hospital utilisation outcomes, such as use of investigations, hospital admissions and hospital re-admissions.

Reis and colleagues<sup>108</sup> conducted a review of reviews to investigate the evidence base for 'cost-benefits' of EHRs, standards and interoperability. Six reviews were included, none of which included measures of cost-effectiveness.

Menachemi and colleagues<sup>109</sup> published an updated systematic review of studies of the relationship between HIE and health-care outcomes. The authors<sup>109</sup> reported substantial numbers of quantitative papers that included evidence of process measures, including hospital readmission rates and laboratory and radiology request rates. In relation to quality of care, 9 out of 10 included papers reported a positive impact of HIE on medicine reconciliation, immunisation and medical record completeness, and a reduction in care disparities and measures specific to HIV (human immunodeficiency virus). Of these, the most relevant is the report on medicine reconciliation, which we turn to in the next chapter.

### Commentary

We did not find any useful evidence about the effects of interoperable networks on patient outcomes. The evidence in the articles is, at best, indirect and relatively weak. The wider evidence is barely more positive.

## Conclusions

There is good evidence about the nature of co-ordination problems in the care of older people living at home. There is also good evidence about users' experiences of interoperable networks, which suggests that users find such networks difficult to use. There was no evidence about the effectiveness of interoperable networks on the outcomes of older people. There was some more and better evidence about wider adult and older populations, but this too suggests that interoperable networks may not have substantial effects on patient outcomes.

In relation to the main programme theory, the evidence supports the contention that there may be problems that interoperable networks play a role in solving – communication problems. However, there is also evidence that undermines the programme theory, which assumes that users can access networks and find information – there is good evidence that this is not the case. Finally, we are struck by the lack of strong evidence from well-designed experimental or observational studies about patient outcomes.

# Chapter 6 The co-ordination of medicine reconciliation

## Introduction

This chapter presents the evidence about the role of interoperable systems in medicine reconciliation for older people. Our nominal groups and PPI panel identified medicine reconciliation as a priority. Medicine reconciliation involves the reconciliation of two or more lists of medications, or the reconciliation of a medication list with a patient's assessed needs (or both). Barnsteiner<sup>110</sup> defined this aspect of reconciliation as:

*The process of obtaining and documenting a complete and accurate list of current patient medications and comparing this list with medication orders at each point of care transition to identify and rectify any discrepancies.*

Barnsteiner<sup>110</sup>

Medicine reconciliation offers an appropriate 'test case' for interoperable systems. Interoperable systems might be a source of increased patient risks or they might be part of a strategy to reduce those risks. An interoperable network allows professionals to access medication lists both in their own patient record systems and in remote systems. Lists therefore need to be reconciled before systems can be used safely, and clinical risks may be associated with a failure to reconcile lists or with errors made in the process of reconciliation. Equally, there is the prospect that interoperable systems can be designed to support the accurate reconciliation of medication lists, contributing to the assurance of safe treatment and care.

There are three main sections, reflecting the questions set out in *Chapter 3*:

1. What is the nature and extent of problems with medication reconciliation?
2. What evidence is there about the experiences of the use of interoperable systems in medicine reconciliation in care transitions?
3. What evidence is there about the safety-related effects of interoperable systems?

## The nature of the medication reconciliation problem

The search identified 1194 records for screening; of these, 22 studies were eligible for inclusion (*Figure 13* and *Table 8*).

We noted in *Chapter 4* that there was suggestive evidence that interoperable networks were associated with improvements in process measures relevant to our main programme theory.<sup>77,78</sup> One systematic review, one other review and three observational studies were included. Godfrey and colleagues<sup>111</sup> conducted a systematic review of studies exploring the safety of medicine management among older adults living at home. The authors<sup>111</sup> included 36 studies, 24 from the USA and 12 from other countries, the majority of which (28 studies) were observational. The most commonly cited problem was the large number of medications prescribed (polypharmacy): if medicines were prescribed by more than one provider, this was as predictor of inappropriate prescribing and, hence, of adverse events.

The authors<sup>111</sup> argued that responsibility for medication management has shifted over the years. The earlier studies showed that doctors took responsibility, and nurses and pharmacists were not closely involved. More recent studies described the active involvement of pharmacists and nurses. The review did not mention HITs as an issue in medicine management.

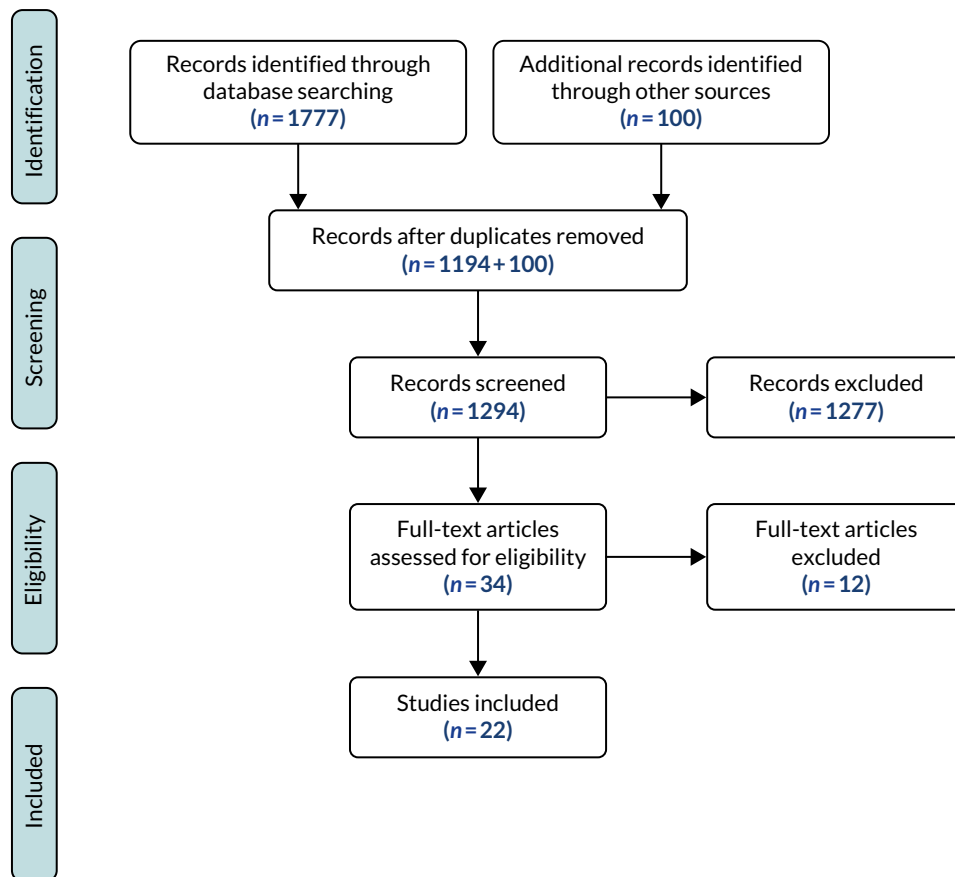


FIGURE 13 A PRISMA flow diagram: medicine reconciliation – nature of the problem.

Fernandes and Shojania<sup>115</sup> reviewed evidence about the ‘what, why, when, who and how’ of medication reconciliation. The article is described as a combination of a literature review and the authors’ personal experiences. It does not describe the literature review method in any detail; it would be excluded from a conventional systematic review but is included here on the basis that it provides a useful summary of empirical evidence. The review found that few studies have examined medication reconciliation in ambulatory (i.e. community) care. Most studies have been conducted in hospitals, and for elective rather than emergency admissions. This said, the authors<sup>115</sup> make two relevant points about transitions in care, notably hospital discharge to home. First, reconciliation practice is typically different from the normative ideal. In the ideal case, reconciliation is an interprofessional process that leads to active medication management. This is not always reflected in actual working practices, as reconciliation may be viewed as an administrative task (rather than a safety-promoting one) and community-based clinicians have to contact hospital staff post discharge. The authors argued that there was no clear consensus in the literature on who should be responsible for reconciliation. Second, they cite evidence that reconciliation can be used to reduce clinically important discrepancies during care transitions. That is, the review offers evidence of both a co-ordination problem and the possibility of addressing it.

Hernandez<sup>113</sup> conducted interviews with 15 registered nurses in the USA to explore their experiences of medicine management for older patients. All participants practised in rural or urban clinics. Two relevant themes were identified. The first theme concerned communication between professionals to avoid the prescription of unnecessary medication and to avoid the ‘prescription cascade’ (when one drug is prescribed to manage to the side effect of another drug). One interviewee was quoted as saying that ‘I think it takes a very skilled clinician to be able to piece everything together; piece all the specialists’ work together; piece all the transitions of care together’.<sup>113</sup> The second theme focused on the problems of polypharmacy and avoidable drug–drug interactions. In relation to interoperable



TABLE 8 The nature of medicine reconciliation problems

Study	Country	Method	Topic	Data type	Rigour	Relevance	Processes	Outcomes/errors
Godfrey <i>et al.</i> <sup>111</sup>		Scoping review	Medication management	Quantitative (E & O) and qualitative	2	1	Time costs, responsibility for reconciliation, communication problems	Polypharmacy, potentially inappropriate prescribing
Tommelein <i>et al.</i> <sup>112</sup>	Europe	Systematic prevalence survey	Potentially inappropriate prescribing	Quantitative (O)	2	3		Polypharmacy, patient characteristics, including advanced age
Hernandez <sup>113</sup>	USA	Interviews (community nurses)	Co-ordination of services	Qualitative	1	1	Interprofessional co-ordination, communication problems	Polypharmacy, medication errors, adverse events
Kennelty <i>et al.</i> <sup>114</sup>	USA	Interviews (pharmacists)	Reconciliation post hospital discharge	Qualitative	1	1	Resources, communication, interprofessional relationships	

E, experimental study; O, observational study.

networks, an interviewee was quoted as saying of patients and carers that, 'If we had access to medical records ... we'd be better able to support them'.<sup>113</sup>

Kennelty and colleagues<sup>114</sup> conducted face-to-face interviews with 10 community pharmacists in USA, focusing on the pharmacists' understanding of medicine reconciliation and its barriers and facilitators following hospital discharge. Interviewees reported a number of challenges, including a lack of clarity about roles and responsibilities and difficulties in communicating across organisational boundaries. The authors<sup>114</sup> also reported that pharmacists were frustrated with not having access to patients' (hospital) electronic medical records. One pharmacist stated that trying to confirm a prescription following a patient's hospital discharge was 'almost impossible'. When they did try, they encountered problems:

*... we get transferred all around the hospital ... And any time that [the hospital doctor] is not there, they always tell us, refer your questions to the primary care physician. Nine times out of ten, the primary care physician doesn't even know that this patient was in the hospital ...*

*Kennelty and colleagues<sup>114</sup>*

### Commentary

The systematic review by Godfrey and colleagues<sup>111</sup> provides the strongest evidence about the nature of co-ordination problems in medicine reconciliation. The review by Fernandes<sup>115</sup> has to be treated with more caution, but it is consistent with the results of the systematic review. These reviews,<sup>111,115</sup> together with the individual studies,<sup>112-114</sup> paint a picture that is broadly similar to that for the co-ordination of services in *Chapter 5*. Communication problems are a clear theme, which we interpret as offering a possible role for interoperable networks, hinted at in some of the articles. These problems are, however, embedded in others, notably uncertainty about roles and responsibilities for medicine reconciliation between doctors, nurses and pharmacists.

### Cognitive processes in medicine reconciliation

The searches identified 436 records for screening, of which a total of eight<sup>114,116-123</sup> were eligible for inclusion (*Figure 14*).

As explained in *Chapter 4*, we came across a book chapter by Cook<sup>124</sup> that suggested that there might be an additional source of evidence about the nature of medicine reconciliation problems. The chapter summarised psychological research into the cognitive processes involved in reconciling lists of medications. We took the view, taking our cue from the World Health Organization,<sup>125</sup> that cognitive processes involving professionals' ability to reason and judge can have effects on patients' clinical risks.

### Cluster search findings

We found three studies, reported in four articles<sup>116-119</sup> (*Table 9*). They all involved essentially theoretical, laboratory-type experiments, designed to reveal some aspect of the cognitive processes involved in medicine reconciliation (either matching medications to a clinical condition or matching medication lists). As a result, all are in the outer ring of the relevance 'target' described in *Chapter 2*. In *Table 9*, a relevance score of 1 indicates that the article is in the centre of the target, a 2 that it is in the middle ring, and a 3 in the outer ring. Rigour scores were assigned on the basis of judgements by the team, with 1 being most and 3 being least rigorous use of methods. A broad objective was to understand how best to present data on computer and tablet screens in putative future applications.

Vashitz and colleagues<sup>120</sup> undertook a simulation experiment, based on a real case from a US anaesthesiology department of a 66-year-old woman presenting for resection of a base-of-tongue lesion. The authors<sup>120</sup> used an affinity diagram method. Twenty-four clinicians were given paper cards, each with a disease (grey background) or medication (white background) printed on it. The task was to sort the cards into a pattern that made sense to them clinically; the performance of the task was video-recorded.

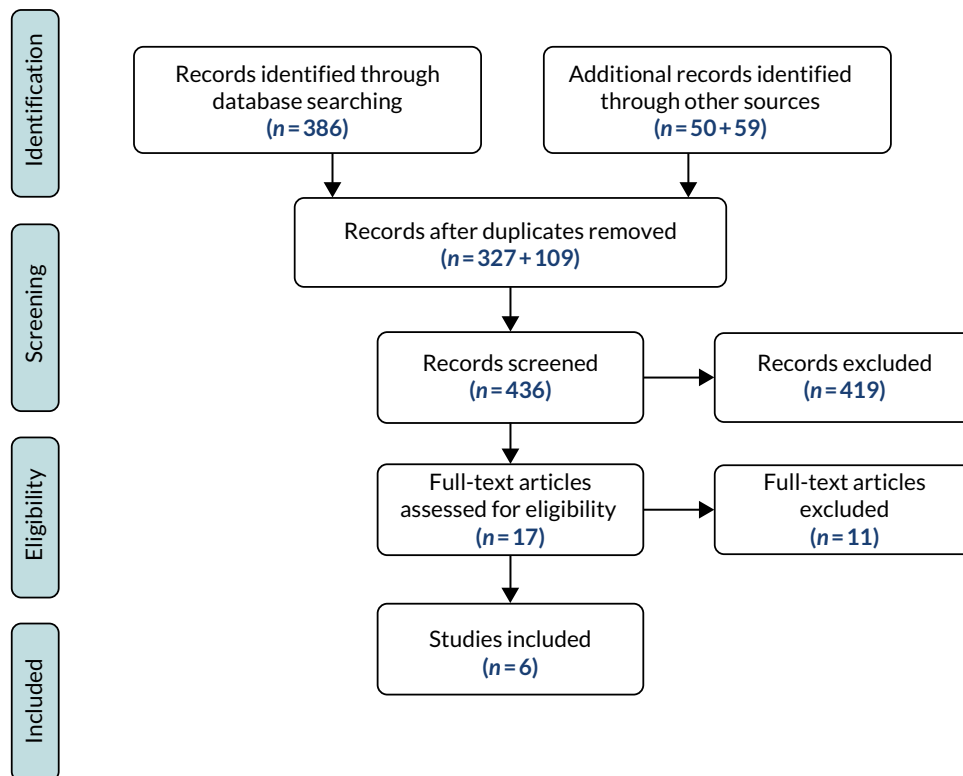


FIGURE 14 A PRISMA flow diagram: medicine reconciliation – users' experiences.

TABLE 9 Medicine reconciliation: cognitive reasoning and observational studies

Study	Country	Methods	Main findings	Rigour	Relevance
Horsky <i>et al.</i> <sup>116</sup>	USA	Clinical scenario	Better-designed tools associated with more accurate reconciliation	2	3
Bitan <i>et al.</i> <sup>117</sup>	USA	Clinical scenario	Insights into cognitive processes in reconciliation	3	3
van Stiphout <i>et al.</i> <sup>118</sup>	USA and Netherlands	Interviews	Insights into cognitive processes in reconciliation	1	3
Vashitz <i>et al.</i> <sup>119</sup>	USA	Clinical scenario	Insights into cognitive processes in reconciliation	3	3
Vashitz <i>et al.</i> <sup>120</sup>	USA	Clinical scenario	Insights into cognitive processes in reconciliation	3	3
Foged <i>et al.</i> <sup>121</sup>	Denmark	Observation of working practices, focus groups	E-messaging system did not meet nurses' needs	1	1
Fanizza <i>et al.</i> <sup>122</sup>	USA	Descriptive statistics	HIE data insufficient for pharmacists to perform reconciliation	2	2
Hohmeier <i>et al.</i> <sup>123</sup>	USA	Mixed quantitative and qualitative methods	Pharmacists able to perform reconciliation	2	2
Kennelty <i>et al.</i> <sup>114</sup>	USA	Interviews	Pharmacists found reconciliation difficult and time-consuming	2	2

Post-task interviews were also undertaken and recorded. The final patterns of cards were measured and their spatial relationships were analysed statistically. The results indicated that anaesthetists with different levels of training demonstrated a common tendency: they organised the disease cards by relevant organ system and then matched the medication cards to them. The interview data confirmed that participants used medical conditions as 'anchors', and then arranged cards by organ system and then medication. In a second paper,<sup>119</sup> Vashitz and colleagues undertook a reanalysis of the same data. The authors<sup>119</sup> argued that they found further evidence that organ-based information was central to the cognitive sorting task.

Bitan and colleagues<sup>117</sup> also undertook a card sorting experiment. The design was similar to that used by Vashitz and colleagues<sup>120</sup> using the same clinical scenario, although it involved 130 hospital clinicians and the experiment was undertaken on a tablet screen, with cards represented on the screen. Bitan and colleagues<sup>117</sup> found that clinicians used one of three strategies to sort the 'cards'. In the most popular, 'most conditions first', clinicians first sorted conditions and then matched medications by condition. In the second, 'crossover', they sorted a few cards from either the condition or the medication list, matched them and then moved on to the remaining 'cards'. A third group used an 'alternating' strategy, in which clinicians chose a condition, matched a medication to it and then moved on to another condition. The authors argue that there was no 'one size fits all' cognitive strategy and that this should be taken into account in the design of future software solutions.<sup>117</sup>

Horsky and colleagues<sup>116</sup> also developed a clinical scenario but in this case involving reconciliation of two lists containing 16 medications each. Discrepancies were designed into the scenario, so that participants would have to make clinical judgements, rather than simply verify that a medication was appropriate. Eleven clinicians performed reconciliation on each of two different hospital EHRs, in alternating order. They were all familiar with one EHR, having used it for at least 4 months. Medication lists were presented on a single screen, with one above the other, so that users had to scroll up and down between the two lists. None of the participants had used the second EHR, in which medication lists were presented side by side. A research administrator was present throughout and fulfilled the role of the patient, answering questions about the scenario condition, including whether or not they had taken a medication, and also provided information about the listed medications. Participants were also interviewed after completing the tasks.

The error rates observed were higher for the first, familiar EHR (1.29 vs. 0.37 errors per participant). There were between zero and three errors per task per clinician for both EHRs. The difference in mean number of errors between systems was not significant ( $p < 0.057$ ). The most common error made was a dosing error. The authors argue that the presentation of medication lists influenced the observed error rates.<sup>116</sup>

### **Structured database search findings**

Once we had identified the book chapter and journal article in the cluster search, we were able to design a structured database search, which included experiences of using interoperable networks. After full-text screening, one study was included. The ecological validity of the studies in this and the last section was judged as low or medium, using a simple set of categories devised by us (low, medium and high) (see *Table 9*). All of the studies were in the outer ring of the relevance 'target'.

Van Stiphout and colleagues<sup>118</sup> sought to identify the procedural, cognitive and macrocognitive skills needed for medication management using interoperable networks.<sup>118</sup> They used a formal task analysis method. This involved developing a general description of the medication management process based on a combination of relevant literature and exploratory interviews. In-depth interviews were then conducted with 20 domain experts in the Netherlands and the USA. The study made three observations that are relevant to this synthesis:

1. Medication reconciliation is a task that involves both cognitive and procedural skills.
2. There was no agreement among health-care professionals about what constitutes an adverse event.
3. Current IT systems did not support specific prescription actions, such as taking a medication at different doses per day or medication tapering schemes.

The authors concluded that:

*Educating physicians in the cognitive skills of IT mediated medication management could be one of the missing links of patient safety.*

*Van Stiphout and colleagues<sup>118</sup>*

### Commentary

The articles in this section report laboratory-style experimental rather than observational studies, and so offer limited direct evidence about the nature of reconciliation. However, it is enough to allow us to sketch the nature of the cognitive processes involved. The evidence suggests that cognitive errors can be made in reconciliation, but we note that the error rates are relatively low: reconciliation was completed successfully more often than not. Insofar as this sheds light on our main programme theory, it contributes to our understanding of the nature of medicine reconciliation problems.

### Clinicians' experiences of interoperable networks and patient outcomes

The searches identified 289 records for screening, of which seven<sup>114,121-123,126-128</sup> were eligible for inclusion (Figure 15). In the course of the screening and selection we identified articles on the accuracy and completeness of data, which are also presented (Table 10).

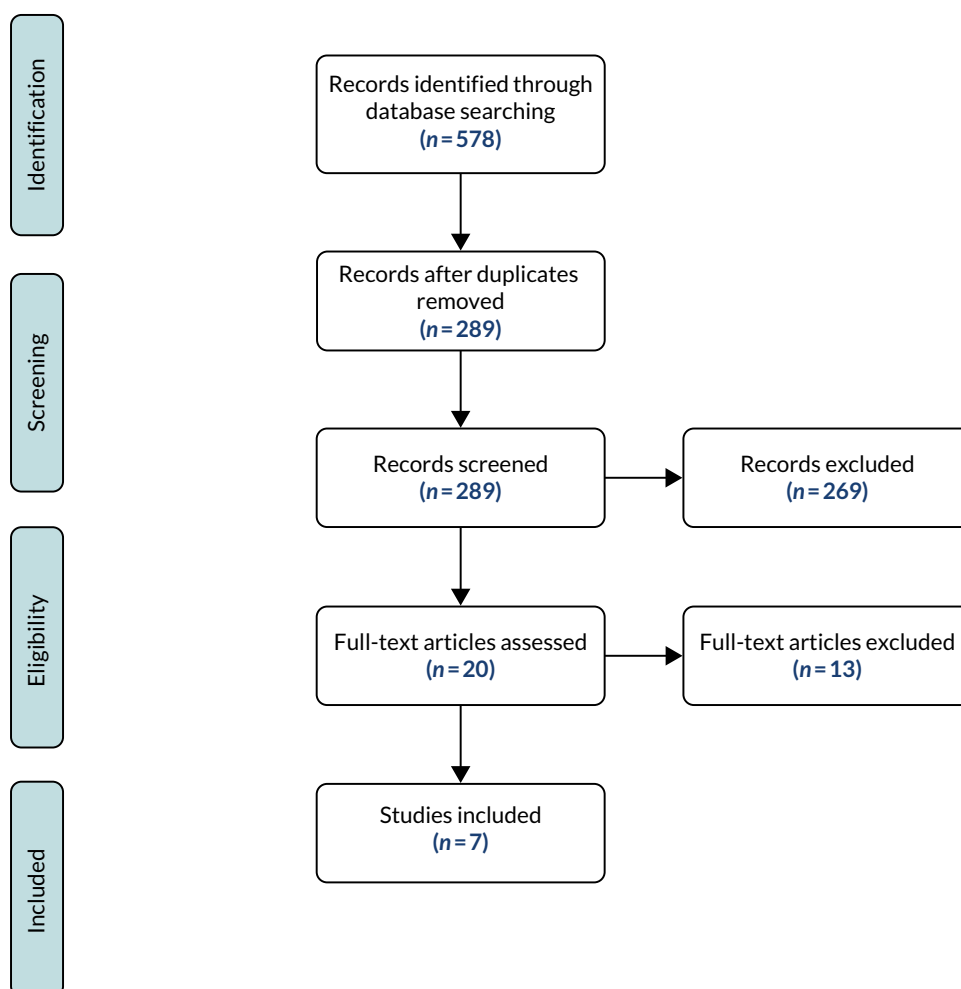


FIGURE 15 A PRISMA flow diagram: medicine reconciliation – outcomes.

TABLE 10 Clinicians' experiences and outcomes

Study	Country	Methods	Main findings	Rigour	Relevance
Foged <i>et al.</i> <sup>121</sup>	Denmark	Participant observation and focus groups	System did not support medicine reconciliation; problems with professional responsibility for reconciliation	1	2
Fanizza <i>et al.</i> <sup>122</sup>	USA	Quasi-experiment: access to medication lists	Problems accessing medication lists	2	2
Hohmeier <i>et al.</i> <sup>123</sup>	USA	Pharmacist reconciliation of 25 patients' medication lists	Problems with use of network; all lists had at least one 'discordant' medication; time constraints in pharmacies	3	2
Kennelty <i>et al.</i> <sup>114</sup>	USA	Interviews	Reconciliation time-consuming; time pressures for pharmacists	2	3
Moniz <i>et al.</i> <sup>126</sup>	USA	Before-and-after study of electronic transmission on dispensing errors	Incomplete system implementation; dispensing error rates halved following electronic transmission of prescription data	2	2
Pfoh <i>et al.</i> <sup>127</sup>	USA	Retrospective review of medication data in three databases	Reconciliation improved accuracy and completeness	1	2
Pourrat <i>et al.</i> <sup>128</sup>	France	Observational: comparison of medication lists, interviews	High incidence of medication list discrepancies	3	3

### Experiences of interoperable networks

The article by Foged and colleagues<sup>121</sup> is in the inner ring of the relevance 'target', and the others are in the middle ring. Foged and colleagues<sup>121</sup> reported on a study of Danish nurses' working practices, and their perceptions of their working practices, in relation to an e-messaging system. The e-messaging system linked a university hospital and community-based services in 10 municipalities, six of which participated in the study. The system had been developed locally and had five modules: (1) admission report, (2) care plan, (3) discharge report, (4) discharge notification and (5) a 'message platform' that enabled users to exchange messages. Each of the organisations had an electronic patient record, but none of them was integrated with any other. Two methods were used: participant observation and focus groups.

Three main themes related to the e-messaging system were identified.<sup>121</sup> First, the e-messaging system did not support safe medication reconciliation. The authors found that the exchange of electronic data about medication in relation to both admission and discharge was limited. For example, automatic admission reports were sent from municipalities when a patient was admitted to hospital, which included a medication list alongside other service information. Reports were rarely read by hospital nurses, and some nurses were not aware of the availability of medication lists. Interface issues were also reported (e.g. it was not clear when medication information in the reports had been uploaded).

Home care nurses reported that information needed for safe medication post discharge was often missing. Patients' printouts of medications were often the only source of information available, and these did not include any reasons for changes in medication, information that was important to the nurses.

Second, nurses bypassed the e-message system to assure medication-related safety. Home care nurses reported that accurate information about patients' medications were a priority. The nurses did not trust the hospital medication lists and compared dispensed medications against the lists. If there was a discrepancy in the numbers of tablets or doses, they checked each affected tablet issued. It was also usual for them to telephone hospital nurses or sometimes to send an e-message list to a GP for an assessment. The nurses explained that this reflected a belief that hospital colleagues' workloads were onerous and mistakes were therefore inevitable. Home care nurses also reported that they did not use the message platform as they were worried that messages would not be read. They also expressed frustration with the alternative namely telephoning hospital nurses. This could be time-consuming, and some home care nurses said that hospital nurses were not always helpful.

Third, nurses often assumed responsibility for medication reconciliation. Responsibility for medications was not always clear. Home care nurses reported that formal responsibility post discharge lay with GPs, but discharge medication information could be delayed and GPs could be reluctant to take responsibility for medication prescribed by a hospital doctor. GPs usually asked nurses to contact the relevant hospital doctor for information. Hospital doctors could, in turn, be reluctant to take responsibility for medication after discharge. Hospital nurses, who could also be contacted, reported that they could often do little more than check a patient's hospital records. There was, then, typically extensive communication between nurses and hospital staff to ensure that patients received the correct post-discharge medication. Nurses reported that the result was that, in practice, they often found themselves taking responsibility for patients' medications.

Fanizza and colleagues<sup>122</sup> undertook a study of the use of interoperable networks by three pharmacies in a supermarket chain in Kansas, USA. They accessed (all) patients' hospital discharge information from a hospital EHR, including discharge medication lists (a broader population than older people). The three pharmacies offered a free 'transitions of care' service to all members of a local community who were identified as having been discharged from hospital within the previous 14 days. Forty patients were screened in a 4-month study period in 2016/17, and all 40 were included in the study. Eighteen patients were assigned to the intervention group and 22 patients were assigned to a control group. Pharmacists could access EHRs via the network for 85% ( $n = 34$ ) of patients. However, they could only access medication lists for only 12.5% ( $n = 5$ ) of patients.

Hohmeier and colleagues<sup>123</sup> reported a pilot study of the use of an interoperable network in a community pharmacy in east Tennessee, USA. A study of medication reconciliation was one component of the larger study. Pharmacists accessed the hospital discharge records of 25 patients and, when the records were available, reconciled their discharge medications with pharmacy medication lists. The average number of prescription medications per patient was 14. All 25 patients had at least one 'discordant' medication. The wider study found problems with the use of the network, including delays in the availability of hospital discharge summaries and time constraints in pharmacies, the latter meaning that reconciliation did not always occur in practice.

Kennelty and colleagues<sup>114</sup> undertook an interview programme focusing on medicine reconciliation following hospital discharge with 10 community pharmacists in the Midwest of the USA. Interviews focused on two broad topics: (1) their experiences of medication reconciliation for patients recently discharged, and (2) their preferences for the content and presentation of information about medications. None of the pharmacies had access to hospital or clinical patient records.

Interviewees stressed the importance of medicine reconciliation post discharge to ensure that patients received the right medication and to avoid any potential errors. The interviewees noted that local care co-ordination teams alerted them, usually by telephone, when a patient was about to be discharged, and that this was helpful. Discharge medication lists would often be faxed to them. All interviewees reported that the process was time-consuming; they felt that having access to patient records would facilitate reconciliation and save time. The interviewees also believed that staffing was an issue; there

were not enough staff and this increased time pressures on them. All interviewees said that electronic information transfer and/or access to electronic records would be helpful.

### **Accuracy and completeness of data**

We found three papers<sup>126–128</sup> that shed light on the accuracy and completeness of data in interoperable systems. These are included on the basis that they enhance understanding, albeit indirectly, on the main programme theory. All of the studies in this section were judged to be in the outer ring of the relevance 'target'.

Pfoh and colleagues<sup>127</sup> reported a retrospective study of the accuracy and completeness of medication data held in three databases in a health system in north-eastern USA. The three databases were the organisation's EHR, a commercial medication database and a community-wide HIE web portal. The EHR was a commercial system that spanned two hospitals and seven ambulatory care clinics in the health system. The commercial database was used to validate medication history records in the EHR. The community portal provided access to patient information held by physician practices, home health agencies, nursing homes and other organisations.

Records were reviewed for 858 patients who were aged  $\geq 18$  years and who were admitted to one of the two hospitals (the mean age of patients was 65 years). A research pharmacist reviewed the three data sources. Data in each source were validated against a 'gold standard', a validated list of patients' medications taken at home (i.e. post discharge). The completeness data are shown in *Table 11*. The authors assessed the incremental value of combining the different data sources. Pooling all three sources increased the proportion of patients with complete data to 85% ( $n = 726$ ). The combination of hospital and community system produced 80% of essential medications ( $n = 682$ ).

Accuracy data are shown in *Table 12*. Twenty-three per cent of medications were found in all three sources and 9% were found in none of them. When all three sources were pooled, accuracy was 91% ( $n = 6997$ ). The hospital EHR plus the community portal yielded an accuracy of 87%.

Pourrat and colleagues<sup>128</sup> undertook a prospective study of 278 orthopaedic inpatients (average age 72 years) in a French hospital. They evaluated non-intentional discrepancies between home and hospital medication records for the inpatients, their potential clinical impact, and the effects of communication between community and hospital pharmacists on prevention of adverse medication-related events.

TABLE 11 Phoh *et al.*:<sup>127</sup> completeness of records

Database	Number of patients with complete data (out of 858)	Percentage of patients with complete data ( $n/858$ )
EHR	611	71
Commercial medication database	400	47
Community HIE web portal	312	36

TABLE 12 Phoh *et al.*:<sup>127</sup> accuracy of records

Database	Number of medications with complete data (out of 7731)	Percentage of medications with complete data ( $n/7731$ )
EHR	6152	80
Commercial medication database	3464	45
Community HIE web portal	2838	37



Hospital pharmacists compared lists of medications at admission with lists of home medications for the previous 3 months provided by community pharmacists. Researchers also conducted interviews with patients' GPs and reviewed their medication lists. These were used, together, to identify patients' appropriate medications. When discrepancies were identified, researchers telephoned both GPs and community pharmacists, and on some occasions also checked with patients. Remaining non-intentional discrepancies were evaluated by a hospital pharmacist and physician, and rated on Bayliff's scale (a 0–3 scale, ranging from no impact to life-threatening). The researchers also identified which non-intentional discrepancies were identified and by what type of clinician. Finally, they retrospectively compared their reconciled medication lists with medications prescribed and administered during hospital stays.

A total of 1532 prescription lines were analysed and 471 discrepancies at admission identified. The authors reported that 34.2% of patients had at least one non-intentional discrepancy at admission and 18.3% had a potentially harmful discrepancy. Clinical staff identified 69% of the discrepancies, thus reducing the numbers of potential adverse events in practice.

Moniz and colleagues<sup>126</sup> reported on a before-and-after study designed to measure the effect of transmitting electronic prescription data to pharmacies on dispensing errors.<sup>126</sup> It was conducted in a health system in Massachusetts, USA, where all clinics used a CPOE. The intervention, in one clinic, was a new 'electronic prescription transmission functionality'.<sup>126</sup> Two clinics were used as controls. Data were collected for 2 months before the new system and 2 months afterwards. In the intervention clinic, prescriptions recorded in the CPOE were reconciled with dispensed prescription data from participating pharmacy chains, linked via a national pharmacy information exchange network.

The systems were not 'seamlessly' interoperable: the majority of pharmacies printed electronically transmitted prescriptions and then re-entered it into the pharmacy system. A large proportion of prescriptions were not, in practice, transmitted electronically. Dispensing errors were defined as discrepancies between the CPOE data and dispensed prescriptions. A total of 41,022 prescriptions were studied: 29,575 from the intervention clinic and 11,447 from the control clinics. The authors found the following:

- control clinics – no significant difference in dispensing error rates between baseline and intervention
- intervention clinic – no significant difference in dispensing error rates between baseline and intervention for prescriptions that were not transmitted electronically
- intervention clinic – dispensing error rates were significantly lower, reduced by about half, in the intervention than during the baseline period.

The most common errors involved prescription strength, dose and frequency of administration.

### *Interoperable networks and patients' risks*

We did not find any quantitative evidence about changes in patients' risks relating to interoperable networks and medicine reconciliation.

### **Commentary**

We found evidence, including high-quality articles,<sup>121–128</sup> about the effects of interoperable networks, with a range of different characteristics, on medicine reconciliation. Taking the articles as a group, it seems reasonable to say that evidence about the effects of interoperable networks on reconciliation is mixed.

We were surprised not to find any empirical evidence about the effects of interoperable networks on patients' risks, given the importance of medication errors as a source of adverse events and the possible contribution of reconciliation errors to event rates.

## Discussion

We found evidence confirming that there are problems with medicine reconciliation that suggests that they are similar to those reported for care co-ordination in *Chapter 5*. That is, communication is reported to be a problem, but one entangled with wider cultural and organisational issues, notably uncertainty about the roles and responsibilities of doctors, nurses and pharmacists. The cognitive evidence contributes to this view.

We also found evidence about users' experiences of interoperable networks with different functionality, which was mixed but suggested that users can experience problems with accessing networks and finding the information they need. Finally, as just highlighted, we were surprised at the lack of evidence of effects on patients' risks. Given the importance of medication errors in health systems around the world, and the amounts of money invested in interoperable networks in recent years, we expected to find evidence, but we did not.

# Chapter 7 The co-ordination of services for at-risk children findings

## Introduction

This chapter reports on the searches conducted on the co-ordination of services for at-risk children. The next three sections, mirroring the structure of earlier chapters, present evidence about the nature of co-ordination problems, experiences of using interoperable networks and patient safety outcomes.

## The nature of co-ordination problems

The searches identified 476 records for screening, of which three<sup>129-131</sup> were eligible for inclusion (Figure 16).

We identified good evidence about the nature of co-ordination problems. Table 13 lists three literature reviews<sup>129-131</sup> and three primary observational studies<sup>132-134</sup> that were not cited in the reviews. The three reviews<sup>129-131</sup> used different methods and focused on different topics. Between them, they provide

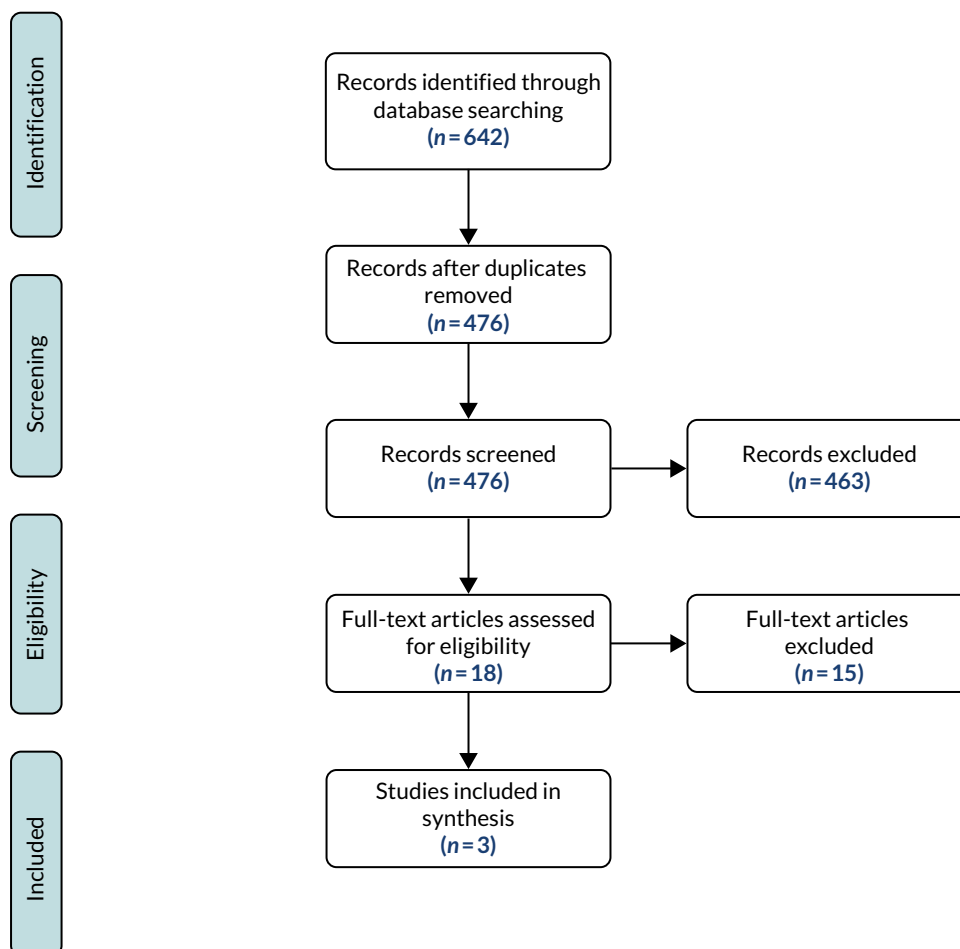


FIGURE 16 A PRISMA flow diagram: at-risk children – nature of the problem.

TABLE 13 Co-ordination problems: at-risk children

Study	Article type	Focus	Rigour	Relevance
Macvean <i>et al.</i> <sup>129</sup>	Scoping review	Interface between child protection and specialist domestic violence services	2	1
Herbert and Bromfield <sup>130</sup>	Review	Effectiveness of multidisciplinary teams	1	1
Bunting <i>et al.</i> <sup>131</sup>	Narrative review	Professional barriers to reporting child maltreatment concerns	2	1
Lees <sup>132</sup>	Observational study	Case study of three teams in one local authority in England: interviews and document analysis	2	1
Hwang <i>et al.</i> <sup>133</sup>	Observational study	Interviews and focus groups	2	1
Thompson <sup>134</sup>	Observational study	Observation of referrals, semistructured interviews	1	1

evidence about the nature of co-ordination problems in services for at-risk children and of those between child protection and domestic violence services.

Macvean and colleagues<sup>129</sup> undertook a scoping literature review and identified 24 collaborative models, each one intended to promote the effective co-ordination of services. They identified five themes, which they termed ‘enablers’: shared vision (across providers of services), formalisation of a service model (involving formal contracts between agencies), and a culture where collaboration, leadership and information sharing was encouraged.

Herbert and Bromfield<sup>130</sup> reviewed evidence of the effectiveness of multidisciplinary teams, focusing on the extent to which these teams improved child protection (i.e. reduced children’s risks of abuse). The authors<sup>130</sup> stress that, even in included papers, there was often a lack of detail about the composition and working practices of a multidisciplinary team, and a corresponding lack of detail about the co-ordination challenges that had (or had not) been successfully addressed. This said, the authors concluded that (1) much of the research focused on criminal justice outcomes, with studies finding differences in both process measures and (higher) conviction rates, and (2) studies of mental health services found that the presence of a team led to increased service use. Putting this another way, the review provided evidence both that there were co-ordination problems involving criminal justice and mental health agencies, and that it was possible to design interventions to address these.

Bunting and colleagues<sup>131</sup> reviewed evidence about information sharing and reporting systems. Their principal concern was with mandatory reporting of concerns about child abuse and the reasons why reporting did not occur. They found evidence of under-reporting. There were a number of reasons why it occurred, including the characteristics of a case, professionals perceiving that they had insufficient grounds to report it and the confidence that professionals themselves had to report more generally. The authors<sup>131</sup> also found evidence about wider institutional considerations, including that reporting was less likely in some types of school (including Catholic and primary schools) than in others, and that training in reporting procedures needed to be improved.

As was the case for the co-ordination of care for older people, as discussed in *Chapter 5*, there is no obvious role for interoperable networks in relation to the social and organisational issues raised in these reviews. There might, however, in principle, be a role to support information sharing. On the one hand, Macvean and colleagues<sup>129</sup> argue for greater standardisation of behaviour across professions. On the other hand, however, several authors reported in the reviews argue that their evidence points in a different direction, for example towards closer interpersonal relationships between professionals.

### Primary studies

Each of the three individual studies focused on information sharing and related activities, including recording (see *Table 11*). Lees<sup>132</sup> undertook observations of teams, 32 semistructured interviews and document analysis in three children and family social work teams in one local authority in England. Lees<sup>132</sup> identified the dual nature of what she termed 'information work'. Lees emphasised the distinction, in practice, between the recording and communication of information across teams and the emotional nature of child protection work. Information-related work was guided by rigid organisational protocols. This was recognised by interviewees as important: the acts of recording and communicating were essential to ensuring children's safety. On the other hand, it led to a tension. Family circumstances were often messy and had to be 'tidied up' for recording and communication to other team members. As Lees put it, the circumstances had to be presented as rational and evidence based. One of the responses to the tension was to maintain interpersonal communication in the course of cases, so that team members could be clear about, and help to interpret, recorded information.

Hwang and colleagues<sup>133</sup> undertook 13 interviews and nine focus groups with mental health professionals, social workers, other child welfare professionals and foster parents. They reported:

- Problems with missing or incomplete information in referrals, assessments and case notes (the use of paperwork, faxes and e-mail was mentioned) and, thus, also concerns about the accuracy of information.
- Problems being couched in contexts in which there was a lack of clarity about professionals' roles, which led to confusion about policies on information sharing across agency boundaries. There were reports of decisions either not to share information with other agencies, or only to share partial information about a case.

Thompson<sup>134</sup> undertook an observational study of referrals to local authorities. In common with Lees,<sup>132</sup> Thompson found that there was a distinction between the situations on the ground and the formal recorded accounts that were required in children's services. Thompson characterised the distinction in terms of different ways of thinking about a jigsaw. Lord Laming, in the Climbie Inquiry, had argued that professionals needed a 'full picture' of a child's circumstances, implying that the picture was static, like a conventional jigsaw. However, Thompson<sup>134</sup> argues that, in practice, professionals have pictures that are constantly in flux and open to ongoing interpretation. For example, the interpretation of the significance of a small scar on a child's face might change over time, leading at one time to a belief that it resulted from an accident and at another that it was evidence of abuse. Thompson<sup>134</sup> used her evidence to critique what she believed was the prevailing rational, bureaucratic approach to recording and information sharing.

### Users' experiences of using interoperable networks

The searches identified 832 records for screening, of which four were eligible for inclusion (*Figure 17*).

Four papers<sup>135-138</sup> described experiences of using networks (*Table 14*). In terms of relevance, all four articles<sup>135-138</sup> were in the outer ring: the interventions were those that we were interested in, but they were focused on both broader populations and limited settings, the latter typically covering just two organisations. The papers were heterogeneous in terms of methods, populations, interventions studied and settings. Our identification of common themes is therefore necessarily tentative, but the articles indicate a state of affairs similar to those reported in *Chapters 5 and 6*.

Drinkwater and colleagues<sup>135</sup> relied principally on interviews (on subjective judgements rather than direct observation of systems in use). The authors<sup>135</sup> reported problems accessing and using HIT infrastructures, which were reported to be 'underdeveloped' and 'limited'. The authors also undertook field observations. The findings were broadly consistent with the interview data. Variation in users'

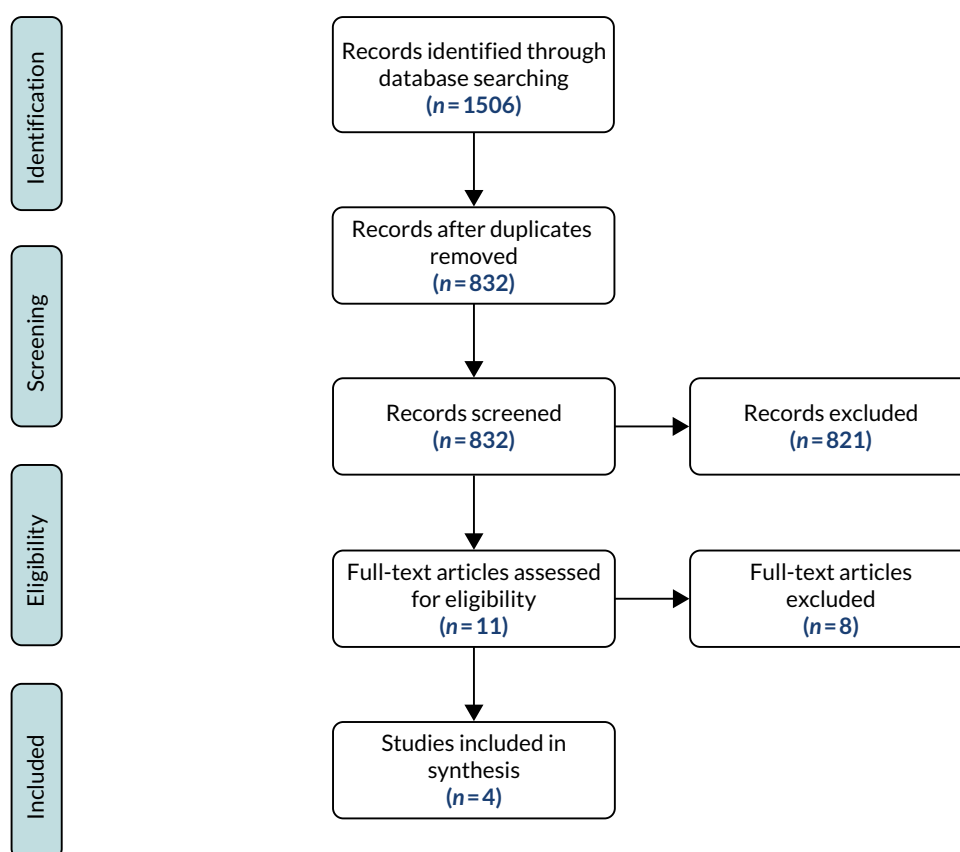


FIGURE 17 A PRISMA flow diagram: at-risk children – users’ experiences and outcomes.

TABLE 14 Users’ experiences of interoperable networks: at-risk children

Study	Study design/ methods	Population	Intervention	Setting
Drinkwater <i>et al.</i> <sup>135</sup>	Interviews	GPs and practice nurses regarding domestic violence and abuse/child safeguarding	Documenting practices in electronic patient records	Six localities in England
Baker <i>et al.</i> <sup>136</sup>	Case study: document analysis, interviews	Broad population, including children and families	‘IT infrastructure’	Nine primary care organisations: Canada and New Zealand
Dellor <i>et al.</i> <sup>137</sup>	Case study: interviews, observation, user feedback	Case worker referrals to social services for children and families	Needs portal	Families and children’s services/social services: Los Angeles, CA, USA
Vest <i>et al.</i> <sup>138</sup>	Analysis of HIE user logs, linked to characteristics of paediatric emergency department encounters	Patients aged < 18 years attending paediatric emergency departments	HIE for ICC	Paediatric emergency departments in an ICC: central Texas, USA

ICC, integrated care collaborative.

confidence in using the intervention (an electronic records system) were emphasised, as were variations in the ways in which caseworkers used the portal. Baker and colleagues<sup>136</sup> drew attention to concerns about the role of HITs, particularly electronic patient records, in the wider context of co-ordinating services. Dellor and colleagues<sup>137</sup> noted tensions between different objectives for records, and by implication for interoperable networks, including supporting continuity of care, facilitating information sharing, serving as a legal document and being an entity ‘owned’ by patients.

Vest and colleagues<sup>138</sup> reported a different type of evidence, concerning the frequency of accessing an interoperable network. They found that the network was accessed in 8.7% of encounters (15,568/179,445) during a 42-month period (2006–9). The network was accessed more often for patients with more comorbidities, and less often if a patient had not been to that location in the previous 12 months or if department staff faced time constraints. This paper<sup>138</sup> did not shed direct light on users' experiences, but it is included on the basis that it complements the findings in the other three articles.

### **Patient safety outcomes**

We did not find any evidence about the effectiveness of interoperable networks on the safety of at-risk children.

### **Commentary**

Given the importance attached to co-ordinating the care of at-risk children, and the current funding of interoperable systems in England and elsewhere, we expected to find evidence in this domain. We also hoped to find evidence of the use of semantically interoperable networks, given the long history of initiatives in the domain. In the event, however, we found good evidence about the nature of co-ordination problems, which are rooted in institutional challenges and particularly evident at professional and organisational boundaries. We also found evidence that users experience problems with using interoperable networks. As in earlier chapters, we did not find any studies of professionals using embedded interoperable networks (i.e. embedded information infrastructures implied by our mid-range theory).

The absence of evidence about safety-related outcome changes is, we think, striking. The result for this study is that we cannot use the example of children's services to assess our main programme theory.





# Chapter 8 Economies of scope and scale searches and results

## Introduction

This chapter focuses on the economies of scope and scale associated with interoperable networks, and presents methods and results. The topics arise from the second programme theory discussed at the end of *Chapter 4*. The key idea behind the programme theory is that interoperable networks can generate a 'network externality'. An externality is a cost or benefit incurred by a third party. Air pollution is often used as an example: you and I do not control most air pollution, but we may suffer from high levels of contaminants and may benefit from policies that reduce those levels.

In the case of interoperable networks, economists have predicted that the benefits of being a member of a network will increase with the number of users. You and I do not control the numbers of people who use Facebook (Facebook, Inc., Menlo Park, CA, USA; [www.facebook.com](http://www.facebook.com)), but may benefit more as the number of users grows (e.g. because it is easier to communicate with our friends if they all use Facebook as well). The benefits might be of two kinds. Economies of scope might be achieved because a network makes it cheaper, on average, to produce a wider range of services (in part because they all share a common infrastructure). Economies of scale might be achieved because the cost of providing a service is shared between larger numbers of users, so the cost of each user reduces with increasing scale.

At the start of the study we were not aware of any evidence about interoperable networks in health and social care. As we have noted in earlier chapters, however, the numbers of digital data in the sector are growing rapidly and many governments are encouraging interoperability, so, in principle, at least economies of scope and scale might be generated.<sup>139,140</sup> It has also been suggested that interoperable networks might lead to the redesign of professionals' working practices, which in turn could produce better patient outcomes.<sup>141</sup> There might, then, be system-wide improvements in patient safety that are attributable to a network as a whole rather than to the actions of single teams of professionals, discussed in the last six chapters. Equally, health and social care may face high transaction costs, partly due to information asymmetries (e.g. when one clinician cannot interpret another's records). Such issues require careful consideration given the complexity of relationships that span organisational and professional boundaries, as highlighted in *Chapters 5* and *6*.<sup>142</sup>

## Results and commentary

The search found 117 records for screening; however, no studies met the inclusion criteria (*Figure 18*). As a result, we are not in a position to comment on the second programme theory. Many of the articles we screened and the full-text articles we reviewed did not focus on patient safety, focusing instead on broader quality or process measures that were outside the scope of this review. Other studies simply did not present any data or were in the wrong setting (e.g. hospital).

By way of illustration of what we hoped to find, the most promising study was the retrospective study by Plantier and colleagues.<sup>143</sup> The researchers evaluated the impact of EHR use on the quality of care management in acute care hospitals in France. This was done using four quality indicators: (1) quality of patient record, (2) delay in sending information at hospital discharge, (3) pain status evaluation and (4) nutritional status evaluation. These indicators were derived by the French National Authority for Health from three national databases. The results revealed that EHR use had a significant positive

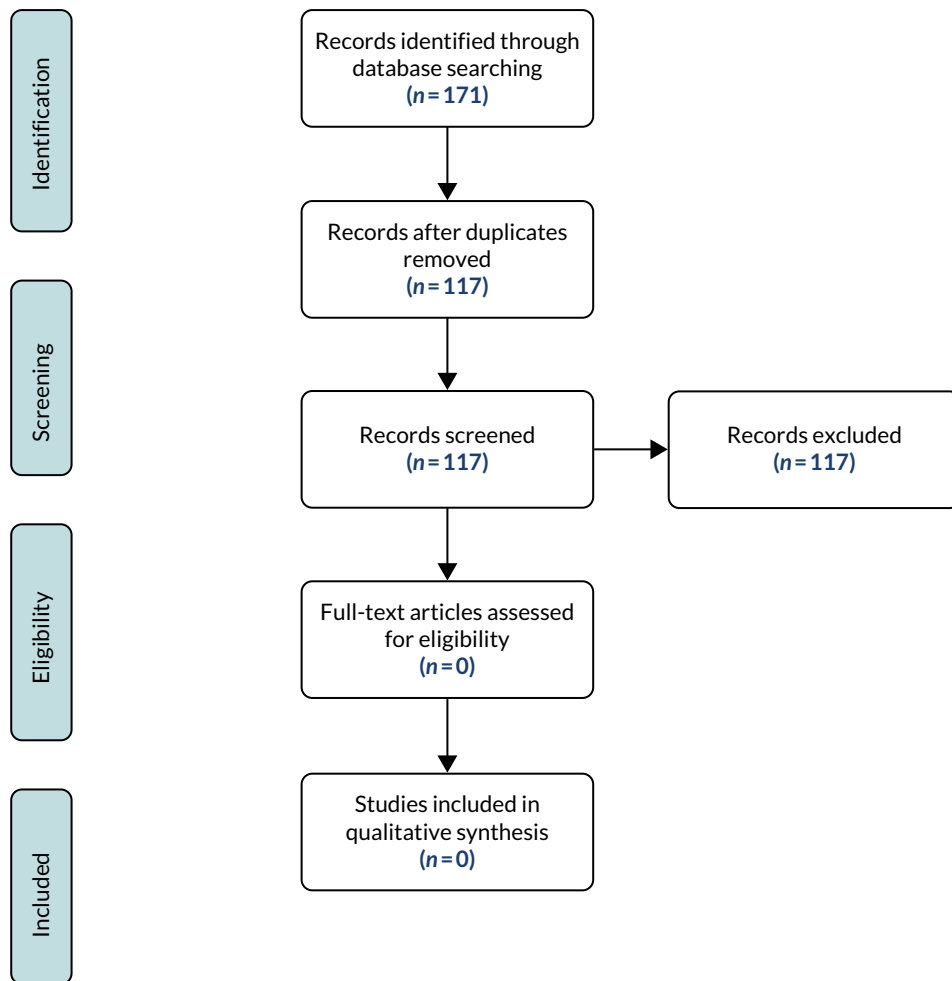


FIGURE 18 A PRISMA flow diagram: economies of scope and scale.

impact on the four quality indicators. The results also found that this impact varied according to the EHR functionality (e.g. the quality of patient records was affected more by the computerisation of drug prescriptions than by the computerisation of patient records). Unfortunately, the focus on hospitals and on a single patient records system meant that this study was out of the scope of our review. Nevertheless, the article indicates the kind of study that might be undertaken in the future.

# Chapter 9 Discussion and conclusions

## Introduction

We have presented our empirical findings in the last five chapters. In this chapter, we draw the findings together and discuss their implications. The next section briefly summarises the findings from each domain, and then reviews the aims and objectives set out in *Chapter 1*. We assess the extent to which they have been met. The following sections reflect on our study design and methods and comment on their strengths and limitations. We then discuss our findings under three cross-cutting headings: *Programme theory: issues and concerns*, *Programme theory: implications* and *Mid-range theory*.

## Summary of findings

In the theory development phase of the synthesis, we did not find any detailed accounts of the ways in which interoperable networks are intended to work and improve patient safety. There were many statements to the effect that they will improve patient safety, improve quality more generally and reduce health-care costs, but the majority did not attempt to explain in any detail how or why they would achieve these effects. We were, however, able to identify a substantial number of theory fragments, and used these to develop initial rough programme theories and to derive a mid-range theory.

### *The co-ordination of services for older people*

We found substantial evidence about the nature and extent of care co-ordination problems. Most of the problems were essentially social or cultural. For example, there were several evidenced-based reports of difficulties due to different health-care professionals having incompatible working assumptions about the kinds of support that older people need. There was no obvious role for interoperable networks in most of these problems. There was one exception, which concerned difficulties associated with communication problems. The problems were attributed to a combination of interprofessional issues not directly related to technology, as well characteristics of the networks (such as multiple log-ons) and the difficulty of locating patient information held on other organisations' servers. We did not find any countervailing studies reporting the 'seamless' use of interoperable networks.

There was limited, and weak, evidence about the effectiveness of interoperable networks in reducing older people's risks. The evidence was for limited networks typically involving a single application (such as a shared assessment process) and was based on the subjective views of users. We did not find any quantitative evidence of effectiveness.

### *The co-ordination of medication reconciliation*

We found evidence of co-ordination problems with medication reconciliation. The evidence suggested that responsibility for reconciliation was not clear on the ground and fell between professionals (principally pharmacists, doctors and nurses).

The second set of searches focused on the nature of problems encountered in reconciliation when using interoperable networks. We found one observational study<sup>114</sup> and seven further 'offline' simulation studies<sup>116–123</sup> about the nature of clinicians' cognitive processes and the error rates associated with them. These studies suggested that errors could occur in both types of reconciliation. There was less field-based evidence about users' experiences in this domain than in services for older people or child protection services.

The third set of searches produced seven articles<sup>121-128</sup> with reasonable-quality, rather than high-quality, mixed results. Some articles indicated that the use of an interoperable network was associated with a (quantitative) reduction in reconciliation errors. Others reported problems with using systems that resulted in interoperable networks having no effects on reconciliation error rates.

### *The co-ordination of services for at-risk children*

We found evidence of co-ordination problems in child protection services. There is a debate in the academic literature about the nature of those problems. In the context of this synthesis, the key difference is that some commentators interpret the problems in mechanistic terms (i.e. as communication failures), whereas others argue that the problems reflect deeper interprofessional and interorganisational problems.

In common with the first two searches, there was evidence that users find interoperable networks difficult to use in the course of the care of at-risk children. There was, however, no evidence about outcomes, defined as changes in children's risks of harm.

### *Economies of scope and scale*

We did not find any empirical evidence about the 'global' effects of interoperable networks on patient safety (or any other outcome). None of the excluded articles reported any evidence of economies of scope or scale: they were excluded because they were not relevant, rather on grounds of rigour.

## **Aims and objectives**

The aim of the study was to establish how and why interoperable networks improved patient safety, failed to do so or increased safety risks. Our main conclusion is that there is insufficient evidence about the effectiveness of interoperable systems to allow us to establish how and why they affect patient safety. We searched for evidence across three distinct domains, (1) the care of older people, (2) medication reconciliation and (3) child protection, which increases our confidence that the paucity of evidence is real and not an artefact of our search strategies. The absence of evidence about economies of scope and scale further tends to increase our confidence in our conclusion.

This synthesis has, however, identified evidence that sheds useful light on two other substantive issues. First, there is good evidence of problems with the co-ordination of services in each of the three domains studied. In common with other authors, we take the view that these problems have deep institutional roots.<sup>144,145</sup> Second, there is evidence across the domains that professionals have found interoperable networks difficult to use. We have not found countervailing accounts: there were no accounts of the kind of high-quality interactions with laptops and other devices that we are used to in our private lives.

The objectives of the study were defined in terms of the stages of a realist synthesis: to identify programme theories, prioritise one or more theories and then evaluate them using relevant empirical evidence. We achieved these objectives in that we were able to complete the synthesis and to produce findings that we are able to describe and explain. This said, we are aware of the limitations as well as the strengths of our study design and methods.

## **Patient and public involvement**

The PPI panel met three times during the study and contributed to its design and conduct on each occasion. At the first meeting, we presented the early findings of our theory development searches and the nominal group meetings. The PPI panel provided valuable comments, in particular in helping us to set priorities for the populations and settings for the evidence searches. It was their comments, taken in tandem with the views of the nominal groups, that led us to focus on services for frail older people

living at home (later broadened, pragmatically, to older people in general). The PPI panel also noted the importance of medication reconciliation and expressed the view that the next most important population to study would be at-risk children. As this report shows, we acted on all three of these comments.

At the second meeting, we presented the interim findings of the first two sets of searches, namely on the co-ordination of services for older people and on medication reconciliation. The group gave their comments on, and interpretations of, those findings. The third meeting was used to comment on a draft of this chapter. Members also commented on a draft of the *Plain English summary*.

## Strengths and limitations

We set out our study design and methods in *Chapters 2 and 3*. Having completed the synthesis, we have arrived at the view that the strengths and limitations of our synthesis are, to a large extent, mirror images.

There were three key strengths and limitations. First, we developed a study design that was suited to addressing our aims and objectives. It emphasised breadth, seeking evidence across different populations and settings rather than depth of evidence about specific aspects of programme theories for a single population and setting. The approach allowed us to compare and contrast evidence for those different populations, and the commonalities gave us confidence in our results. The approach may only work, however, for broadly based questions: the study design is pragmatic and will not suit all realist syntheses. Moreover, some of the searches, namely the three designed to characterise the nature and extent of co-ordination problems, were not exhaustive. The searches relied principally on published systematic reviews. This suited our purposes, as we needed only to establish that there were problems, but we cannot claim that we identified all of the available evidence from these three searches.

Second, we used a mid-range theory. The theory provided the single, independent statement against which relevance could be judged. It also provided a means for making our own theoretical assumptions explicit and, hence, open to wider scrutiny. A disadvantage of the mid-range theory, we found, is that it risked locking us into those same assumptions. It would have taken a great deal of time and intellectual effort to move to another theoretical framework. We are confident that the mid-range theory can be used to interpret our data, but another framework might, in principle, do equally well, and we have not tested alternative theories for their 'fit' with the data.

Third, we are aware that we deliberately biased our choice of domains in favour of services for which we were most likely to find evidence of effects. The advantage, if the strategy had been successful, is that a synthesis would have produced valuable insights into how and why interoperable networks influence patient safety. To set against this, the bias built into our choices means that we have to be particularly cautious about generalising from any of our findings to other HITs and settings. Furthermore, it is worth noting that we have focused on professionals' use of interoperable networks. We are aware, through some of the literature we came across<sup>9,30</sup> and our stakeholder consultation, that many localities are developing networks that patients and clients can also access and use. Our results cannot be used to generalise to patients' and clients' experiences.

## Programme theory: issues and concerns

A realist synthesis should, ideally, identify a range of outcomes associated with an intervention, and use programme and mid-range theories to explain the outcome differences. A fully fledged programme theory should ideally have two characteristics. First, it should be underpinned by coherent reasoning: it should have a clear 'internal logic'. Second, it should represent a solidly evidence-based sequence of

decisions and actions, showing how an intervention leads to process changes and outcomes. As we noted in *Chapter 2*, teams undertaking realist syntheses might reasonably expect to find coherent, and possibly partially evidenced, programme theories in articles or reports.

We were struck by the absence of fully developed programme theories and, indeed, by a more general failure to consider how and why interoperable networks might improve patient safety (or any other outcome). As we found in *Chapter 4*, there has been a tendency to assume that desired outcomes would be achieved, without examining the assumption. Two of the most thoughtful accounts are relatively old: in *To Err is Human: Building a Safer Health System* in 2000<sup>1</sup> and in Bates and Gawande's 2003 article.<sup>71</sup> It is not clear what has happened in the intervening period, as there has been no shortage of journal articles and official reports.<sup>1,71</sup> We are not aware of analyses that explain this state of affairs.

The result, for us, was that we found ourselves piecing together our programme theories from 'fragments'. The iterations of our programme theories are set out in *Chapter 4* and reflect our efforts to create a coherent account based on the fragments. The end result was a simple, initial, main programme theory. It should be stressed that we thought that the initial theory was highly provisional (and recognise that another team might interpret the fragments differently). The advantage, in principle, of the evidence testing in our case was that it might lead to a substantially different final programme theory. As the last four chapters have shown, however, this is not what happened.

These issues were compounded by the fact that we found very little evidence about patient outcomes in this synthesis. As we have noted, this means that it is not possible to evaluate our main programme theory. Without outcome evidence, we cannot know whether or not any given sequence of decisions and actions leads to a reduction in patients' risks.

The paucity of evidence sits in sharp contrast with the emphasis around the world on integrating IT systems across organisational and professional boundaries. We were surprised, for example, that the multibillion-dollar Obama-era initiative in the USA did not lead to more high-quality studies of the effectiveness of interoperable networks.<sup>146,147</sup>

We do not have a good explanation for the lack of evidence. It is not just that there were few high-quality studies – there were hardly any studies. One possible reason is methodology. Applied health researchers have preferences for studies based in single settings (such as hospital wards and departments) and are less interested in studying networks, or believe that such studies cannot produce valid findings. Another possibility is that funders have been reluctant to fund studies, perhaps believing that the value of networks is self-evident. Whatever the reason, we believe that there is a major evidence gap, given that interoperable networks are being actively promoted in current policies in England and many other countries.

### **Programme theory: implications**

These issues notwithstanding, we can make two useful observations on the basis of our findings. The first concerns the evidence that there are co-ordination problems in all three domains studied. Perhaps the most significant aspect of this finding is that most of the problems are institutional in nature, and can be traced to interprofessional and interorganisational differences in objectives and values. If there are genuine differences of opinion between two professionals, say a nurse and a social worker, about the best course of action for a particular patient or client, it is difficult to see how any interoperable network can play a major role in resolving these differences.

We noted in *Chapters 5–7* that one finding, concerning communication problems, suggested a possible role for interoperable networks. If we take a mechanistic view here, then we might say that an interoperable network can provide access to all of the records held about a patient across several organisations. This is the assumption of policy-makers and opinion leaders, captured in our initial programme theories. Wachter<sup>70</sup> and other opinion leaders argue that current IT solutions are simply not very good. When the technologies improve, they believe that improvements in care and outcomes will follow.<sup>148</sup>

Our findings suggest a rather different framing: the problems are institutional in nature and embedded in professionals' working practices. Taking this view, changing the functional characteristics of HIT solutions will not, of itself, change professionals' working practices. If the institutional problems are not addressed – and it seems that they have not been, at least in the places where the studies have been undertaken – then interoperable networks cannot by themselves improve patient safety. There may be an important conceptual gap here between proponents' beliefs about the way in which HIT solutions, including interoperable networks, work, and evidence about the ways in which these solutions actually work.

We have also found evidence across all three domains that users find interoperable networks difficult to use. As far as we are able to tell, all of the reported studies were conducted on functionally interoperable networks: networks that allowed users to access patients' records remotely, but did not link those records together in any way. Users had to interrogate each part of a patient's record separately. If proponents of interoperable networks are right, then the development of more integrated solutions will eventually lead to more positive user experiences. We did not find any evidence that could shed light on this assumption and either support or refute it. As things stand, the argument that greater network integration will lead to improved co-ordination and, hence to safer care is not proven.

## Mid-range theory

We argued in *Chapter 2* that a mid-range theory can perform two roles. One role is to provide an explicit basis for judgements about the relevance of articles and the synthesis of evidence in the course of evidence searches. The other role is to provide a basis for generalising our findings. We noted above that care needs to be taken when generalising from our chosen domains to others. We are also aware of Campbell and colleagues' classic work<sup>149</sup> on external validity, which places strict limits on the extent to which any findings can be generalised. These points made, however, we feel that it is possible to make two observations.

The first observation follows from the end of the last section. Our mid-range theory emphasised the institutional nature of the challenge of designing and deploying interoperable networks, or, more generally, information infrastructures, in health and social care. We can say that the evidence is consistent with the mid-range theory. This is not at all the same as saying that it proves that the theory is right, but similar findings across three domains encourage us to have confidence in the mid-range theory. We can also suggest that proponents of HITs, whose views were highlighted in *Chapter 4*, should review the bases of their claims. Mechanistic assumptions about the effects of HITs once the problems have been 'ironed out' are not supported by the evidence in this synthesis.

Second, and finally, we are struck by the fact that patient safety has rarely been in our line of sight in the last few chapters. One of the implications of our mid-range theory is that, in practice, the various actors (doctors, nurses, informatics teams and others) develop ways of working with one another, and of using interoperable networks to co-ordinate with one another, over long periods of time. The absence of critical reflection about the ways in which interoperable networks affect patient safety, over a period of almost 20 years, suggests that key actors do not believe that the case needs to be made. It is not clear to us why this is the case. The evidence suggests that the embedding of interoperable networks in clinicians' working

practices is clearly important, and, to date, partial but effective use of networks has risked becoming the end rather than the means. That is, in focusing on implementation we may lose sight of the outcomes, including safer patient care, that have provided the basis of claims for investing in networks in the first place. Viewed from a different part of the terrain, that occupied by clinicians and others dedicated to improving patient safety, those interested in interoperable networks currently have little to offer.

### Implications for practice

In the light of our findings, practitioners may wish to take account of the:

- lack of evidence about reductions in patients' risks associated with interoperable networks (and could take steps to monitor the effects of local programmes themselves)
- negative evidence about users' experiences of interoperable networks (and could take steps to engage with patients and other stakeholders in the design and deployment of new services)
- extent to which institutional arrangements and, in particular, the challenges of working across professional and organisational boundaries influence the deployment and use of interoperable networks.

### Implications for research

We have identified the following topics for future research:

- Primary empirical studies of effectiveness will help to shed light on the value of current and future investments in interoperable networks.
- Primary empirical studies of economies of scope and scale associated may, similarly, shed light on the value of investments in interoperable networks.
- The findings indicate that there may be a broader research agenda into the development of information infrastructures in health and social care.
- Given the current focus of IT investments in systems and networks outside hospitals, there may also be a case for evidence syntheses that shed light on the process changes associated with other community-based applications, such as patient portals.
- A wide range of study designs and methods are used in realist syntheses. It is not obvious, in a burgeoning literature, which of them produce the most robust findings. There may be value in revisiting the RAMESES guidance on the design and conduct of realist syntheses to identify and highlight the best of current research practices.

### Conclusions

We conclude that there is good evidence of problems with the co-ordination of services in each of the three domains studied. There is also evidence across the domains that professionals have found interoperable networks difficult to use. We found no evidence about economies of scope and scale. There is insufficient evidence about the effectiveness of interoperable networks to allow us to establish how and why they affect patient safety.



# Acknowledgements

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## Contributions of authors

**Justin Keen** (<https://orcid.org/0000-0003-2753-8276>) (Professor of Health Politics) developed the proposal for the study; undertook screening and data extraction; identified the topic for the economies of scope and scale search, undertook screening and drafted *Chapter 8*; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Maysam Abdulwahid** (<https://orcid.org/0000-0002-4316-8589>) (Research Officer) undertook screening and data extraction; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Natalie King** (<https://orcid.org/0000-0002-4215-2323>) (Information Specialist) designed and undertook structured database searches; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Judy Wright** (<https://orcid.org/0000-0002-5239-0173>) (Senior Information Specialist) developed the proposal for the study; designed and undertook structured database searches; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Rebecca Randell** (<https://orcid.org/0000-0002-5856-4912>) (Professor in Digital Innovations in Healthcare) developed the proposal for the study; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Peter Gardner** (<https://orcid.org/0000-0002-8799-0443>) (Professor of Healthcare Quality and Safety) developed the proposal for the study; provided specialist input for the design and interpretation of specific searches; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Justin Waring** (<https://orcid.org/0000-0003-1459-5896>) (Professor of Medical Sociology and Healthcare Organisation) developed the proposal for the study; provided specialist input for the design and interpretation of specific searches; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

**Roberta Longo** (<https://orcid.org/0000-0002-9379-1627>) (Lecturer in Health Economics) developed the proposal for the study; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; identified the topic for the economies of scope and scale search, and undertook screening and drafted *Chapter 8*; and drafted, or commented on drafts of, this report.

**Silviya Nikolova** (<https://orcid.org/0000-0002-6922-5115>) (Lecturer in Health Economics) contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; identified the topic for the economies of scope and scale search, and undertook screening and drafted *Chapter 8*; and drafted, or commented on drafts of, this report.

**Claire Sloan** (<https://orcid.org/0000-0002-5324-8275>) (Research Assistant) contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; identified the topic for the economies of scope and scale search, and undertook screening and drafted *Chapter 8*; and drafted, or commented on drafts of, this report.

**Joanne Greenhalgh** (<https://orcid.org/0000-0003-2189-8879>) (Associate Professor) developed the proposal for the study; undertook screening and data extraction; contributed to the detailed study design set out in *Chapter 2*, and to the interpretation of overall findings; and drafted, or commented on drafts of, this report.

## Publications

Keen J, Greenhalgh J, Randell R, Gardner P, Waring J, Longo R, *et al.* Networked information technologies and patient safety: a protocol for a realist synthesis. *Syst Rev* 2019;**8**:307.

Keen J, Abdulwahid MA, King N, Wright JM, Randell R, Gardner P, *et al.* Effects of interorganisational information technology networks on patient safety: a realist synthesis. *BMJ Open* 2020;**10**:e036608.

## Data-sharing statement

This is a qualitative study and therefore the data generated are not suitable for sharing beyond those contained within the report. Further information can be obtained from the corresponding author.

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# Appendix 1 Search strategies and databases and sources searched

TABLE 15 List of theory development and evidence searches

Number	Title
1	Theory development
1.1a	Theory development: structured subject search – patient safety in networked IT
1.1b	Theory development: structured subject search – interoperability and networked IT
1.2a	Theory development: named author searches – David Bates and interoperable systems or HIE
1.2b	Theory development: named author searches – Robert Wachter
1.3	Theory development: systematic reviews searches
1.4	Theory development: usage count search
<b>Evidence reviews</b>	
2	The co-ordination of services for older people living at home
2.1	The nature and extent of care co-ordination problems for frail older people living at home
2.2	What are the experiences of professionals using interoperable networks in the course of care co-ordination?
2.3	Do interoperable networks improve patient safety outcomes for frail older people living at home?
3	Medication reconciliation for older people living at home
3.1	What is the nature of the medicine reconciliation problem in frail older people population?
3.2	What are professionals' experiences of using interoperable networks in medicine reconciliation for frail older people?
3.3	What are the patient outcomes of using interoperable networks in medicine reconciliation?
4	The co-ordination of services for at-risk children
4.1	What is the nature and extent of the co-ordination problem for services for at-risk children?
4.2 and 4.3 (single strategy)	What are clinicians' and other professionals' experiences of using interoperable HIT to co-ordinate the care of children at risk?
	What are the effects of interoperable networks on outcomes for at-risk children?
5	Economies of scope and scale of interoperable networks in health economies

## Theory development searches

### *Theory development: structured subject search – patient safety in networked information technology*

#### EMBASE (via Ovid)

Search date: 10 March 2018.

Date range searched: 1996 to week 10 2018.

#### Search strategy

1. "Comment on".ti. (16,738)
2. (letter\* adj3 editor\*).ti. (19,988)
3. opinion\*.ti. (12,189)
4. (view or views).ti. (37,100)
5. (editorial or journal letter or journal note or letter or note or report editorial or report letter or trade journal letter or trade journal note).pt. (1,772,500)
6. or/1-5 [opinion pieces - hidden theories] (1,817,733)
7. (policy or policies or guideline\* or recommendation\* or position).ti. (171,688)
8. \*practice guideline/ (54,860)
9. exp \*public policy/or \*policy/ (58,445)
10. (theor\* or concep\* or logic).ti. (110,842)
11. ((theor\* or concep\* or logic) adj (framework\* or model\* or analy\* or evaluat\*)).ab. (52,231)
12. or/7-11 [Policy, Guideline or overt Theory] (383,366)
13. 6 or 12 [Theories search] (2,155,076)
14. \*safety/and (outpatient\* or patient\*).tw. (31,576)
15. exp medical error/and (outpatient\* or patient\*).tw. (51,726)
16. ((patient or patients or outpatient\*) adj2 (safety or harm\* or adverse\*)).tw. (54,275)
17. exp \*patient safety/ (12,682)
18. \*risk management/ (13,493)
19. exp \*adverse event/ (53,911)
20. or/14-19 [patient safety] (196,559)
21. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw,kw. (2649)
22. (patient information adj5 (exchang\* or shar\* or network\*)).tw,kw. (285)
23. \*medical information system/ (6904)
24. 21 or 22 or 23 (9433)
25. exp medical record/ (176,429)
26. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (77,872)
27. medical informatics/or nursing informatics/ (18,665)
28. (electronic adj3 record\*).tw. (46,895)
29. ((health or medical or clinical) adj5 (information or record\*)).tw. (300,330)
30. computer system/ (20,409)
31. or/25-30 [health records & systems] (462,934)
32. exp computer network/ (11,623)
33. information dissemination/ (17,918)
34. (network\* or exchange\* or data shar\*).tw. (603,816)
35. (information adj3 (shar\* or distribut\* or disseminat\*)).tw. (16,717)
36. (record\* adj3 (shar\* or distribut\* or disseminat\*)).tw. (2683)
37. or/32-36 [networked systems] (641,855)

38. 31 and 37 (30,994)
39. 38 or 24 [Networked IT or HIEs] (36,767)
40. 20 and 39 [safety in networked systems] (1353)
41. 13 and 40 [Theory & Opinion networked IT safety systems] (94)

### Health Management Information Consortium (via Ovid)

Search date: 10 March 2018.

Date range searched: 1983 to present.

### Search strategy

1. Commentaries/ (18)
2. "Comment on".ti. (29)
3. editorial.ti. (265)
4. letter.ti. (328)
5. opinion\*.ti. (508)
6. (view or views).ti. (3538)
7. (letter\* adj3 editor\*).ti. (1)
8. or/1-7 (4667)
9. (evidence\* adj8 (policy or policies)).tw. (1368)
10. policy/or health policy/or public policy/ (8823)
11. (policy or policies or guideline\* or recommendation\* or position).ti. (12,107)
12. exp guidelines/ (6653)
13. (theor\* or concep\* or logic).ti. (2774)
14. ((theor\* or concep\* or logic) adj (framework\* or model\* or analy\* or evaluat\*)).ab. (1825)
15. or/9-14 [Policy, Guideline or overt Theory] (27,515)
16. 8 or 15 [Theories] (31,886)
17. patient safety/ (3678)
18. adverse events/ (718)
19. exp Errors/or exp Medication errors/ (1165)
20. ((patient or patients or outpatient\*) adj2 (safety or harm\* or adverse\*)).tw. (2830)
21. risk management/or safety measures/ (2818)
22. or/17-21 [patient safety] (7784)
23. information exchange/ (345)
24. exp Medical information exchange/ (20)
25. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw. (105)
26. (patient information adj5 (exchang\* or shar\* or network\*)).tw. (38)
27. or/23-26 (485)
28. exp medical records/ (3144)
29. information technology/ (4796)
30. exp information systems/ (4895)
31. exp informatics/ (308)
32. (electronic adj3 record\*).tw. (1319)
33. ((health or medical or clinical) adj5 (information or record\*)).tw. (9925)
34. exp computer systems/ (4522)
35. or/28-34 [health records] (21,052)
36. exp information transfer/ (1978)
37. exp computer networks/ (1667)
38. (network\* or exchange\* or data shar\*).tw. (7125)
39. (information adj3 (shar\* or distribut\* or disseminat\*)).tw. (1342)
40. (record\* adj3 (shar\* or distribut\* or disseminat\*)).tw. (145)

41. or/36-40 [networked] (11,264)
42. 35 and 41 (3305)
43. 42 or 27 [networked IT, HIE] (3541)
44. 22 and 43 [safety in networked systems] (67)
45. 16 and 44 [Theory & Opinion networked IT safety systems] (3)

## Ovid MEDLINE

Search date: 10 March 2018.

Date range searched: 1946 to February week 5 2018.

### Search strategy

1. (policy or policies or guideline\* or recommendation\* or position).ti. (157,471)
2. guideline/or practice guideline/ (29,721)
3. policy/or public policy/or exp health policy/ (126,430)
4. (theor\* or concep\* or logic).ti. (140,361)
5. ((theor\* or concep\* or logic) adj (framework\* or model\* or analy\* or evaluat\*)).ab. (44,188)
6. or/1-5 [Policy, Guideline or overt Theory] (445,038)
7. Comment/ (664,894)
8. Letter/ (926,791)
9. Editorial/ (405,400)
10. news/or newspaper article/ (190,273)
11. "Comment on".ti. (16,286)
12. (letter\* adj3 editor\*).ti. (6376)
13. opinion\*.ti. (11,812)
14. (view or views).ti. (43,579)
15. or/7-14 [Discussion papers Hidden Theory] (1,710,573)
16. 6 or 15 [Theory Search] (2,103,940)
17. "Safety Management"/and (outpatient\* or patient\*).tw. (7050)
18. "Medical Errors"/and (outpatient\* or patient\*).tw. (7399)
19. patient safety/ (13,787)
20. ((patient or patients or outpatient\*) adj2 (safety or harm\* or adverse\*)).tw. (31,734)
21. \*risk management/ (8572)
22. or/17-21 [Patient Safety] (53,654)
23. Health Information Exchange/ (562)
24. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw,kw. (2012)
25. (patient information adj5 (exchang\* or shar\* or network\*)).tw,kw. (198)
26. 23 or 24 or 25 (2551)
27. exp Medical Records/ (132,774)
28. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (67,432)
29. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (15,531)
30. exp Decision Making, Computer-Assisted/ (124,934)
31. (electronic adj3 record\*).tw. (20,676)
32. ((health or medical or clinical) adj5 (information or record\*)).tw. (190,180)
33. Computer Systems/ (12,550)
34. or/27-33 [health records] (484,060)
35. community network/ (6385)
36. computer communication networks/or local area networks/ (13,961)
37. information dissemination/ (14,049)



38. (network\* or exchange\* or data shar\*).tw. (492,792)
39. (information adj3 (shar\* or distribut\* or disseminat\*).tw. (12,562)
40. (record\* adj3 (shar\* or distribut\* or disseminat\*).tw. (2196)
41. or/35-40 [networking systems] (529,805)
42. 41 and 34 (28,255)
43. 42 or 26 [Networked IT systems] (28,641)
44. 43 and 22 [safety in networked systems] (468)
45. 16 and 44 [Theory & Opinion networked IT safety systems] (47)

### Ovid MEDLINE Epub Ahead of Print

Search date: 8 March 2018.

Date range searched: 1946 to February week 5 2018.

#### Search strategy

Same strategy as Ovid MEDLINE.

### Ovid MEDLINE In-Process & Other Non-Indexed Citations

Search date: 8 March 2018.

Date range searched: 1946 to February week 5 2018.

#### Search strategy

Same strategy as Ovid MEDLINE.

### *Theory development: structured subject search – interoperability and networked information technology*

### EMBASE Classic and EMBASE (via Ovid)

Search date: 16 March 2018.

Date range searched: 1947 to 15 March 2018.

#### Search strategy

1. "Comment on".ti. (20,221)
2. (letter\* adj3 editor\*).ti. (24,062)
3. opinion\*.ti. (16,905)
4. (view or views).ti. (61,981)
5. (editorial or journal letter or journal note or letter or note or report editorial or report letter or trade journal letter or trade journal note).pt. (2,268,207)
6. or/1-5 [opinion pieces - hidden theories] (2,344,004)
7. (policy or policies or guideline\* or recommendation\* or position).ti. (222,165)
8. \*practice guideline/ (56,643)
9. exp \*public policy/or \*policy/ (85,626)
10. (theor\* or concep\* or logic).ti. (182,117)
11. ((theor\* or concep\* or logic) adj (framework\* or model\* or analy\* or evaluat\*)).ab. (60,995)
12. or/7-11 [Policy, Guideline or overt Theory] (533,584)
13. 6 or 12 [Theories search] (2,821,744)
14. exp medical record/ (204,622)
15. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (94,578)

16. medical informatics/or nursing informatics/ (19,599)
17. (electronic adj3 record\*).tw. (47,862)
18. ((health or medical or clinical) adj5 (information or record\*)).tw. (333,516)
19. computer system/ (24,959)
20. or/14-19 [health records & systems] (534,936)
21. "data interoperability"/ (30)
22. interoperab\*.tw,kw. (3422)
23. 21 or 22 (3434)
24. 23 and 20 and 13 [Theory interoperable health systems] (218)

### **Health Management Information Consortium**

Search date: 16 March 2018.

Date range searched: 1983 to present.

#### **Search strategy**

1. Commentaries/ (18)
2. "Comment on".ti. (29)
3. editorial.ti. (265)
4. letter.ti. (328)
5. opinion\*.ti. (508)
6. (view or views).ti. (3538)
7. (letter\* adj3 editor\*).ti. (1)
8. or/1-7 (4667)
9. (evidence\* adj8 (policy or policies)).tw. (1368)
10. policy/or health policy/or public policy/ (8823)
11. (policy or policies or guideline\* or recommendation\* or position).ti. (12,107)
12. exp guidelines/ (6653)
13. (theor\* or concep\* or logic).ti. (2774)
14. ((theor\* or concep\* or logic) adj (framework\* or model\* or analy\* or evaluat\*)).ab. (1825)
15. or/9-14 [Policy, Guideline or overt Theory] (27,515)
16. 8 or 15 [Theories] (31,886)
17. exp medical records/ (3144)
18. information technology/ (4796)
19. exp information systems/ (4895)
20. exp informatics/ (308)
21. (electronic adj3 record\*).tw. (1319)
22. ((health or medical or clinical) adj5 (information or record\*)).tw. (9925)
23. exp computer systems/ (4522)
24. or/17-23 [health records] (21,052)
25. interoperab\*.tw. (87)
26. 16 and 24 and 25 (4)

### **Ovid MEDLINE**

Search date: 16 March 2018.

Date range searched: 1946 to March week 2 2018.

#### **Search strategy**

1. (policy or policies or guideline\* or recommendation\* or position).ti. (157,588)
2. guideline/or practice guideline/ (29,719)

3. policy/or public policy/or exp health policy/ (126,529)
4. (theor\* or concep\* or logic).ti. (140,426)
5. ((theor\* or concep\* or logic) adj (framework\* or model\* or analy\* or evaluat\*)).ab. (44,221)
6. or/1-5 [Policy, Guideline or overt Theory] (445,305)
7. Comment/ (665,509)
8. Letter/ (927,149)
9. Editorial/ (405,687)
10. news/or newspaper article/ (190,369)
11. "Comment on".ti. (16,291)
12. (letter\* adj3 editor\*).ti. (6383)
13. opinion\*.ti. (11,818)
14. (view or views).ti. (43,602)
15. or/7-14 [Discussion papers Hidden Theory] (1,711,671)
16. 6 or 15 [Theory Search] (2,105,265)
17. exp Medical Records/ (132,810)
18. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (67,435)
19. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (15,539)
20. exp Decision Making, Computer-Assisted/ (125,028)
21. (electronic adj3 record\*).tw. (20,720)
22. ((health or medical or clinical) adj5 (information or record\*)).tw. (190,394)
23. Computer Systems/ (12,552)
24. or/17-23 [health records] (484,384)
25. HEALTH INFORMATION INTEROPERABILITY/ (36)
26. interoperab\*.tw,kw. (2537)
27. 25 or 26 (2555)
28. 16 and 24 and 27 [Theory interoperability records] (163)

### Ovid MEDLINE In-Process & Other Non-Indexed Citations

Search date: 15 March 2018.

Date range searched: 1946 to March week 2 2018.

#### Search strategy

Same search strategy as Ovid MEDLINE.

### Ovid MEDLINE Epub Ahead of Print

Search date: 15 March 2018.

Date range searched: 1946 to March week 2 2018.

#### Search strategy

Same search strategy as Ovid MEDLINE.

### *Theory development: named author searches – David Bates and interoperable systems or health information exchange*

### EMBASE Classic and EMBASE (via Ovid)

Search date: 22 March 2018.

Date range searched: 1947 to 21 March 2018.

**Search strategy**

1. exp medical record/ (205,201)
2. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (94,759)
3. medical informatics/or nursing informatics/ (19,627)
4. (electronic adj3 record\*).tw. (48,101)
5. ((health or medical or clinical) adj5 (information or record\*)).tw. (334,714)
6. computer system /(24,988)
7. or/1-6 [health records & systems] (536,527)
8. "data interoperability"/ (31)
9. (interoperab\* or inter-operab\*).tw,kw. (3489)
10. 8 or 9 (3502)
11. 7 and 10 [interoperable systems] (2272)
12. \*medical information system/ (7111)
13. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw,kw. (2874)
14. (patient information adj5 (exchang\* or shar\* or network\*)).tw,kw. (301)
15. or/12-14 [health info exchange] (9873)
16. 11 or 15 (11,761)
17. Bates, DW.au. (865)
18. (Bates adj2 David).ti,ab,kw. (9)
19. or/17-18 (873)
20. 19 and 16 [Bates on HIE and interoperability] (59)

**Health Management Information Consortium (via Ovid)**

Search date: 22 March 2018.

Date range searched: 1983 to present.

**Search strategy**

1. exp medical records/ (3144)
2. information technology/ (4796)
3. exp information systems/ (4895)
4. exp informatics/ (308)
5. (electronic adj3 record\*).tw. (1319)
6. ((health or medical or clinical) adj5 (information or record\*)).tw. (9925)
7. exp computer systems/ (4522)
8. or/1-7 [health records] (21,052)
9. (interoperab\* or inter-operab\*).tw. (95)
10. 8 and 9 [interoperable systems] (78)
11. information exchange/ (345)
12. exp Medical information exchange/ (20)
13. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw. (105)
14. (patient information adj5 (exchang\* or shar\* or network\*)).tw. (38)
15. or/11-14 [health info exchange] (485)
16. 10 or 15 (551)
17. Bates, D\*.au. (17)
18. Bates.ti,ab. (12)
19. 17 or 18 (29)
20. 19 and 16 [Bates on HIE and interoperability] (1)

**Ovid MEDLINE**

Search date: 22 March 2018.

Date range searched: 1946 to March week 3 2018.

**Search strategy**

1. exp Medical Records/ (132,904)
2. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (67,498)
3. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (15,554)
4. exp Decision Making, Computer-Assisted/ (125,253)
5. (electronic adj3 record\*).tw. (20,785)
6. ((health or medical or clinical) adj5 (information or record\*)).tw. (190,733)
7. Computer Systems/ (12,558)
8. or/1-7 [health records] (485,075)
9. (interoperab\* or inter-operab\*).tw,kw. (2582)
10. 9 and 8 [interoperable systems] (1800)
11. HEALTH INFORMATION INTEROPERABILITY/ (36)
12. 10 or 11 (1820)
13. Health Information Exchange/ (567)
14. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw,kw. (2018)
15. (patient information adj5 (exchang\* or shar\* or network\*)).tw,kw. (199)
16. or/13-15 [health information exchange] (2561)
17. 12 or 16 (4170)
18. Bates, DW.au. (696)
19. (Bates adj2 David).ti,ab,kw. (7)
20. or/18-19 (702)
21. 20 and 17 [Bates on HIE and interoperability] (29)

**Ovid MEDLINE In-Process & Other Non-Indexed Citations**

Date searched: 21 March 2018.

Date range searched: 1946 to March week 3 2018.

**Search strategy**

Same search strategy as Ovid MEDLINE.

**Ovid MEDLINE Epub Ahead of Print**

Date searched: 21 March 2018.

Date range searched: 1946 to March week 3 2018.

**Search strategy**

Same search strategy as Ovid MEDLINE.

**Web of Science Core Collection (Clarivate Analytics)**

Date searched: 21 March 2018.

Database searched (date range searched): Arts and Humanities Citation Index (1975 to present), Book Citation Index – Social Sciences and Humanities (2005 to present), Conference Proceedings Citation Index – Science (1990 to present), Conference Proceedings Citation Index – Social Science & Humanities (1990 to present), Sciences Citation Index (1900 to present), Social Sciences Citation Index (1900 to present) and Emerging Sources Citation Index (2015 to present).

### **Search strategy**

- # 14 #13 AND #3 3 [1 Bates and HIE/interoperability]\*\* (28)
- # 13 #12 OR #8 2 [HIE/interop] (3837)
- # 12 #11 OR #10 OR #9 (2442)
- # 11 TOPIC: (("patient information" NEAR/5 (exchang\* or shar\* or network\*))) (208)
- # 10 TOPIC: (((("health information" or "medical information" or "clinical information") NEAR/5 (exchang\* or shar\* or network\*))) (2265)
- # 9 TOPIC: ("health information exchange") (694)
- # 8 #7 AND #6 (1618)
- # 7 TS = (interoperab\* or inter-operab\*) (25,500)
- # 6 #5 OR #4 (212,986)
- # 5 TOPIC: (((health or medical or clinical) NEAR/5 (information or record\*))) (207,575)
- # 4 TOPIC: ((electronic NEAR/3 record\*)) (28,520)
- # 3 #2 OR #1 [Bates as author]\*\* (921)
- # 2 TOPIC: (Bates NEAR/2 David) (27)
- # 1 AUTHOR: (Bates DW) (894)

\*\*Bates is a prolific author on HITs and patient safety so we looked at only (1) articles he authored on HIT (line #14), or (2) any article he authored or articles in which he was mentioned with a usage count  $\geq 20$  (line #3), which gave 74 references from the 921 identified.

### **Theory development: named author searches – Robert Wachter**

#### **EMBASE (via Ovid)**

Search date: 10 March 2018.

Date range searched: 1996 to 2018 week 10.

#### **Search strategy**

1. wachter rm.au. (244)
2. wachter.ti,ab,kw. (40)
3. 1 or 2 (284)
4. limit 3 to yr = "2015 -Current" (32)

#### **Health Management Information Consortium (via Ovid)**

Search date: 10 March 2018.

Date range searched: 1983 to present.

#### **Search strategy**

1. wachter r\*.au. (12)
2. wachter.ti,ab. (3)
3. 1 or 2 (14)
4. limit 3 to yr = "2015 -Current" (3)

**Ovid MEDLINE**

Search date: 10 March 2018.

Date range searched: 1946 to February week 5 2018.

**Search strategy**

1. wachter rm.au. (232)
2. wachter.ti,ab,kw. (45)
3. 1 or 2 (277)
4. limit 3 to yr = "2015 -Current" (18)

**Ovid MEDLINE Epub Ahead of Print**

Search date: 8 March 2018.

Date range searched: 1946 to February week 5 2018.

**Search strategy**

Same strategy as Ovid MEDLINE.

**Ovid MEDLINE In-Process & Other Non-Indexed Citations**

Search date: 8 March 2018.

Date range searched: 1946 to February week 5 2018.

**Search strategy**

Same strategy as Ovid MEDLINE.

**Web of Science Core Collection (Clarivate Analytics)**

Search date: 21 March 2018.

Database searched (date range searched): Arts and Humanities Citation Index (1975 to present), Book Citation Index – Social Sciences and Humanities (2005 to present), Conference Proceedings Citation Index – Science (1990 to present), Conference Proceedings Citation Index – Social Science & Humanities (1990 to present), Sciences Citation Index (1900 to present), Social Sciences Citation Index (1900 to present) and Emerging Sources Citation Index (2015 to present).

**Search strategy**

PUBLICATION YEARS: (2015 OR 2016 OR 2017) \*Note there was no option for 2018

- # 3 #1 OR #2 (41)
- # 2 AUTHOR: (wachter rm) (27)
- # 1 TOPIC: (wachter) (14)

**Agency for Healthcare Research and Quality PSNeT Patient Safety Network**

Search date: 28 February 2018.

**Search strategy**

Search term 'Robert Wachter' was entered in the search tab. This retrieved all publications that were authored or co-authored by Robert Wachter.

### *Theory development: systematic reviews searches*

#### **Cochrane Database of Systematic Reviews (via Wiley Online Library)**

Search date: 5 February 2018 and 5 July 2019.

Issue 7 of 12, July 2019.

#### **Search strategy**

- #1 MeSH descriptor: [Safety Management] explode all trees (164)
- #2 MeSH descriptor: [Medical Errors] explode all trees (2865)
- #3 #1 or #2 (3008)
- #4 (outpatient\* or patient\*):ti,ab (864,355)
- #5 #3 and #4 (1959)
- #6 ((patient or patients or outpatient\*) N2(safety or harm\* or adverse)):ti,ab,kw (343)
- #7 MeSH descriptor: [Risk Management] explode all trees (8736)
- #8 MeSH descriptor: [Patient Safety] explode all trees (515)
- #9 #5 or #6 or #7 or #8 (11,261)
- #10 MeSH descriptor: [Medical Informatics] this term only (71)
- #11 MeSH descriptor: [Medical Informatics Applications] this term only (23)
- #12 MeSH descriptor: [Health Information Exchange] explode all trees (5)
- #13 MeSH descriptor: [Medical Informatics Computing] explode all trees (0)
- #14 MeSH descriptor: [Nursing Informatics] explode all trees (10)
- #15 MeSH descriptor: [Public Health Informatics] explode all trees (1)
- #16 MeSH descriptor: [Information Systems] explode all trees (2180)
- #17 MeSH descriptor: [Decision Making, Computer-Assisted] explode all trees (5060)
- #18 ("Information technolog\*" or computer\*):ti (4965)
- #19 MeSH descriptor: [Technology] this term only (29)
- #20 MeSH descriptor: [Biomedical Technology] explode all trees (21)
- #21 MeSH descriptor: [Computer Systems] explode all trees (5149)
- #22 #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 (15,121)
- #23 #9 and #22 (640)

#### **Database of Abstracts of Reviews of Effects (via Wiley Online Library)**

Search date: 5 February 2018.

Issue 2 of 4, April 2015.

#### **Search strategy**

Same search strategy as Cochrane Database of Systematic Reviews (Wiley): Issue 7 of 12, July 2019.

#### **EMBASE Classic and EMBASE (via Ovid)**

Search date: 5 February 2018 and 5 July 2019.

Date range searched: 1947 to 3 July 2019.

#### **Search strategy**

- 1. \*safety/and (outpatient\* or patient\*).tw. (32,312)
- 2. medical error/and (outpatient\* or patient\*).tw. (8475)
- 3. ((patient or patients or outpatient\*) adj2 (safety or harm\* or adverse\*)).tw. (66,683)
- 4. exp patient safety/ (112,296)
- 5. \*risk management/ (15,976)



6. exp adverse event/ (591,775)
7. or/1-6 (774,080)
8. exp \*information system/ (65,112)
9. medical information system/ (20,086)
10. medical informatics/ (19,591)
11. ("Information technolog\*" or computer\*).ti. (90,275)
12. \*information technology/or \*medical technology/or \*technology/ (33,552)
13. \*computer system/ (6527)
14. or/8-13 [IT systems] (211,487)
15. 7 and 14 (5785)
16. limit 15 to "reviews (maximizes specificity)" (117)

### Epistemonikos (Epistemonikos Foundation)

Two searches were conducted using the advanced search interface.

#### Search strategy

1. *Search title*: information technology OR *search title/abstract* health information exchange AND *Search title/abstract*: patient safety OR Medical error\* OR Adverse event\* (26 results)
2. *Search title*: information technology OR information exchange OR interoperability AND *Search title/abstract*: patient safety OR Medical error\* OR Adverse event\* (44 results)

### Health Technology Assessment Database (via Wiley Online Library)

Search date: 5 February 2018.

Issue 4 of 4, October 2016.

#### Search strategy

Same search strategy as Cochrane Database of Systematic Reviews (Wiley): Issue 2 of 12, February 2018.

### Health Systems Evidence (McMaster University)

Search date: 5 February 2018 and 5 July 2019.

#### Search strategy

The search terms "health information exchange" AND "patient safety" were entered into the basic search interface (12).

### Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily

Search date: 5 February 2018 and 5 July 2019.

Date range searched: 1946 to 3 July 2019 (includes MEDLINE 1946 to June week 5 2019).

#### Search strategy

1. "Safety Management"/and (outpatient\* or patient\*).tw. (7369)
2. "Medical Errors"/and (outpatient\* or patient\*).tw. (7856)
3. patient safety/ (17,099)
4. ((patient or patients or outpatient\*) adj2 (safety or harm\* or adverse\*)).tw. (42,840)
5. \*risk management/ (8922)
6. or/1-5 [Patient Safety] (67,271)
7. medical informatics/ (11,141)
8. health information exchange/ (717)

9. medical informatics applications/ (2417)
10. medical informatics computing/or nursing informatics/or public health informatics/ (3347)
11. exp \*information systems/ (82,805)
12. exp \*decision making, computer-assisted/ (96,082)
13. ("Information technolog\*" or computer\*).ti. (74,167)
14. \*technology/or \*biomedical technology/ (8748)
15. exp \*Computer Systems/ (89,894)
16. or/7-15 [IT systems] (319,910)
17. 6 and 16 (3123)
18. limit 17 to "reviews (maximizes specificity)" (82)

### *Theory development: usage count search*

#### **Web of Science Core Collection (Clarivate Analytics)**

Search date: 22 March 2018.

Database searched (date range searched): Arts and Humanities Citation Index (1975 to present), Book Citation Index – Social Sciences and Humanities (2005 to present), Conference Proceedings Citation Index – Science (1990 to present), Conference Proceedings Citation Index – Social Science & Humanities (1990 to present), Sciences Citation Index (1900 to present), Social Sciences Citation Index (1900 to present) and Emerging Sources Citation Index (2015 to present).

#### **Search strategy**

- # 10 #9 OR #5 [HIE/interop]\*\* (3837)
- # 9 #8 OR #7 OR #6 (2442)
- # 8 TOPIC: (("patient information" NEAR/5 (exchang\* or shar\* or network\*))) (208)
- # 7 TOPIC: (((("health information" or "medical information" or "clinical information") NEAR/5 (exchang\* or shar\* or network\*))) (2265)
- # 6 TOPIC: ("health information exchange") (694)
- # 5 #4 AND #3 (1618)
- # 4 TS = (interopab\* or inter-operab\*) (25,500)
- # 3 #1 OR #2 (212,986)
- # 2 TOPIC: (((health or medical or clinical) NEAR/5 (information or record\*))) (207,575)
- # 1 TOPIC: ((electronic NEAR/3 record\*)) (28,520)

\*\*We selected only those records with a usage count  $\geq 50$  accesses, which gave 56 records from the 3837 identified.

## **Evidence review: the co-ordination of services for older people living at home**

### *The nature and extent of care co-ordination problems for frail older people living at home*

#### **Structured database searches**

##### ***Applied Social Sciences Index and Abstracts (via ProQuest)***

Search date: 6 August 2019.

Date range searched: 1987 to present.

## Reviews search

((su(frail) OR (ti((function\* NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*)) OR ab((function\* NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*))) OR (ti((cognitive NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*)) OR ab((cognitive NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*))) OR (ti((complex NEAR/2 needs) AND (old\* OR elderly OR geriatric\*)) OR ab((complex NEAR/2 needs) AND (old\* OR elderly OR geriatric\*))) OR (ti(frail\*) OR ab(frail\*)))

AND

(su(Integrated care pathways) OR (ti((co-ordinat\* OR coordinat\* OR integrat\* OR continuity) NEAR/3 (care OR service\*)) OR ab((co-ordinat\* OR coordinat\* OR integrat\* OR continuity) NEAR/3 (care OR service\*))) OR su(continuity) OR su(Joint working) OR (ti((joint NEAR/1 (working OR care OR service\*))) OR ab((joint NEAR/1 (working OR care OR service\*)))) OR su(transition program) OR (ti((intermediate OR transition\* OR transfer\* OR team\*) NEAR/3 care) OR ab((intermediate OR transition\* OR transfer\* OR team\*) NEAR/3 care)) OR su(intercessional approach) OR su (multidisciplinary care) OR su(Interdisciplinary team work) OR su(Interdisciplinary approach) OR (ti ((interinstitution\* OR interagenc\* OR interdisciplin\* OR Interprofession\* OR multiprofessional\* OR multidisciplin\* OR multiagenc\*) NEAR/6 (relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR care OR service\*)) OR ab((interinstitution\* OR interagenc\* OR interdisciplin\* OR interprofession\* OR multiprofessional\* OR multidisciplin\* OR multiagenc\*) NEAR/6 (relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR care OR service\*))))

AND

(su(systematic review) OR ti(review OR meta-analysis OR synthesis))

*n* = 10

## Qualitative search

((MAINSUBJECT.EXACT.EXPLODE("Surveys") OR MAINSUBJECT.EXACT.EXPLODE("Interviews") OR MAINSUBJECT.EXACT.EXPLODE("Questionnaires") ti(((purpos\* NEAR/4 sampl\*) OR (focus NEAR/4 group\*))) OR ab(((purpos\* NEAR/4 sampl\*) OR (focus NEAR/4 group\*))) OR (ti((grounded NEAR/4 (theor OR study OR studies OR research OR analys?s))) OR ab((grounded NEAR/4 (theor OR study OR studies OR research OR analys?s)))) OR (ti(phenomenol\*) OR ab(phenomenol\*)) OR (ti(qualitative) OR ab(qualitative)) OR (ti(ethnolog\* OR ethnograph\* OR ethnonursing) OR ab(ethnolog\* OR ethnograph\* OR ethnonursing)) OR su(Observational research) OR su(qualitative methods) OR su(qualitative research))

AND

((su(frail) OR (ti((function\* NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*)) OR ab((function\* NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*))) OR (ti((cognitive NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*)) OR ab((cognitive NEAR/1 impair\*) AND (old\* OR elderly OR geriatric\*))) OR (ti((complex NEAR/2 needs) AND (old\* OR elderly OR geriatric\*)) OR ab((complex NEAR/2 needs) AND (old\* OR elderly OR geriatric\*))) OR (ti(frail\*) OR ab(frail\*)))

AND

(su(Integrated care pathways) OR (ti((co-ordinat\* OR coordinat\* OR integrat\* OR continuity) NEAR/3 (care OR service\*)) OR ab((co-ordinat\* OR coordinat\* OR integrat\* OR continuity) NEAR/3 (care OR service\*))) OR su(continuity) OR su(Joint working) OR (ti((joint NEAR/1 (working OR care OR service\*))) OR ab((joint NEAR/1 (working OR care OR service\*)))) OR su(transition program) OR (ti((intermediate OR transition\* OR transfer\* OR team\*) NEAR/3 care) OR ab((intermediate OR

transition\* OR transfer\* OR team\*) NEAR/3 care)) OR su(intercessional approach) OR su (multidisciplinary care) OR su(Interdisciplinary team work) OR su(Interdisciplinary approach) OR (ti((interinstitution\* OR interagenc\* OR interdisciplin\* OR Interprofession\* OR multiprofessional\* OR multidisciplin\* OR multiagenc\*) NEAR/6 (relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR care OR service\*)) OR ab((interinstitution\* OR interagenc\* OR interdisciplin\* OR interprofession\* OR multiprofessional\* OR multidisciplin\* OR multiagenc\*) NEAR/6 (relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR care OR service\*))))))

n = 57

### **Cumulative Index to Nursing and Allied Health Literature (via EBSCOhost)**

Search date: 6 August 2019.

Date range searched: 1981 to present.

Note: records downloaded from S30 (reviews search) and S44 (qualitative studies search).

### **Search strategy**

- S44 S18 AND S42 Limiters - Published Date: 20000101-20181231 (193)
- S43 S18 AND S42 (202)
- S42 S40 OR S41 (452,543)
- S41 ((MH "Interviews+") or (MH "Questionnaires+")) OR ((MH "Grounded Theory") or (MH "Research, Nursing")) OR ((MH "Ethnographic Research") or (MH "Ethnonursing Research") or (MH "Ethnological Research")) (376,306)
- S40 S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 (184,864)
- S39 TX narrative analys?s (1981)
- S38 TX ((discourse\* or discours\*) N3 analys?s (3857)
- S37 TX content analys?s (29,365)
- S36 TX observational method\* (16,252)
- S35 TX cluster sampl\* (3625)
- S34 TX ((purpos\* N4 sampl\*) or (focus N1 group\*)) (53,728)
- S33 TX (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*) (7632)
- S32 TX participant observ\* (8986)
- S31 TX (emic or etic or hermeneutic\* or heuristic\* or semiotic\*) (4619)
- S30 TX data N1 saturat\* (447)
- S29 TX grounded N1 (theor\* or stud\* or research or analys?s) (13,658)
- S28 TX Ethnonursing OR TX ethnograph\* or TX ethnolog\* (31,218)
- S27 (MH "Phenomenology") (2529)
- S26 (MH "Field Studies") (2264)
- S25 (MH "Observational Methods+") (16,978)
- S24 (MH "Content Analysis") (24,944)
- S23 (MH "Discourse Analysis") (3303)
- S22 (MH "Focus Groups") (28,512)
- S21 (MH "Qualitative Studies+") (96,870)
- S20 S18 AND S19 (30)
- S19 Limiters - Published Date: 20000101-20181231; Publication Type: Systematic Review (55,215)
- S18 S6 AND S17 (784)
- S17 S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 (72,963)
- S16 TI (((interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) N6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)) (3115)

- S15 TI ((intermediate or transition\* or transfer\* or team\*) N3 care) (4346)
- S14 (MH "Transitional Care") (530)
- S13 (MH "Interprofessional Relations+") (20,004)
- S12 (MH "Transfer, Discharge") (3884)
- S11 TI (joint N1 (working or care or service\*)) OR AB (joint N1 (working or care or service\*)) (524)
- S10 (MH "Continuity of Patient Care+") (12,923)
- S9 (MH "Health Care Delivery, Integrated") (6466)
- S8 TI ((co-ordinat\* or coordinat\* or integrat\* or continuity) N3 (care or service\*)) (5770)
- S7 (MH "Multidisciplinary Care Team+") (28,652)
- S6 S1 OR S2 OR S3 OR S4 OR S5 (15,529)
- S5 TI frail\* OR AB frail\* (6412)
- S4 TI ((complex\* N2 needs) AND (old\* or elderly or geriatric\*)) OR AB ((complex\* N2 needs) AND (old\* or elderly or geriatric\*)) (353)
- S3 TI ((cognitive\* N6 impair\*) AND (old\* or elderly or geriatric\*)) OR AB ((cognitive\* N6 impair\*) AND (old\* or elderly or geriatric\*)) (5464)
- S2 TI ((function\* N6 impair\*) AND (old\* or elderly or geriatric\*)) OR AB ((function\* N6 impair\*) AND (old\* or elderly or geriatric\*)) (2556)
- S1 (MH "Frail Elderly") OR (MH "Frailty Syndrome") (5380)

### Health Management Information Consortium (via Ovid)

Search date: 6 August 2019.

Date range searched: 1983 to present.

Note: records downloaded from line 46 (reviews search) and line 41 (qualitative studies search).

### Search strategy

1. exp frail older people/or exp Frail elderly people/ (314)
2. ((function\* adj1 impair\*) and (old\* or elderly or geriatric\*).tw,hw. (48)
3. ((cognitive\* adj1 impair\*) and (old\* or elderly or geriatric\*).tw,hw. (265)
4. ((complex\* adj2 needs) and (old\* or elderly or geriatric\*).tw,hw. (129)
5. frail\*.tw. (989)
6. or/1-5 [frailty] (1444)
7. collaborative care/or integrated care/or interagency collaboration/or joint working/ (5576)
8. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*).tw,hw. (6550)
9. (joint adj (working or care or service\*).tw,hw. (2667)
10. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,hw. (4138)
11. patient transfer/ (348)
12. health care teams/ (137)
13. long term care /(1778)
14. exp Intermediate care/ (518)
15. exp interorganisational relations/ (5496)
16. ((interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*).tw. (1881)
17. or/7-16 [care coordination] (19,596)
18. 6 and 17 (294)
19. limit 18 to yr = "2000 -Current" (223)
20. exp qualitative techniques/ (323)
21. mixed methods research/or qualitative research/ (1250)
22. qualitative.tw. (8732)
23. (ethnolog\* or ethnograph\* or ethnonursing).tw. (691)

24. phenomenol\*.af. (457)
25. (grounded adj (theor\$ or study or studies or research or analys?s)).af. (687)
26. (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*).mp. (745)
27. (emic or etic or hermeneutic\* or heuristic\* or semiotic\*).af. or (data adj1 saturat\*).tw. or participant observ\*.tw. (774)
28. ((purpos\* adj4 sampl\*) or (focus adj group\*)).af. (3723)
29. (life world or life-world or conversation analys?s or personal experience\* or theoretical saturation).mp. (506)
30. cluster sampl\*.mp. (40)
31. observational method\*.af. (36)
32. content analysis.af. (1021)
33. ((discourse\* or discours\*) adj3 analys?s).tw. (146)
34. narrative analys?s.af. (48)
35. or/20-34 [adapted qualitasitve filter] (13,942)
36. qualitative research/ (1244)
37. interviews/ (952)
38. interviews.tw. (11,703)
39. or/35-38 [qual & interviews] (20,362)
40. 18 and 39 (46)
41. limit 40 to yr = "2000 -Current" (43)
42. systematic reviews/or literature reviews/or meta analysis/ (6475)
43. ((systematic or metaanalys\* or meta-analys\* or rapid or evidence or qualitative or realist) adj2 (review or synthesis)).tw. (4442)
44. 42 or 43 (8119)
45. 18 and 44 (15)
46. limit 45 to yr = "2000 -Current" (13)

### **Ovid MEDLINE**

Search date: 6 August 2019.

Date range searched: 1996 to July week 4 2018.

Note: records downloaded from line 22 (reviews search) and line 48 (qualitative studies search).

### **Search strategy**

1. Frail Elderly/or Frailty/ (9088)
2. "Aged, 80 and over"/and (frail\* or complex).tw. (24,288)
3. ((function\* adj1 impair\*) and (old\* or elderly or geriatric\*)).tw. (3174)
4. ((cognitive\* adj1 impair\*) and (old\* or elderly or geriatric\*)).tw. (13,985)
5. ((complex\* adj2 needs) and (old\* or elderly or geriatric\*)).tw. (362)
6. frail\*.tw,kw. (12,564)
7. or/1-6 [frailty] (49,873)
8. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*)).ti,kw. (5599)
9. "Delivery of Health Care, Integrated"/ (10,714)
10. \*"Continuity of Patient Care"/ (7808)
11. (joint adj (working or care or service\*)).tw,kw. (418)
12. Patient Transfer/ (6188)
13. \*Patient Care Team/ (18,406)
14. ((intermediate or transition\* or transfer\* or team\*) adj3 care).ti,kw. (3712)
15. Transitional Care/ (389)
16. Intermediate Care Facilities/ (365)
17. \*interprofessional relations/or \*interdisciplinary communication/ (18,983)

18. ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)).ti,kw. (3305)
19. or/8-18 [Care co-ordination] (63,400)
20. 7 and 19 [Care co-ordination in the frail] (837)
21. limit 20 to (meta analysis or systematic reviews) [1a Frailty care co-ordination reviews] (50)
22. limit 21 to yr = "2000 -Current" (50)
23. limit 20 to (yr = "2000 -Current" and "qualitative (maximizes specificity)") (82)
24. exp qualitative research/ (40,247)
25. qualitative.tw,kf. (133,174)
26. Nursing Methodology Research/ (14,985)
27. observational study/ (50,230)
28. ethnolog\*.mp. (124,547)
29. ethnograph\*.mp. (7008)
30. ethnonursing.af. (85)
31. phenomenol\*.af. (14,598)
32. (grounded adj (theor\$ or study or studies or research or analys?s)).af. (8093)
33. (emic or etic or hermeneutic\* or heuristic\* or semiotic\*).af. or (data adj1 saturat\*).tw. or participant observ\*.tw. (14,268)
34. (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*).mp. (2724)
35. ((purpos\* adj4 sampl\*) or (focus adj group\*)).af. (42,519)
36. (life world or life-world or conversation analys?s or personal experience\* or theoretical saturation).mp. (7793)
37. cluster sampl\*.mp. (4726)
38. observational method\*.af. (462)
39. content analysis.af. (16,341)
40. ((discourse\* or discours\*) adj3 analys?s).tw. (1529)
41. narrative analys?s.af. (810)
42. or/24-41 [qualitative] (383,980)
43. "Surveys and Questionnaires"/ (361,279)
44. INTERVIEW/ (17,657)
45. interviews.tw,kf. (112,381)
46. or/42-45 [qual & interviews] (759,992)
47. 20 and 46 (191)
48. limit 47 to yr = "2000 -Current" (185)

### **Ovid MEDLINE Epub Ahead of Print**

Search date: 3 August 2018.

**Search strategy** Same search strategy as Ovid MEDLINE 1996 to July week 4 2018.

### **Ovid MEDLINE In-Process & Other Non-Indexed Citations**

Search date: 3 August 2018.

**Search strategy** Same search strategy as Ovid MEDLINE 1996 to July week 4 2018.

### **PsycINFO (via Ovid)**

Search date: 6 August 2019.

Date range searched: 1806 to July week 5 2018.

Note: records downloaded from line 17 (reviews search) and line 41 (qualitative studies search).

## Search strategy

1. health impairments/ (2299)
2. \*geriatric patients/or elder care/ (13,064)
3. ((function\* adj1 impair\*) and (old\* or elderly or geriatric\*)).tw. (1987)
4. ((cognitive\* adj1 impair\*) and (old\* or elderly or geriatric\*)).tw. (12,949)
5. ((complex\* adj2 needs) and (old\* or elderly or geriatric\*)).tw. (279)
6. frail\*.tw. (4263)
7. cognitive impairment/and (old\* or elderly or geriatric\*).tw. (9247)
8. or/1-7 [frailty] (33,360)
9. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*)).ti.id. (4237)
10. integrated services/ (3213)
11. interdisciplinary treatment approach/ (6866)
12. "continuum of care"/ (1628)
13. (joint adj (working or care or service\*)).tw.id. (238)
14. ((intermediate or transition\* or transfer\* or team\*) adj3 care).ti.id. (1981)
15. ((interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)).ti.id. (3090)
16. or/9-15 (17,309)
17. 8 and 16 [care coordination in the frail elderly] (516)
18. limit 17 to ("reviews (maximizes specificity)" and yr = "2000 -Current") (19)
19. exp qualitative research/(7890)
20. qualitative.tw.id. (144,618)
21. survey\*.mp. (301,041)
22. ethnolog\*.mp. (2683)
23. ethnograph\*.mp. (26,448)
24. ethnonursing.af. (138)
25. phenomenol\*.af. (104,146)
26. (grounded adj (theor\$ or study or studies or research or analys?s)).af. (50,918)
27. (emic or etic or hermeneutic\* or heuristic\* or semiotic\*).af. or (data adj1 saturat\*).tw. or participant observ\*.tw. (90,872)
28. (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*).mp. (8286)
29. ((purpos\* adj4 sampl\*) or (focus adj group\*)).af. (57,965)
30. (life world or life-world or conversation analys?s or personal experience\* or theoretical saturation).mp. (13,865)
31. cluster sampl\*.mp. (1382)
32. observational method\*.af. (1952)
33. observation methods/ (5201)
34. or/19-33 [qualitative terms] (670,126)
35. interviews/ (8107)
36. questionnaires/ (17,252)
37. interview\*.tw.id. (297,486)
38. questionnaire\*.mp. (369,227)
39. or/34-38 [qual & interviews] (1,076,024)
40. 17 and 39 (168)
41. limit 40 to yr = "2000 -Current" (154)

## Complementary searches

### ***The King's Fund: hand-searched***

The King's Fund integrated care topic web page, publications list (URL: [www.kingsfund.org.uk/topics/integrated-care?f%5B0%5D=type%3A5842](http://www.kingsfund.org.uk/topics/integrated-care?f%5B0%5D=type%3A5842)).



The King's Fund integrated care and partnership working reading list (URL: <https://koha.kingsfund.org.uk/cgi-bin/koha/opac-shelves.pl?op=view%26shelfnumber=108%26sortfield=copyrightdate%26direction=desc>).

$n = 137$

### **The Journal of Integrated Care: *hand-searched***

Titles in all issues from 2014 to present were screened for relevance and possibly included studies were downloaded.

$n = 72$

### ***What are the experiences of professionals using interoperable networks in the course of care co-ordination?***

#### **Structured database searches**

#### **Association for Computing Machinery's Digital Library full text collection (Association for Computing Machinery's Guide to Computing Literature) – advanced search mode**

Search date: 30 September 2018.

Date range searched: 1947 to present.

#### **Search strategy**

1. [any field – matches all] interoperab\* record\* AND [any field – any] health clinical medical patient AND [any field all] review = 5
2. [any field – matches all] [interoperab\* AND [any field – any] metaanalysis = 0
3. [any field – matches all] interoperab\* AND [any field – all] Coordinat\* AND [any field all] review = 0
4. [any field – matches all] interoperab\* AND [any field – all] communicat\* AND [any field all] review = 2
5. [any field – matches all] interoperab\* AND [any field – all] collaborat\* AND [any field all] review = 0
6. [any field – matches all] interoperab\* AND [any field – all] integrat\* AND [any field all] review = 0
7. [any field – matches all] interoperab\* AND [any field – all] transition\* AND [any field all] review = 0
8. [any field – matches all] “health information exchange” [any field all] AND care [any field] AND [any field all] review = 6
9. [any field – matches all] “health information exchange” [any field all] AND record\* [any field] AND [any field all] review = 9
10. [any field – matches all] “health information exchange” [any field all] AND coordinat\* [any field] AND [any field all] review = 0
11. [any field – matches all] “health information exchange” [any field all] AND communicat\* [any field] AND [any field all] review = 0
12. [any field – matches all] “health information exchange” [any field all] AND integrat\* [any field] AND [any field all] review = 0
13. [any field – matches all] “health information exchange” [any field all] AND transition\* [any field] AND [any field all] review = 0
14. [any field – matches all] “health information exchange” [any field all] AND [any field all] review = 14

Combined 14 searches ( $n = 36$ ).

**Applied Social Sciences Index and Abstracts (via ProQuest)**

Search date: 30 September 2018.

Date range searched: 1987 to present.

**Search strategy**

(((((MAINSUBJECT.EXACT.EXPLODE("Health records") OR MAINSUBJECT.EXACT.EXPLODE("Medical records") OR MAINSUBJECT.EXACT("Computerized medical records")) OR MAINSUBJECT.EXACT("Records")) OR TI,AB(electronic NEAR/3 record\*) OR TI,AB((health or medical or clinical) NEAR/5 (information or record)))

AND

TI,AB(interoperab\*) OR TI,AB("health information exchange")

AND

(TI,AB((co-ordinat\* OR coordinat\* OR integrat\* OR continuity) NEAR/3 (care OR service\*)) OR ((MAINSUBJECT.EXACT("Care") OR MAINSUBJECT.EXACT("Integrated care pathways") OR MAINSUBJECT.EXACT("Intermediate care") OR MAINSUBJECT.EXACT("Shared care") OR MAINSUBJECT.EXACT("Continuing care") OR MAINSUBJECT.EXACT("Home care")) OR (MAINSUBJECT.EXACT("Transition programmes") OR MAINSUBJECT.EXACT("Continuity")) OR (MAINSUBJECT.EXACT("Care coordinators") OR MAINSUBJECT.EXACT("Care management") OR MAINSUBJECT.EXACT("Care delivery")) OR MAINSUBJECT.EXACT("Joint working")) OR Ti,AB(joint NEAR/1 (working OR care OR service\*)) OR TI,AB((intermediate OR transition\* OR transfer\* OR team\*) NEAR/3 care) OR (MAINSUBJECT.EXACT.EXPLODE("Interdisciplinary team work") OR MAINSUBJECT.EXACT("Interdisciplinary approach")) OR TI,AB((interinstitution\* OR interagenc\* OR interdisciplin\* OR Interprofession\* OR multiprofessional\* OR multidisciplin\* OR multiagenc\*) NEAR/6 (relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR care OR service\*)))

AND

at.exact("Literature Review") (1)

**EMBASE (via Ovid)**

Search date: 30 September 2018.

Date range searched: 1996 to week 40 2018.

**Search strategy**

1. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*)).tw,kw. (42,958)
2. integrated health care system/ (9709)
3. transitional care/ (1675)
4. \*patient care/ (49,167)
5. (joint adj (working or care or service\*)).tw,kw. (790)
6. patient transport/ (19,866)
7. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,kw. (35,683)
8. Intermediate Care Facilities/ (34,086)
9. interdisciplinary communication/ (10,573)
10. ((interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)).tw. (33,105)

11. interpersonal communication/ (124,500)
12. public relations/ (37,161)
13. or/1-12 [care-coordination] (345,988)
14. exp medical record/ (186,463)
15. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (81,079)
16. medical informatics/or nursing informatics/ (19,364)
17. (electronic adj3 record\*).tw. (52,350)
18. ((health or medical or clinical) adj5 (information or record\*)).tw. (321,597)
19. computer system/ (20,637)
20. or/14-19 [health records & systems] (489,700)
21. data interoperability/ (77)
22. interoperab\*.tw,kw. (3660)
23. 21 or 22 (3687)
24. 20 and 23 [interoperable records - based on theory search 3 interoperability] (2396)
25. \*medical information system/ (7112)
26. 24 or 25 (9298)
27. 13 and 26 [care coordination interoperability] (969)
28. limit 27 to yr = "2000 -Current" (956)
29. limit 28 to "reviews (best balance of sensitivity and specificity)" (141)

### **Inspec (El Village)**

Search date: 30 September 2018.

Date range searched: 1896 to present.

### **Search strategy**

(((\$meta-analysis OR \$review OR search\*) WN ALL))

AND

(((((health information exchange} WN ALL))) OR (((((((electronic health records} WN CV) OR ({medical information systems} WN CV) OR ({information systems} WN CV)))))) OR ((((\$electronic NEAR/3 record\* OR \$health NEAR/3 record\* OR \$medical NEAR/3 record\* OR \$clinical NEAR/3 record\* OR \$health NEAR/3 \$information OR \$medical NEAR/3 \$information OR \$clinical NEAR/3 \$information) WN ALL))))

AND

((((((open systems} WN CV)))))) OR (((interoperab\*) WN ALL))))))

AND

((((((patient care} WN CV) OR (^1 WN CV) OR ({professional communication} WN CV)))))) OR ((continuity NEAR/3 care OR continuity NEAR/3 service OR integrat\* NEAR/3 service OR integrat\* NEAR/3 care OR Coordinat\* NEAR/3 care OR Co-ordinat\* NEAR/3 service)) OR ((({joint working} OR {joint care} OR {joint service}) WN ALL))) OR ((((\$intermediate NEAR/3 \$Care OR transition\* NEAR/3 \$Care OR \$transfer NEAR/3 \$Care OR \$team NEAR/3 \$Care OR \$shared NEAR/3 \$Care) WN ALL)) OR ((((\$interinstitution OR \$interagency OR interdisciplin\* OR interprofession\* OR multiprofession\* OR multidisciplin\* OR multiagenc\*)

AND

(relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR \$care OR service\*) WN ALL) AND (1896-2019 WN YR)))))

AND

(2000-2019 WN YR))

132 results.

### **Ovid MEDLINE**

Search date: 30 September 2018.

Date range searched: 1946 to September week 3 2018.

### **Search strategy**

1. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*).tw,kw. (28,296)
2. "Delivery of Health Care, Integrated"/ (11,146)
3. \*"Continuity of Patient Care"/ (9463)
4. (joint adj (working or care or service\*).tw,kw. (551)
5. Patient Transfer/ (7453)
6. \*Patient Care Team/ (25,367)
7. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,kw. (20,298)
8. Transitional Care/ (414)
9. Intermediate Care Facilities/ (675)
10. \*interprofessional relations/or \*interdisciplinary communication/ (25,620)
11. ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*).tw,kw. (19,897)
12. or/1-11 [care co-ordination] (121,977)
13. exp Medical Records/ (135,875)
14. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (68,814)
15. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (16,030)
16. exp Decision Making, Computer-Assisted/(129,591)
17. (electronic adj3 record\*).tw. (22,494)
18. ((health or medical or clinical) adj5 (information or record\*).tw. (199,314)
19. Computer Systems/ (12,730)
20. or/13-19 [health records] (501,264)
21. Health Information Interoperability/ (64)
22. interoperab\*.tw,kw. (2744)
23. 21 or 22 (2769)
24. 23 and 20 [interoperable records - based on theory search 3 interoperability] (1927)
25. Health Information Exchange/ (638)
26. 24 or 25 (2499)
27. 12 and 26 [coordinated care and interoperable systems] (270)
28. limit 27 to yr = "2000 -Current" (267)
29. limit 28 to "reviews (best balance of sensitivity and specificity)" (17)

### **Ovid MEDLINE In-Process & Other Non-Indexed Citations**

Date searched: 28 September 2018.

**Search strategy** Same strategy as Ovid MEDLINE 1946 to September week 3 2018.

**Ovid MEDLINE Epub Ahead of Print**

Date searched: 25 September 2018.

**Search strategy** Same strategy as Ovid MEDLINE 1946 to September week 3 2018.

**Sociological Abstracts (via ProQuest)**

Search date: 30 September 2018.

Date range searched: 1952 to present.

**Search strategy**

((TI,AB(electronic NEAR/3 record\*) OR TI,AB((health or medical or clinical) NEAR/5 (information or record))) AND TI,AB(interoperab\*)) OR TI,AB("health information exchange")

AND

(TI,AB((co-ordinat\* OR coordinat\* OR integrat\* OR continuity) NEAR/3 (care OR service\*)) OR TI,AB(joint NEAR/1 (working OR care OR service\*)) OR TI,AB((intermediate OR transition\* OR transfer\* OR team\*) NEAR/3 care) OR (MAINSUBJECT.EXACT("Cooperation") OR MAINSUBJECT.EXACT("Teamwork") OR MAINSUBJECT.EXACT("Interdisciplinary Approach")) OR TI,AB((interinstitution\* OR interagenc\* OR interdisciplin\* OR Interprofession\* OR multiprofessional\* OR multidisciplin\* OR multiagenc\*) NEAR/6 (relations\* OR collaborat\* OR co-ordinat\* OR coordinat\* OR communicat\* OR care OR service\*)))

Narrowed by: Document type: Review

$n = 0$

**Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 30 September 2018.

Date range searched: 1900 to present.

Indexes: Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Emerging Sources Citation Index.

Time span: 2000–18.

**Search strategy**

# 17 #16 OR #15 (17)

# 16 #14 AND #13 (9)

# 15 #12 AND #5 Refined by: DOCUMENT TYPES: (REVIEW) (10)

# 14 TS = (meta-analysis or search\*) (758,107)

# 13 #12 AND #5 (297)

# 12 #11 OR #10 (2350)

# 11 TOPIC: ("health information exchange") (766)

# 10 #9 AND #8 (1700)

# 9 TOPIC: ((interoperab\* or inter-operab\*)) (24,924)

# 8 #7 OR #6 (198,344)

# 7 TOPIC: (((((health or medical or clinical) NEAR/5 (information or record\*)))))) (193,461)

- # 6 TOPIC: (((electronic NEAR/3 record\*))) (30,013)
- # 5 #4 OR #3 OR #2 OR #1 (87,790)
- # 4 TOPIC: ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) near/6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)) (25,278)
- # 3 TOPIC: ((intermediate or transition\* or transfer\* or team\*) near/3 care) (23,166)
- # 2 TOPIC: (joint near/1 (working or care or service)) (2884)
- # 1 TOPIC: ((co-ordinat\* or coordinat\* or integrat\* or continuity) NEAR/3 (care or service\*)) (44,446)

### Complementary searches

Forward citation searches of Fitzpatrick G, Ellingsen G. A review of 25 years of CSCW research in healthcare: contributions, challenges and future agendas. *CSCW Conf Comput Support Coop Work* 2013;**22**:609–65. In the following sources:

- ACM Digital Library (full text) – 1947 to present
- Google Scholar
- Scopus (Elsevier) – 1823 to present
- Web of Science Core Collection: Citation Indexes (Clarivate Analytics) – 1900 to present.

### *Do interoperable networks improve patient safety outcomes for frail older people living at home?*

#### Structured database searches

Search date: 30 September 2018 and updated 3 March 2019.

#### *Applied Social Sciences Index and Abstracts (via ProQuest)*

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1987 to present.

#### Search strategy

```
(((MAINSUBJECT.EXACT("Care") OR MAINSUBJECT.EXACT("Integrated care pathways") OR
MAINSUBJECT.EXACT("Intermediate care") OR MAINSUBJECT.EXACT("Shared care") OR
MAINSUBJECT.EXACT("Continuing care") OR MAINSUBJECT.EXACT("Home care")) OR
(MAINSUBJECT.EXACT("Transition programmes") OR MAINSUBJECT.EXACT("Continuity")) OR
(MAINSUBJECT.EXACT("Care coordinators") OR MAINSUBJECT.EXACT("Care management")
OR MAINSUBJECT.EXACT("Care delivery")) OR MAINSUBJECT.EXACT("Joint working")) OR
TI,AB(joint NEAR/1 (working OR care OR service*)) OR TI,AB((intermediate OR transition* OR
transfer* OR team*) NEAR/3 care) OR (MAINSUBJECT.EXACT.EXPLODE("Interdisciplinary team work")
OR MAINSUBJECT.EXACT("Interdisciplinary approach")) OR TI,AB((interinstitution* OR interagenc* OR
interdisciplin* OR Interprofession* OR multiprofessional* OR multidisciplin* OR multiagenc*) NEAR/6
(relations* OR collaborat* OR co-ordinat* OR coordinat* OR communicat* OR care OR service*)))
```

AND

```
(((MAINSUBJECT.EXACT.EXPLODE("Health records") OR MAINSUBJECT.EXACT.EXPLODE("Medical
records") OR MAINSUBJECT.EXACT("Computerized medical records")) OR MAINSUBJECT.EXACT
("Records")) OR TI,AB(electronic NEAR/3 record*) OR TI,AB((health or medical or clinical) NEAR/5
(information or record))) AND TI,AB(interoperab*) OR TI,AB("information exchang*"))
```

AND

((MAINSUBJECT.EXACT.EXPLODE("Evaluation") OR (MAINSUBJECT.EXACT("Clinical effectiveness") OR MAINSUBJECT.EXACT("Medical effectiveness research") OR MAINSUBJECT.EXACT("Effectiveness") OR MAINSUBJECT.EXACT("Organizational effectiveness") OR MAINSUBJECT.EXACT("Cost effectiveness")) OR (MAINSUBJECT.EXACT("Total quality management") OR MAINSUBJECT.EXACT("Impact analysis"))) OR Ti,AB(evaluat\* or impact or effectiveness))

$n = 21$

### EMBASE (via Ovid)

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1996 to week 9 2019.

### Search strategy

1. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*).tw,kw. (45,502)
2. integrated health care system/ (9937)
3. transitional care/ (1940)
4. \*patient care/ (50,706)
5. (joint adj (working or care or service\*).tw,kw. (813)
6. patient transport/ (20,362)
7. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,kw. (37,753)
8. Intermediate Care Facilities/ (33,832)
9. interdisciplinary communication/ (10,818)
10. ((interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*).tw. (35,024)
11. interpersonal communication/ (126,578)
12. public relations/ (37,525)
13. or/1-12 [care-coordination] (355,713)
14. exp medical record/ (194,712)
15. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (83,582)
16. medical informatics/or nursing informatics/ (19,674)
17. (electronic adj3 record\*).tw. (56,327)
18. ((health or medical or clinical) adj5 (information or record\*).tw. (337,393)
19. computer system/ (20,773)
20. \*medical information system/ (7264)
21. or/14-20 [health records & systems] (510,028)
22. data interoperability/ (117)
23. interoperab\*.tw,kw. (3928)
24. 22 or 23 (3975)
25. 21 and 24 [interoperable records - based on theory search 3 interoperability] (2515)
26. \*health information exchange/ (3887)
27. information exchang\*.tw,kw. (3829)
28. or/25-27 [info exchange or records interoperability] (9666)
29. 13 and 28 (1558)
30. exp evaluation study/ (55,500)
31. total quality management/ (52,914)
32. (evaluat\* or impact or effectiveness).tw,kw. (4,914,881)
33. \*health care quality/ (55,418)
34. outcome assessment/ (458,167)

- 35. 30 or 31 or 32 or 33 or 34 (5,284,599)
- 36. 29 and 35 (563)
- 37. limit 36 to conference abstract (137)
- 38. 36 not 37 (426)
- 39. limit 38 to (english language and yr = "2000 -Current") (405)

**Inspec (El Village)**

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1896 to present.

**Search strategy**

(((((evaluat\* OR \$impact OR \$effectiveness) WN KY)) OR ((({computer network performance evaluation} WN CV) OR ({performance evaluation} WN CV)))))) AND (((((((((((({electronic data interchange} WN CV)))))) OR (((interoperab\*) WN KY))))))

AND

((((((\$electronic NEAR/3 record\* OR \$health NEAR/3 record\* OR \$medical NEAR/3 record\* OR \$clinical NEAR/3 record\* OR \$health NEAR/3 \$information OR \$medical NEAR/3 \$information OR \$Clinical NEAR/3 \$information) WN KY)) OR (((({electronic health records} WN CV) OR ({medical information systems} WN CV)))))) OR ((({health information exchange} WN KY))))

AND

((((((\$continuity NEAR/3 \$care OR \$Continuity NEAR/3 service\* OR integrat\* NEAR/3 \$care OR integrat\* NEAR/3 service\* OR coordinat\* NEAR/3 \$care OR Coordinat\* NEAR/3 service\*) WN KY)) OR ((((\$interinstitution OR \$interagency OR interdisciplin\* OR interprofession\* OR multiprofession\* OR Multidisciplin\* OR Multiagenc\*) AND (relations\* OR Collaborat\* OR Coordinat\* OR Coordinat\* OR Communicat\* OR \$care OR service\*)) WN KY)) OR ((((\$intermediate NEAR/3 \$care OR transition\* NEAR/3 \$care OR transfer\* NEAR/3 \$care OR team\* NEAR/3 \$care OR \$shared NEAR/3 \$care)) WN KY)) OR (((({patient care} WN CV) OR ({professional communication} WN CV)))) OR ((({joint care} OR {joint working} OR {joint service\*}) WN KY))

AND

((1896-2019 WN YR)))))) NOT ((1999 OR 1998 OR 1997 OR 1996 OR 1995 OR 1994 OR 1989) WN YR))

n = 258

**Ovid MEDLINE**

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1996 to February week 4 2019.

**Search strategy**

- 1. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*).tw,kw. (25,475)
- 2. "Delivery of Health Care, Integrated"/ (11,164)
- 3. \*"Continuity of Patient Care"/ (7990)
- 4. (joint adj (working or care or service\*).tw,kw. (437)
- 5. Patient Transfer/ (6382)
- 6. \*Patient Care Team/ (18,805)
- 7. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,kw. (18,067)



8. Transitional Care/ (468)
9. Intermediate Care Facilities/ (360)
10. \*interprofessional relations/or \*interdisciplinary communication/ (19,479)
11. ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)).tw,kw. (18,762)
12. or/1-11 [care co-ordination] (101,963)
13. exp Medical Records/ (86,564)
14. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (50,023)
15. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (14,946)
16. exp Decision Making, Computer-Assisted/ (120,599)
17. (electronic adj3 record\*).tw. (23,090)
18. ((health or medical or clinical) adj5 (information or record\*)).tw. (179,423)
19. Computer Systems/ (8476)
20. or/13-19 [health records] (410,352)
21. Health Information Interoperability/ (74)
22. interoperab\*.tw,kw. (2830)
23. 21 or 22 (2859)
24. 23 and 20 [interoperable records - based on theory search 3 interoperability] (1963)
25. Health Information Exchange/ (671)
26. information exchang\*.tw,kf. (2539)
27. or/24-26 [HIE or interoperable records] (4727)
28. 12 and 27 (635)
29. "quality of healthcare"/ (50,954)
30. Quality Improvement/ (19,241)
31. exp program evaluation/ (64,176)
32. evaluation studies/or exp evaluation studies as topic/ (949,715)
33. (evaluat\* or impact or effectiveness).tw,kw. (2,878,224)
34. "Outcome Assessment (Health Care)"/ (62,896)
35. "Process Assessment (Health Care)"/ (4027)
36. Quality Indicators, Health Care/ (14,355)
37. or/29-36 [evaluation] (3,547,278)
38. 28 and 37 [evaluating interoperable care coordination] (273)
39. limit 38 to (english language and yr = "2000 -Current") (255)

**Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily**

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1946 to 1 March 2019.

**Search strategy** Same strategy as Ovid MEDLINE 1996 to February week 4 2019.

**Sociological Abstracts (via ProQuest)**

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1952 to present.

**Search strategy**

((MAINSUBJECT.EXACT("Quality") OR MAINSUBJECT.EXACT("Quality of Health Care")) OR (MAINSUBJECT.EXACT("Evaluation") OR MAINSUBJECT.EXACT.EXPLODE("Program Evaluation")) OR

MAINSUBJECT.EXACT.EXPLODE("Technology Assessment") OR MAINSUBJECT.EXACT.EXPLODE("Effectiveness"))

AND

(TI,AB (evaluat\* or impact or effectiveness))

n = 34

**Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 30 September 2018 and updated 3 March 2019.

Date range searched: 1900 to present.

Indexes: Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Emerging Sources Citation Index.

Time span: 1900–2019.

**Search strategy**

- #18 #16 AND #13 SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan = 2000-2019 (247)
- # 17 #16 AND #13 (251)
- # 16 #15 OR #14 (7,450,991)
- # 15 TOPIC: (quality NEAR/3 (improvement\* or healthcare or "health care")) (96,954)
- # 14 TOPIC: ((evaluat\* or impact or effectiveness)) (7,392,745)
- # 13 #12 AND #5 (678)
- # 12 #11 OR #10 (14,578)
- # 11 TS = (" information exchang\*") (12,854)
- # 10 #9 AND #8 (1937)
- # 9 TOPIC: ((interoperab\* or inter-operab\*)) (27,738)
- # 8 #7 OR #6 (237,037)
- # 7 TOPIC: (((((health or medical or clinical) NEAR/5 (information or record\*)))) (231,092)
- # 6 TOPIC: (((electronic NEAR/3 record\*))) (33,877)
- # 5 #4 OR #3 OR #2 OR #1 (103,553)
- # 4 TOPIC: ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) near/6 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)) (29,498)
- # 3 TOPIC: ((intermediate or transition\* or transfer\* or team\*) near/3 care) (27,214)
- # 2 TOPIC: (joint near/1 (working or care or service)) (3593)
- # 1 TOPIC: ((co-ordinat\* or coordinat\* or integrat\* or continuity) NEAR/3 (care or service\*)) (52,368)

**Complementary searches**

Search date: 10 April 2019.

Google Scholar forward citation searches of:

Vimarlund V, Olve NG, Scandurra I, Koch S. Organizational effects of information and communication technology (ICT) in elderly homecare: a case study. *Health Informatics J* 2008;**14**:195–210.<sup>33</sup>

Waterson P, Soares MM, Jacobs K, Eason K, Tutt D, Dent M. Using HIT to deliver integrated care for the frail elderly in the UK: current barriers and future challenges. *Work* 2012;**41**:4490–3.<sup>34</sup>

King G, O'Donnell C, Boddy D, Smith F, Heaney D, Mair FS. Boundaries and e-health implementation in health and social care. *BMC Med Inf Decis Mak* 2012;**12**:100.<sup>35</sup>

## Evidence review: medication reconciliation for older people living at home

### *What is the nature of the medicine reconciliation problem in frail older people population?*

#### Structured database searches

##### **EMBASE (via Ovid)**

Search date: 14 December 2018.

Date range searched: 1996 to week 50 2018.

Note: records downloaded from line 38 (reviews search) and line 42 (qualitative studies search).

#### Search strategy

1. exp qualitative research/ (58,974)
2. exp questionnaire/ (582,556)
3. exp interview/ (224,600)
4. interview\*.tw,kw. (355,209)
5. qualitative.tw,kw. (215,788)
6. nursing methodology research/ (13,443)
7. questionnaire\*.mp. (766,883)
8. survey\*.mp. (963,944)
9. ethnolog\*.mp. (60,189)
10. ethnograph\*.mp. (10,319)
11. ethn nursing.af. (90)
12. phenomenol\*.af. (25,685)
13. (grounded adj (theor\$ or study or studies or research or analys?s)).af. (12,366)
14. (emic or etic or hermeneutic\* or heuristic\* or semiotic\*).af. or (data adj1 saturat\*).tw. or participant observ\*.tw. (21,081)
15. (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*).mp. (4349)
16. ((purpos\* adj4 sampl\*) or (focus adj group\*)).af. (61,811)
17. (life world or life-world or conversation analys?s or personal experience\* or theoretical saturation).mp. (40,560)
18. cluster sampl\*.mp. (7667)
19. observational method\*.af. (2041)
20. content analysis.af. (27,040)
21. ((discourse\* or discurs\*) adj3 analys?s).tw. (2084)
22. narrative analys?s.af. (1180)
23. or/1-22 [Qualitative Filter] (2,047,405)
24. \*medication therapy management/ (3526)
25. exp \*medication error/ (7536)
26. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrepant\* or reconciliation\* or safety)).ti, kw. (12,898)
27. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrepant\* or reconciliation)).ti,kw. (1089)
28. (inappropriate prescribing or inappropriate prescription\*).ti,kw. (977)

29. exp \*inappropriate prescribing/ (1670)
30. ((medicine\* or medication) adj3 (review or management)).ti,kw. (5754)
31. "drug utilization review"/ (304)
32. or/24-31 [meds rec] (25,664)
33. exp \*aged/ (27,394)
34. (elderly or geriatric\*).tw. (284,835)
35. (old\* adj1 (age or adult\* or person\* or patient)).tw. (194,590)
36. or/33-35 [focussed older pt] (452,120)
37. 32 and 36 (2462)
38. limit 37 to (english language and "systematic review" and yr = "2000 -Current") (109)
39. 23 and 32 and 36 (554)
40. limit 39 to (english language and yr = "2000 -Current") (519)
41. limit 40 to conference abstracts (147)
42. 40 not 41 (372)

**Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily**  
Search date: 14 December 2018.

Date range searched: 1946 to 12 December 2018.

Note: records downloaded from line 37 (reviews search) and line 39 (qualitative studies search).

### Search strategy

1. exp qualitative research/ (42,909)
2. qualitative.tw,kf. (197,303)
3. Nursing Methodology Research/ (16,190)
4. observational study/ (55,507)
5. ethnolog\*.mp. (153,408)
6. ethnograph\*.mp. (9570)
7. ethnnonursing.af. (108)
8. phenomenol\*.af. (23,694)
9. (grounded adj (theor\$ or study or studies or research or analys?s)).af. (10,307)
10. (emic or etic or hermeneutic\* or heuristic\* or semiotic\*).af. or (data adj1 saturat\*).tw. or participant observ\*.tw. (20,663)
11. (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*).mp. (3761)
12. ((purpos\* adj4 sampl\*) or (focus adj group\*)).af. (54,815)
13. (life world or life-world or conversation analys?s or personal experience\* or theoretical saturation).mp. (14,207)
14. cluster sampl\*.mp. (6469)
15. observational method\*.af. (675)
16. content analysis.af. (22,875)
17. ((discourse\* or discours\*) adj3 analys?s).tw. (1956)
18. narrative analys?s.af. (1061)
19. or/1-18 [qualitative] (515,468)
20. "Surveys and Questionnaires"/ (413,145)
21. INTERVIEW/ (28,252)
22. interviews.tw,kf. (150,544)
23. or/19-22 [qual & interviews] (970,120)
24. exp \*Medication Errors/ (10,626)
25. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrepant\* or reconciliation\* or safety)).ti,kw. (6769)
26. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrepant\* or reconciliation)).ti,kw. (670)
27. ((medicine\* or medication) adj3 (review or management)).ti,kw. (3580)

28. "Drug Utilization Review"/ (3575)
29. (inappropriate prescribing or inappropriate prescription\*).ti,kw. (606)
30. \*Inappropriate Prescribing/ (1676)
31. or/24-30 [tight meds rec] (21,474)
32. exp \*aged/ (24,847)
33. (elderly or geriatric\*).tw. (252,221)
34. (old\* adj1 (age or adult\* or person\* or patient)).tw. (166,191)
35. or/32-34 (403,927)
36. 31 and 35 (1803)
37. limit 36 to (english language and yr = "2000 -Current" and systematic reviews) (140)
38. 23 and 31 and 35 (252)
39. limit 38 to (english language and yr = "2000 -Current") (223)

### **PsycINFO (via Ovid)**

Search date: 14 December 2018.

Date range searched: 1806 to December week 1 2018.

Note: records downloaded from line 33 (reviews search) and line 35 (qualitative studies search).

### **Search strategy**

1. exp qualitative research/ (8015)
2. questionnaires/ (17,465)
3. interviews/ (8164)
4. interview\*.tw,id. (302,732)
5. qualitative.tw,id. (148,364)
6. questionnaire\*.mp. (375,718)
7. survey\*.mp. (306,730)
8. ethnolog\*.mp. (2690)
9. ethnograph\*.mp. (26,946)
10. ethn nursing.af. (138)
11. phenomenol\*.af. (106,332)
12. (grounded adj (theor\$ or study or studies or research or analys?s)).af. (52,076)
13. (emic or etic or hermeneutic\* or heuristic\* or semiotic\*).af. or (data adj1 saturat\*).tw. or participant observ\*.tw. (92,483)
14. (action research or cooperative inquir\* or co operative inquir\* or co-operative inquir\*).mp. (8457)
15. ((purpos\* adj4 sampl\*) or (focus adj group\*)).af. (59,543)
16. (life world or life-world or conversation analys?s or personal experience\* or theoretical saturation).mp. (14,066)
17. cluster sampl\*.mp. (1423)
18. observational method\*.af. (1994)
19. content analysis.af. (51,663)
20. ((discourse\* or discours\*) adj3 analys?s).tw. (8505)
21. narrative analys?s.af. (6468)
22. or/1-21 [Qualitative Filter] (1,118,848)
23. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrepant\* or reconciliation\* or safety)).tw. (3188)
24. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrepant\* or reconciliation)).tw. (270)
25. ((medicine\* or medication) adj3 (review or management)).tw. (3003)
26. (inappropriate prescribing or inappropriate prescription\*).tw. (245)
27. or/23-26 [med Rec] (6414)
28. geriatric patients/ (12,889)

29. (elderly or geriatric\*).tw. (71,023)
30. (old\* adj1 (age or adult\* or person\* or patient)).tw. (72,103)
31. or/28-30 (130,504)
32. 27 and 31 (732)
33. limit 32 to (english language and "reviews (maximizes specificity)" and yr = "2000 -Current") (52)
34. 22 and 27 and 31 (209)
35. limit 34 to (english language and yr = "2000 -Current") (193)

### **Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 14 December 2018.

Date range searched: 1900 to present.

Indexes: Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Emerging Sources Citation Index.

Time span: 2000–18.

Note: records downloaded from line 40 (reviews search) and line 41 (qualitative studies search).

### **Search strategy**

- # 41 (#39 AND #36 AND #31) AND LANGUAGE: (English)Timespan = 2000-2018 (414)
- # 40 (#39 AND #36) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Review) Timespan = 2000-2018 (274)
- # 39 #38 OR #37 (556,063)
- # 38 TOPIC: ((old\* NEAR/1 (age or adult\* or person\* or patient)).) (310,703)
- # 37 TOPIC: (elderly or geriatric\*) (307,597)
- # 36 #35 OR #34 OR #33 OR #32 (17,068)
- # 35 TI = (((medicine\* or medication) NEAR/3 (review or management))) (4894)
- # 34 TS = (("inappropriate prescribing" or "inappropriate prescription\*")) (1581)
- # 33 TS = ((prescrib\* or prescription\*) NEAR/3 (safety or error\* or discrepant\* or reconciliation)) (3536)
- # 32 TI = (((drug\* or medicine\* or medication\*) NEAR/3 (error\* or discrepant\* or reconciliation\* or safety))) (7839)
- # 31 #30 OR #29 OR #28 OR #27 OR #26 OR #25 OR #24 OR #23 OR #22 OR #21 OR #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 OR #1 (5,935,626)
- # 30 TS = (narrative analys?s) (29,138)
- # 29 TS = (discourse analys?s) or TS = (discurs\* analys?s) (47,161)
- # 28 TS = (constant comparative) (13,874)
- # 27 TS = (content analysis) (429,822)
- # 26 TS = observational method\* (96,128)
- # 25 TS = (cluster sampl\*) (110,512)
- # 24 TS = (lived experience\*) OR TS = (life experience\*) (227,063)
- # 23 TS = (life world) OR TS = (conversation analys?s) OR TS = (theoretical saturation) (99,750)
- # 22 TS = (open-ended account\*) OR TS = (unstructured account) OR TS = (narrative\*) OR TS = (text\*) (693,982)
- # 21 TS = (purposive sampl\*) (8614)
- # 20 TS = (theoretical sampl\*) (72,461)
- # 19 TS = (biographical method\*) (1660)
- # 18 TS = (human science) (134,004)
- # 17 TS = (field stud\*) OR TS = (field research) (1,361,559)

- # 16 TS = (humanistic) OR TS = (existential) OR TS = (experiential) OR TS = (paradigm\*) (295,094)
- # 15 TS = (action research) OR TS = (co-operative inquir\*) (111,334)
- # 14 TS = (social construct\*) OR TS = (postmodern\*) OR TS = (post structural\*) OR TS = (feminis\*) OR TS = (interpret\*) (1,047,850)
- # 13 TS = (emic) OR TS = (etic) OR TS = (hermeneutic) OR TS = (heuristic) OR TS = (semiotic) OR TS = (data saturat\*) OR TS = (participant observ\*) (325,003)
- # 12 TS = (life stor\*) OR TS = (women's stor\*) (77,757)
- # 11 TS = (grounded theor\*) OR TS = (grounded stud\*) OR TS = (grounded research) OR TS = (grounded analys?s) (392,859)
- # 10 TS = (phenomenol\*) (97,714)
- # 9 TS = (ethnological research) (329)
- # 8 TS = (ethnonursing) (61)
- # 7 TS = (ethnograph\*) (47,723)
- # 6 TS = (questionnaire) (541,312)
- # 5 TS = (nursing research methodology) (3099)
- # 4 TS = (qualitative) (396,431)
- # 3 TS = (thematic analysis) (30,065)
- # 2 TS = (theme\*) (143,321)
- # 1 TS = (interview\*) (457,600)

### Complementary searches

Two Google searches were run; the first used the phrase 'Nature of Medicine Reconciliation problem' and second used the terms 'medicine reconciliation, barriers, ethnography, qualitative'. The first 50 records were screened from each search. A total of 17 references were potentially relevant and included for further screening.

### *What are professionals' experiences of using interoperable networks in medicine reconciliation for frail older people?*

### Structured database searches

These specific searches were designed to retrieve the Vashitz and colleagues papers<sup>119,120</sup> and those with similar concepts.

### *Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily*

Search date: 29 November 2018.

Date range searched: 1946 to 27 November 2018.

### Search strategy

1. exp Medication Errors/ (15,326)
2. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrepant\* or reconciliation\* or safety)).ti, kw. (6762)
3. (inappropriate prescribing or inappropriate prescription\*).tw,kw. (1562)
4. Inappropriate Prescribing/ (2395)
5. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrepant\* or reconciliation)).ti,kw. (670)
6. ((medicine\* or medication) adj3 (review or management)).ti,kw. (3567)
7. \*"Drug Utilization Review"/ (2012)
8. or/1-7 [medicines reconciliation] (25,073)
9. \*Clinical Decision-Making/ (1962)
10. Heuristics/ (297)
11. \*decision making/ (37,627)
12. (cognit\* adj3 (step\* or task\* or reason\* or process\* or analys\* or error\* or mistake\*)).tw. (35,271)

13. thinking/ (15,151)
14. (diagnostic adj2 (knowledge or judgement or reasoning)).tw. (1002)
15. (clinical adj2 (knowledge or judgement or reasoning)).ti,kw. (1897)
16. heuristic\*.tw. (10,382)
17. ((prescrib\* or prescription\*) adj2 (choice\* or decision\* or process\*)).ti,kw. (228)
18. or/9-17 [cognitive tasks] (100,525)
19. 8 and 18 (170)
20. limit 19 to english language (164)

### **PsycINFO (via Ovid)**

Search date: 29 November 2018.

Date range searched: 1806 to November week 4 2018.

### **Search strategy**

1. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrepant\* or reconciliation\* or safety)).tw. (3185)
2. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrepant\* or reconciliation)).tw. (270)
3. (inappropriate prescribing or inappropriate prescription\*).tw. (244)
4. ((medicine\* or medication) adj3 (review\* or management)).tw. (3409)
5. or/1-4 [medicines reconciliation] (6805)
6. (cognit\* adj3 (step\* or task\* or reason\* or process\* or analys\* or error\* or mistake\*)).tw. (60,429)
7. \*Decision Making/ (54,907)
8. \*"Cognitions"/ (6786)
9. heuristics/ (3326)
10. (diagnostic adj2 (knowledge or judgement or reasoning)).tw. (434)
11. (clinical adj2 (knowledge or judgement or reasoning)).ti. (735)
12. heuristic\*.tw. (14,130)
13. ((prescrib\* or prescription\*) adj2 (choice\* or decision\* or process\*)).ti. (56)
14. exp reasoning/ (24,798)
15. cognitive processes/ (70,647)
16. or/6-15 [cognitive tasks] (200,582)
17. 5 and 16 (148)
18. limit 17 to english language (144)

### **Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 29 November 2018.

Date range searched: 1900 to present.

Indexes: Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Emerging Sources Citation Index.

Time span: 2000–18.

### **Search strategy**

- # 13 (#11 AND #5) AND LANGUAGE: (English) (78)
- # 12 #11 AND #5 (80)
- # 11 #10 OR #9 OR #8 OR #7 OR #6 (184,189)
- # 10 TI = (((prescrib\* or prescription\*) NEAR/2 (choice\* or decision\* or process\*))) (350)
- # 9 TOPIC: (heuristic\*) (114,793)
- # 8 TI = ((clinical NEAR/2 (knowledge or judgement or reasoning))) (3348)



- # 7 TOPIC: ((diagnostic NEAR/2 (knowledge or judgement or reasoning))) (2879)
- # 6 TOPIC: ((cognit\* NEAR/3 (step\* or task\* or reason\* or process\* or analys\* or error\* or mistake\*))) (63,853)
- # 5 #4 OR #3 OR #2 OR #1 (17,010)
- # 4 TI = (((medicine\* or medication) NEAR/3 (review or management))) (4879)
- # 3 TOPIC: (("inappropriate prescribing" or "inappropriate prescription\*")) (1565)
- # 2 TOPIC: ((prescrib\* or prescription\*) NEAR/3 (safety or error\* or discrepant\* or reconciliation)) (3528)
- # 1 TI = (((drug\* or medicine\* or medication\*) NEAR/3 (error\* or discrepant\* or reconciliation\* or safety\*))) (7818)

### Complementary searches

We searched Google Scholar in December 2018 using the terms 'medicine reconciliation' and 'clinicians cognition' to identify key papers exploring clinicians' rationalisation and making sense of the fragmented disjoint medication information. The first 50 records were screened. This led us to identify a book chapter: Cook RI. Medication Reconciliation is a Window Into 'Ordinary' Work. In Smith P, editor. *Cognitive Systems Engineering*. Boca Raton, FL: CRC Press; 2017. pp. 53–76.<sup>124</sup>

We hand-searched the reference list in Cook,<sup>124</sup> which led us to identify two further studies:<sup>119,120</sup>

1. Vashitz G, Nunnally ME, Parmet Y, Bitan Y, O'Connor MF, Cook RI. How do clinicians reconcile conditions and medications? The cognitive context of medication reconciliation. *Cogn Technol Work* 2011;**15**:109–16.<sup>119</sup>
2. Vashitz G, Nunnally ME, Bitan Y, Parmet Y, O'Connor MF, Cook RI. Making sense of diseases in medication reconciliation. *Cogn Technol Work* 2011;**13**:151–8.<sup>120</sup>

We conducted forward and backward citation searches in Web of Science for the above studies.

### What are the patient outcomes of using interoperable networks in medicine reconciliation?

#### Structured database searches

##### Cumulative Index to Nursing and Allied Health Literature (via EBSCOhost)

Search date: 29 December 2018.

Date range searched: 1981 to present.

#### Search strategy

- S23 S13 AND S21 Limiters - English Language; Published Date: 20000101-20190131 (115)
- S22 S13 AND S21 (118)
- S21 S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 (29,326)
- S20 TI (inappropriate prescribing or inappropriate prescription\*) OR AB (inappropriate prescribing or inappropriate prescription\*) (1077)
- S19 (MH "Inappropriate Prescribing") (1790)
- S18 TI ((medicine\* or medication) N3 (review or management)) OR AB ((medicine\* or medication) N3 (review or management)) (8238)
- S17 TI ((prescrib\* or prescription\*) N3 (safety or error\* or discrepant\* or reconciliation)) OR ((prescrib\* or prescription\*) N3 (safety or error\* or discrepant\* or reconciliation)) (1364)
- S16 TI ((drug\* or medicine\* or medication\*) N3 (error\* or discrepant\* or reconciliation\* or safety)) OR AB ((drug\* or medicine\* or medication\*) N3 (error\* or discrepant\* or reconciliation\* or safety)) (11,690)
- S15 (MH "Medication Reconciliation") (1336)

- S14 (MH "Medication Errors+") (14,014)
- S13 S10 OR S11 OR S12 (6167)
- S12 TI information exchange\* OR AB information exchange\* (2695)
- S11 (MH "Electronic Data Interchange+") OR (MH "Health Care Information Exchange (Iowa NIC)") (3130)
- S10 S8 AND S9 (1070)
- S9 TI (interoperab\* or inter-operab\*) OR AB (interoperab\* or inter-operab\*) (1594)
- S8 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 (229,710)
- S7 (MH "Computer Systems") (1802)
- S6 TI ((health or medical or clinical) N5 (information or record\*)) OR AB ((health or medical or clinical) N5 (information or record\*)) (89,751)
- S5 TI (electronic N3 record\*) OR AB (electronic N3 record\*) (16,641)
- S4 (MH "Decision Making, Computer Assisted+") (36,843)
- S3 (MH "Health Informatics+") (12,213)
- S2 (MH "Information Systems") OR (MH "Health Information Systems+") (51,203)
- S1 (MH "Medical Records+") (88,785)

**EMBASE (via Ovid)**

Search date: 29 December 2018.

Date range searched: 1996 to week 53 2018.

**Search strategy**

1. exp medical record/ (192,230)
2. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (82,903)
3. medical informatics/or nursing informatics.mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word] (19,823)
4. (electronic adj3 record\*).tw. (54,793)
5. ((health or medical or clinical) adj5 (information or record\*)).tw. (332,154)
6. computer system/ (20,765)
7. \*medical information system/ (7209)
8. or/1-7 [health records and systems] (503,935)
9. data interoperability/ (102)
10. 1interoperab\*.tw,kw. (3839)
11. 9 or 10 (3879)
12. 8 and 11 (2479)
13. information exchange.tw,kw. (3484)
14. or/12-13 (5771)
15. medication therapy management/ (9126)
16. exp medication error/ (16,437)
17. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrepant\* or reconciliation\* or safety)).tw, kw. (33,640)
18. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrepant\* or reconciliation)).tw,kw. (3812)
19. (inappropriate prescribing or inappropriate prescription\*).tw,kw. (2523)
20. ((medicine\* or medication) adj3 (review or management)).tw,kw. (17,135)
21. "drug utilization review"/ (314)
22. or/15-21 [medicines reconciliation] (64,138)
23. 14 and 22 (188)
24. limit 23 to (english language and yr = "2000 -Current") (183)

**Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily Search** date: 29 December 2018.

Date range searched: 1946 to 26 December 2018.

**Search strategy**

1. exp Medical Records/ (137,059)
2. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (69,366)
3. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (16,168)
4. exp Decision Making, Computer-Assisted/ (131,543)
5. (electronic adj3 record\*).tw. (29,521)
6. ((health or medical or clinical) adj5 (information or record\*)).tw. (237,174)
7. Computer Systems/ (12,789)
8. or/1-7 [medical records] (543,132)
9. Health Information Interoperability/ (65)
10. interoperab\*.tw,kw. (3561)
11. or/9-10 (3586)
12. 8 and 11 (2208)
13. Health Information Exchange/ (661)
14. information exchang\*.tw,kw. (3343)
15. or/12-14 [HIE or interoperability] (5754)
16. exp Medication Errors/ (15,389)
17. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrep\* or reconciliation\* or safety)).tw, kw. (20,422)
18. (inappropriate prescribing or inappropriate prescription\*).tw,kw. (1568)
19. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrep\* or reconciliation)).tw,kw. (2219)
20. ((medicine\* or medication) adj3 (review or management)).tw,kw. (10,587)
21. "Drug Utilization Review"/ (3582)
22. or/16-21 [medicines reconciliation] (45,032)
23. 15 and 22 (130)
24. limit 23 to (english language and yr = "2000 -Current") (128)

**PsycINFO (via Ovid)**

Search date: 29 December 2018.

Date range search: 1806 to December week 4 2018.

**Search strategy**

1. exp medical records/ (3506)
2. exp information systems/or decision support systems/ (36,629)
3. (electronic adj3 record\*).tw. (3681)
4. ((health or medical or clinical) adj5 (information or record\*)).tw. (108,603)
5. or/1-4 [records] (144,480)
6. interoperab\*.tw. (513)
7. 5 and 6 [interoperable records] (202)
8. information exchang\*.tw. (1778)
9. 7 or 8 [HIE or interoperability] (1960)
10. ((drug\* or medicine\* or medication\*) adj3 (error\* or discrep\* or reconciliation\* or safety)).tw. (3192)

11. ((prescrib\* or prescription\*) adj3 (safety or error\* or discrep\* or reconciliation)).tw. (271)
12. (inappropriate prescribing or inappropriate prescription\*).tw. (246)
13. ((medicine\* or medication) adj3 (review or management)).tw. (3008)
14. or/10-13 [medicines reconciliation] (6424)
15. 9 and 14 (18)

limit 15 to (english language and yr = "2000 -Current") (17)

**Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 29 December 2018.

Date range searched: 1900 to present.

Indexes: Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Emerging Sources Citation Index.

Time span: 2000–18.

**Search strategy**

- # 14 #13 AND #8 (135)
- # 13 #12 OR #11 OR #10 OR #9 (39,463)
- # 12 TOPIC: ("inappropriate prescribing" or "inappropriate prescription\*") (1471)
- # 11 TOPIC: ((medicine\* or medication) NEAR/3 (review or management)) (14,452)
- # 10 TS = ((prescrib\* or prescription\*) NEAR/3 (safety or error\* or discrep\* or reconciliation)) (3277)
- # 9 TOPIC: (((drug\* or medicine\* or medication\*) NEAR/3 (error\* or discrep\* or reconciliation\* or safety)).) (23,025)
- # 8 #7 OR #6 (15,833)
- # 7 TS = ("information exchang\*") (11,377)
- # 6 #5 AND #4 (4806)
- # 5 TOPIC: (interoperab\* or inter-operab\*) (25,504)
- # 4 #3 OR #2 OR #1 (560,712)
- # 3 TOPIC: ((information or computer\* or clinical or health) NEAR/5 system\*) (382,181)
- # 2 TOPIC: ((health or medical or clinical) NEAR/5 (information or record\*)) (199,473)
- # 1 TOPIC: (electronic NEAR/3 record\*) (31,329)

**Evidence review: the co-ordination of services for at-risk children**

*What is the nature and extent of the coordination problem for services for at-risk children?*

**Structured database searches**

**Cumulative Index to Nursing and Allied Health Literature (via EBSCOhost)**

Search date: 10 May 2019.

Date range searched: 1981 to present.

**Search strategy**

- S27 S16 AND S24 Limiters - Published Date: 20000101-20191231; Clinical Queries: Review - Best Balance (159)
- S26 S16 AND S24 Limiters - Clinical Queries: Review - Best Balance (171)
- S25 S16 AND S24 (1611)
- S24 S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 (68,118)
- S23 TI (Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) N3 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*) OR AB (Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) N3 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*) (12,903)
- S22 (MM "Cooperative Behavior") (3065)
- S21 (MM "Interinstitutional Relations") (3762)
- S20 (MM "Interprofessional Relations") (9180)
- S19 TI (intermediate or transition\* or transfer\* or team\*) N3 care OR AB (intermediate or transition\* or transfer\* or team\*) N3 care (20,674)
- S18 TI (joint N1 (working or care or service\*)) OR AB (joint N1 (working or care or service\*)) (725)
- S17 TI (co-ordinat\* or coordinat\* or integrat\* or continuity) N3 (care or service\*) OR AB (co-ordinat\* or coordinat\* or integrat\* or continuity) N3 (care or service\*) (27,033)
- S16 S8 OR S15 (69,105)
- S15 S11 AND S14 (6042)
- S14 S12 OR S13 (1,015,355)
- S13 TI ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*)) OR AB ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*)) (622,122)
- S12 ((MH "Child+") OR (MH "Adolescence+")) (834,505)
- S11 S9 OR S10 (26,844)
- S10 (MM "Social Welfare") OR (MM "Social Work") (8896)
- S9 TI ("complex needs" OR safeguard\* OR "social care" OR "social worker\*") OR AB ("complex needs" OR safeguard\* OR "social care" OR "social worker\*") (19,996)
- S8 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 (65,337)
- S7 (MH "Orphans and Orphanages") OR (TI (children\* adj home\*) OR AB (children\* adj home\*)) (1102)
- S6 TI ((foster N1 (care or home\*))) OR AB ((foster N1 (care or home\*))) (2595)
- S5 TI ((foster\* or "looked after") and child\*) OR AB ((foster\* or "looked after") and child\*) (4284)
- S4 (MM "Foster Home Care") (2736)
- S3 TI (((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) N2 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")) OR AB (((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) N2 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk"))) (40,960)
- S2 TI (child\* N3 (protect\* or welfare)) OR AB (child\* N3 (protect\* or welfare)) (8766)
- S1 (MM "Child Welfare+") OR (MM "Child Abuse+") OR (MM "Child Safety") (24,370)

**EMBASE (via Ovid)**

Search date: 10 May 2019.

Date range searched: 1996 to week 18 2019.

**Search strategy**

1. exp \*child welfare/ (6410)
2. exp \*child abuse/ (15,215)
3. (child\* adj3 (protect\* or welfare)).tw,kw. (11,746)
4. ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) adj2 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")).tw,kw. (39,832)
5. (foster adj (care or home\*)).tw,kw. (2215)
6. (Children\* adj home\*).tw,kw. (599)
7. foster care/or orphanage/ (4077)
8. ((foster\* or "looked after") and child\*).tw,kw. (6071)
9. or/1-8 (63,615)
10. (social care or social worker\*).tw,kw. (17,754)
11. \*social welfare/or \*social work/or \*social care/ (9667)
12. ("complex needs" or Safeguard\*).tw,kw. (12,128)
13. or/10-12 (36,980)
14. (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*).tw. (1,866,490)
15. exp juvenile/ (2,309,698)
16. 13 and (14 or 15) (8069)
17. 9 or 16 [child protection] (69,911)
18. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*)).tw,kw. (46,843)
19. (joint adj (working or care or service\*)).tw,kw. (832)
20. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,kw. (38,891)
21. \*public relations/ (17,511)
22. \*interdisciplinary communication/or \*interpersonal communication/ (35,520)
23. ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj3 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)).tw,kw. (27,479)
24. \*cooperation/or \*teamwork/ (14,872)
25. or/18-24 [care coordination] (161,347)
26. 17 and 25 (2450)
27. limit 26 to "reviews (best balance of sensitivity and specificity)" (328)
28. limit 27 to (english language and yr = "2000 -Current") (271)

**Health Management Information Consortium (via Ovid)**

Search date: 10 May 2019.

Date range searched: 1983 to present.

**Search strategy**

1. child welfare/or child abuse/ (2336)
2. child protection services/or foster care services/or youth services/ (1293)
3. (child\* adj3 (protect\* or welfare)).tw,hw. (3248)
4. ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) adj2 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")).tw,hw. (3324)
5. exp foster care/ (677)
6. ((foster\* or "looked after") and child\*).tw,hw. (1555)
7. (foster adj (care or home\*)).tw,hw. (872)
8. (children\* adj home\*).tw,hw. (1072)

9. orphan\*.tw,hw. (105)
10. children in care/or exp community homes/ (2417)
11. or/1-10 [child protection] (8916)
12. social care.tw,hw. (17,382)
13. exp social welfare/or exp social work/ (10,132)
14. social worker\*.tw,hw. (6600)
15. ("complex needs" or safeguard\*).tw,hw. (1906)
16. or/12-15 (32,104)
17. (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*).tw. (38,826)
18. exp children/or exp young people/ (26,934)
19. 16 and (17 or 18) (5708)
20. 11 or 19 [child protection] (11,955)
21. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*).tw,hw. (6749)
22. (joint adj (working or care or service\*).tw,hw. (2678)
23. collaborative care/or integrated care/or interagency collaboration/or joint working/ (5730)
24. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,hw. (4181)
25. exp interorganisational relations/or exp interprofessional relations/ (5523)
26. ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj3 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*).tw,hw. (6400)
27. or/21-26 [care coordination] (17,937)
28. 20 and 27 (833)
29. ((comprehensive\* or integrative or systematic\* or scoping) adj3 (bibliographic\* or review\* or literature)).tw,hw. (5548)
30. (meta-analy\* or metaanaly\* or "research synthesis" or "evidence synthesis").tw,hw. (1912)
31. ((information or data) adj3 synthesis).tw,hw. (207)
32. (data adj2 extract\*).tw,hw. (1042)
33. ("Search filter\*" or "search strateg\*" or "literature search\*").tw. (1135)
34. (("mixed method\*" or qualitative or realist) adj3 (synthesis or review)).tw,hw. (341)
35. or/29-34 [review types] (7391)
36. 28 and 35 (5)
37. limit 36 to yr = "2000 -Current" (5)

**Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily Search date: 10 May 2019.**

Date range searched: 1946 to 3 May 2019.

### Search strategy

1. exp \*Child Welfare/ (20,303)
2. exp \*Child Abuse/ (22,657)
3. Child Protective Services/ (326)
4. (child\* adj3 (protect\* or welfare)).tw,kw. (11,695)
5. ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) adj2 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")).tw,kw. (37,761)
6. Foster Home Care/or orphanages/ (3861)
7. ((foster\* or "looked after") and child\*).tw,kw. (5720)
8. (foster adj (care or home\*).tw,kf. (2447)
9. (children\* adj home\*).tw,kf. (794)
10. or/1-9 (77,940)

11. "complex needs".kw,tw. (1308)
12. safeguard\*.tw,kf. (9604)
13. (social care or social worker\*).tw,kw. (14,514)
14. exp \*social welfare/or exp \*social work/ (47,032)
15. or/11-14 (68,661)
16. (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*).tw. (1,952,690)
17. exp Child/or Adolescent/or exp Infant/ (3,399,022)
18. 15 and (16 or 17) (32,253)
19. 10 or 18 [child protection] (87,460)
20. ((co-ordinat\* or coordinat\* or integrat\* or continuity) adj3 (care or service\*)).tw,kw. (35,751)
21. (joint adj (working or care or service\*)).tw,kw. (655)
22. ((intermediate or transition\* or transfer\* or team\*) adj3 care).tw,kw. (25,480)
23. \*interprofessional relations/or \*interdisciplinary communication/ (26,231)
24. ((Interinstitution\* or interagenc\* or interdisciplin\* or interprofession\* or multiprofessional\* or multidisciplin\* or multiagenc\*) adj3 (relations\* or collaborat\* or co-ordinat\* or coordinat\* or communicat\* or care or service\*)).tw,kw. (18,925)
25. \*Interinstitutional Relations/ (4446)
26. \*cooperative behavior/ (16,851)
27. or/20-26 [care coordination] (113,458)
28. 19 and 27 (1708)
29. limit 28 to "reviews (best balance of sensitivity and specificity)" (259)
30. limit 29 to (english language and yr = "2000 -Current") (207)

***What are clinicians' and other professionals' experiences of using interoperable health information technology to co-ordinate the care of children at risk and what are the effects of interoperable networks on outcomes for at-risk children?***

### **Structured database searches**

#### ***Applied Social Sciences Index and Abstracts (via ProQuest)***

Search date: 29 March 2019.

Date range searched: 1987 to present.

#### **Search strategy**

- S1 (MAINSUBJECT.EXACT.EXPLODE("Health records") OR MAINSUBJECT.EXACT.EXPLODE("Medical records") OR MAINSUBJECT.EXACT("Computerized medical records")) OR MAINSUBJECT.EXACT("Records") (2591)
- S2 TI,AB(electronic NEAR/3 record\*) (2040)
- S3 TI,AB((health or medical or clinical) NEAR/5 (information or record)) (16,105)
- S4 S1 OR S2 OR S3 (17,410)
- S5 TI,AB(interoperab\*) (103)
- S6 S4 and S5 (47)
- S7 TI,AB("information exchang\*") (440)
- S8 TI,AB(information NEAR/2 shar\*) (1784)
- S9 S6 OR S7 OR S8 (2209)
- S10 MAINSUBJECT.EXACT.EXPLODE("Child welfare") AND (MAINSUBJECT.EXACT.EXPLODE("Child maltreatment") OR MAINSUBJECT.EXACT.EXPLODE("Child abuse") OR MAINSUBJECT.EXACT.EXPLODE("Child neglect")) (431)



- S11 MAINSUBJECT.EXACT.EXPLODE("Child welfare") OR (MAINSUBJECT.EXACT.EXPLODE ("Child maltreatment") OR MAINSUBJECT.EXACT.EXPLODE("Child abuse") OR MAINSUBJECT.EXACT.EXPLODE("Child neglect")) (8967)
- S12 MAINSUBJECT.EXACT.EXPLODE("Child protection") (2352)
- S13 MAINSUBJECT.EXACT("Orphanages") OR MAINSUBJECT.EXACT.EXPLODE("Foster care") (3074)
- S14 TI,AB(child\* NEAR/3 (protect\* or welfare)) (9194)
- S15 TI,AB((child\* or infant\* or baby or babies or adolescen\* or teen\* or youth\* or juvenile\* or paediatric\* or paediatric\*) NEAR/4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")) (23,383)
- S16 TI,AB((foster\* or "looked after") and child\*). (4957)
- S17 TI,AB((foster or residential OR children\*) NEAR/1 (care or home\*)) (8895)
- S18 TI,AB(orphan\*) (1083)
- S19 S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 (42,192)
- S20 MAINSUBJECT.EXACT("Social care") OR MAINSUBJECT.EXACT("Social welfare") OR MAINSUBJECT.EXACT.EXPLODE("Social work") (28,099)
- S21 TI,AB("complex needs" OR safeguard\* or "social care" or "social worker\*") (21,097)
- S22 MAINSUBJECT.EXACT.EXPLODE("Children") OR MAINSUBJECT.EXACT.EXPLODE ("Adolescents") (117,450)
- S23 TI,AB(child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) (256,581)
- S24 (S20 OR S21) AND (S22 OR S23) (15,283)
- S25 S9 AND (S19 OR S24) (145)
- S26 TI,AB("child\* protection information") (5)
- S27 S25 OR S26 (148)
- S28 (S25 OR S26) AND yr(2000-2019) (137)

### **Cumulative Index to Nursing and Allied Health Literature (via EBSCOhost)**

Search date: 29 March 2019.

Date range searched: 1981 to present.

### **Search strategy**

- S35 s32 or s33 Limiters - Published Date: 20000101- (237)
- S34 S32 OR S33 (247)
- S33 TI "child\* protection information" OR AB "child\* protection information" (7)
- S32 S13 AND S31 (243)
- S31 S22 OR S30 (101,683)
- S30 S26 AND S29 (8172)
- S29 S27 OR S28 (1,002,488)
- S28 ((MH "Child+") OR (MH "Adolescence+")) (826,514)
- S27 TI ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*)) OR AB ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*)) (611,880)
- S26 S23 OR S24 OR S25 (38,490)
- S25 (MH "Social Welfare") OR (MH "Social Work") (15,525)
- S24 (MH "Residential Facilities") OR (MH "Assisted Living") (6501)
- S23 TI ("complex needs" OR safeguard\* OR "social care" OR "social worker\*") OR AB ("complex needs" OR safeguard\* OR "social care" OR "social worker\*") (19,726)
- S22 S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 (97,180)
- S21 (MH "Orphans and Orphanages") (1095)
- S20 TI (orphan\*) OR AB (orphan\*) (2476)

- S19 TI (((foster or residential or children\*) N1 (care or home\*))) OR AB (((foster or residential or children\*) N1 (care or home\*))) (14,766)
- S18 TI ((foster\* or "looked after") and child\*) OR AB ((foster\* or "looked after") and child\*) (4161)
- S17 (MH "Foster Home Care") (3974)
- S16 TI (((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) N4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")) OR AB (((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) N4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")) (53,074)
- S15 TI (child\* N3 (protect\* or welfare)) OR AB (child\* N3 (protect\* or welfare)) (8598)
- S14 (MH "Child Welfare+") OR (MH "Child Abuse+") OR (MH "Child Safety") (35,023)
- S13 S9 OR S10 OR S11 OR S12 (8756)
- S12 TI (information N2 shar\*) OR AB (information N2 shar\*) (4155)
- S11 TI "information exchang\*" OR AB "information exchang\*" (1668)
- S10 (MH "Health Care Information Exchange (Iowa NIC)") OR (MH "Electronic Data Interchange") (2755)
- S9 S7 AND S8 (999)
- S8 TI interoperab\* OR AB interoperab\* (1642)
- S7 S1 OR S2 OR S3 OR S4 OR S5 OR S6 (182,082)
- S6 (MH "Computer Systems") (1824)
- S5 TI ((health or medical or clinical) N5 (information or record\*)) OR AB ((health or medical or clinical) N5 (information or record\*)) (92,449)
- S4 TI electronic N3 record\* OR AB electronic N3 record\* (17,310)
- S3 ((MH "Health Informatics") OR (MH "Nursing Informatics") OR (MH "Medical Informatics")) OR (MH "Decision Making, Computer Assisted") (10,693)
- S2 (MH "Information Systems") OR (MH "Health Information Systems") OR (MH "Management Information Systems+") (11,550)
- S1 (MH "Medical Records+") (89,799)

### ***Criminal Justice Abstracts (via EBSCOhost)***

Search date: 29 March 2019.

Date range searched: 1830 to present.

### **Search strategy**

- S32 S29 OR S30 Limiters - Published Date: 20000101-20191231 (73)
- S31 S29 OR S30 (88)
- S30 TI "child\* protection information" OR AB "child\* protection information" (2)
- S29 S11 AND S28 (86)
- S28 S20 OR S27 (28,010)
- S27 S23 AND S26 (2050)
- S26 S24 OR S25 (89,604)
- S25 (((ZU "children") or (ZU "infants")) or ((ZU "teenagers"))) or ((ZU "toddlers")) (6417)
- S24 TI (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) OR AB (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) (89,407)
- S23 S21 OR S22 (7502)
- S22 (ZU "social workers") (3160)
- S21 TI (("complex needs" OR Safeguar\* OR "social care" OR "social worker\*") OR AB (("complex needs" OR Safeguar\* OR "social care" OR "social worker\*")) (6590)
- S20 S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 (27,157)
- S19 TI orphan\* OR AB orphan\* (236)

- S18 TI (((foster or residential or children\*) N1 (care or home\*)) OR AB (((foster or residential or children\*) N1 (care or home\*))) (2820)
- S17 (((((ZW "group homes"))) or ((ZU "orphanages") or (ZU "orphans"))) or ((ZU "group homes for children"))) (145)
- S16 TI ((foster\* or "looked after") and child\*) OR AB ((foster\* or "looked after") and child\*) (1952)
- S15 ((ZW "foster care") or (ZU "foster children")) or ((ZW "looked after children")) (695)
- S14 TI (((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) N4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk"))) OR AB (((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) N4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk"))) (18,695)
- S13 TI (child\* N3 (protect\* or welfare)) OR AB (child\* N3 (protect\* or welfare)) (6399)
- S12 ((((((ZU "child protection services") or ((ZW "child protection"))) or ((ZW "child welfare"))) or ((ZU "child welfare"))) or ((ZU "child abuse"))) or ((ZW "child abuse") or (ZW "child abuse & neglect"))) (10,957)
- S11 S7 OR S8 OR S9 OR S10 (1407)
- S10 TI "information exchang\*" OR AB "information exchang\*" (195)
- S9 (ZU "information sharing") (385)
- S8 TI information N2 shar\* OR AB information N2 shar\* (1080)
- S7 S5 AND S6 (31)
- S6 TI interoperab\* OR AB interoperab\* (285)
- S5 S1 OR S2 OR S3 OR S4 (7060)
- S4 TI ("information system\*" OR "information technolog\*") OR AB ("information system\*" OR "information technolog\*") (2846)
- S3 ((((((ZU "electronic records") or ((ZW "electronic records"))) or ((ZU "medical records"))) or ((ZU "computer systems"))) or ((ZU "information technology"))) (2455)
- S2 TI ((health or medical or clinical) N5 (information or record\*)) OR AB ((health or medical or clinical) N5 (information or record\*)) (2930)
- S1 TI electronic N3 record\* OR AB electronic N3 record\* (377)

**EMBASE (via Ovid)**

Search date: 29 March 2019.

Date range searched: 1996 to week 12 2019.

**Search strategy**

1. exp medical record/ (195,666)
2. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (83,862)
3. medical informatics/or nursing informatics/ (19,734)
4. (electronic adj3 record\*).tw. (56,765)
5. ((health or medical or clinical) adj5 (information or record\*)).tw. (339,394)
6. computer system/ (20,815)
7. \*medical information system/ (7280)
8. or/1-7 [health records & systems] (512,665)
9. data interoperability/ (123)
10. interoperab\*.tw,kw. (3957)
11. 9 or 10 (4009)
12. 8 and 11 [interoperable records - based on theory search 3 interoperability] (2536)
13. \*health information exchange/ (3903)
14. information exchang\*.tw,kw. (3856)

15. (information adj2 shar\*).tw,kw. (8172)
16. or/12-15 [HIE or interoperable records] (17,536)
17. exp child welfare/ (12,511)
18. exp child abuse/ (27,245)
19. (child\* adj3 (protect\* or welfare)).tw,kw. (11,587)
20. ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) adj4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")).tw,kf. (48,251)
21. ((foster or residential or children\*) adj (care or home\*)).tw,kw. (7168)
22. orphan\*.tw,kw. (20,217)
23. foster care/or orphanage/ (4048)
24. ((foster\* or "looked after") and child\*).tw,kw. (5979)
25. or/17-24 (104,463)
26. assisted living facility/or residential care/or residential home/ (15,726)
27. social care.tw,kw. (6399)
28. social welfare/or social work/or social care/ (34,843)
29. social worker\*.tw,kw. (11,096)
30. ("complex needs" or Safeguard\*).tw,kw. (11,907)
31. or/26-30 (72,651)
32. (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*).tw. (1,840,170)
33. exp juvenile/ (2,279,545)
34. 31 and (32 or 33) (16,042)
35. 25 or 34 [child protection] (116,436)
36. 16 and 35 [HIE and child protection] (260)
37. child\* protection information.tw,kw. [named system] (6)
38. 36 or 37 (265)
39. limit 38 to yr = "2000 -Current" (261)

### ***Health Management Information Consortium (via Ovid)***

Search date: 29 March 2019.

Date range searched: 1983 to present.

### **Search strategy**

1. exp medical records/ (3183)
2. information technology/or exp information systems/or exp informatics/ (8981)
3. (electronic adj3 record\*).tw. (1347)
4. ((health or medical or clinical) adj5 (information or record\*)).tw. (10,035)
5. exp computer systems/ (4552)
6. or/1-5 [health records] (21,256)
7. interoperab\*.tw,hw. (90)
8. 6 and 7 (76)
9. exp information exchange/ (424)
10. information exchang\*.tw,hw. (554)
11. (information adj2 shar\*).tw,hw. (755)
12. or/8-11 [HIE or interoperable records] (1349)
13. child welfare/or child abuse/ (2336)
14. child protection services/or foster care services/or youth services/ (1293)
15. (child\* adj3 (protect\* or welfare)).tw,hw. (3248)

16. ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) adj4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")).tw,hw. (3643)
17. exp foster care/ (677)
18. ((foster\* or "looked after") and child\*).tw,hw. (1555)
19. ((foster or residential or children\*) adj (care or home\*)).tw,hw. (7430)
20. orphan\*.tw,hw. (105)
21. or/13-20 (13,484)
22. exp residential care/or care homes/ (6848)
23. exp community homes/ (1015)
24. social care.tw,hw. (17,382)
25. exp social welfare/or exp social work/ (10,132)
26. social worker\*.tw,hw. (6600)
27. ("complex needs" or safeguard\*).tw,hw. (1906)
28. or/22-27 (37,980)
29. (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*).tw. (38,826)
30. exp children/or exp young people/ (26,934)
31. 28 and (29 or 30) (7670)
32. 31 or 21 [child protection] (16,750)
33. 12 and 32 [HIE and child protection] (100)
34. child\* protection information.tw,hw. (2)
35. 33 or 34 (101)
36. limit 35 to yr = "2000 -Current" (62)

### **Inspec (El Village)**

Search date: 29 March 2019.

Date range searched: 1896 to present.

### **Search strategy**

((("child\* protection information") WN KY) OR ((((((child\* NEAR abuse\* OR child\* NEAR neglect\* OR child\* NEAR mistreat\* OR child\* NEAR maltreat\* OR child\* NEAR \$vulnerable OR child\* NEAR {at risk}) WN KY) OR ((((\$foster NEAR/2 \$care OR \$foster NEAR/2 home\* OR \$residential NEAR/2 \$care OR \$residential NEAR/2 home\* OR children\* NEAR/2 \$care OR children\* NEAR/2 home\*) WN KY) OR (((foster\* AND child\*) WN KY) AND OR ((({Looked after} AND child\*) WN KY) OR (((orphan\*) WN KY) OR (((child\* NEAR/3 protect\* OR child\* NEAR/3 \$welfare) WN KY) OR ((((((complex needs} OR safeguard\* OR <sup>48</sup> OR {social worker\*}) WN KY) OR (((({public administration} WN CV))))

AND

(((((child\* OR infant\* OR \$baby OR \$babies OR toddler\* OR adolescen\* OR teen\* OR youth\* OR juvenile\* OR pediatric\* OR paediatric\*) WN KY) AND (((((((interoperab\*) WN ALL))) OR (((({electronic data interchange} WN CV)))) AND ((((((electronic health records} WN CV) OR ({medical information systems} WN CV)))) OR ((((\$electronic NEAR/3 record\* OR \$health NEAR/3 record\* OR \$medical NEAR/3 record\* OR \$clinical NEAR/3 record\* OR \$health NEAR/3 \$information OR \$medical NEAR/3 \$information OR \$Clinical NEAR/3 \$information) WN ALL) OR ((({health information exchange}) WN ALL) OR ((((\$Information NEAR/2 shar\*) WN KY)

AND

((1896-2019 WN YR))))

**Ovid MEDLINE**

Search date: 29 March 2019.

Date range searched: 1996 to March week 4 2019.

**Search strategy**

1. exp Medical Records/ (87,257)
2. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (50,239)
3. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (15,021)
4. exp Decision Making, Computer-Assisted/ (121,476)
5. (electronic adj3 record\*).tw. (23,413)
6. ((health or medical or clinical) adj5 (information or record\*)).tw. (180,921)
7. Computer Systems/ (8496)
8. or/1-7 [health records] (413,430)
9. Health Information Interoperability/ (82)
10. interoperab\*.tw,kw. (2852)
11. 9 or 10 (2886)
12. 11 and 8 [interoperable records - based on theory search 3 interoperability] (1979)
13. Health Information Exchange/ (677)
14. information exchang\*.tw,kf. (2554)
15. (information adj2 shar\*).tw,kw. (4820)
16. or/12-15 [HIE or interoperable records] (9348)
17. exp Child Welfare/ (18,706)
18. exp Child Abuse/ (19,268)
19. Child Protective Services/ (305)
20. (child\* adj3 (protect\* or welfare)).tw,kf. (7880)
21. ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) adj4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or "at risk")).tw,kf. (32,132)
22. Foster Home Care/or orphanages/ (2456)
23. ((foster\* or "looked after") and child\*).tw,kw. (3729)
24. ((foster or residential or children\*) adj (care or home\*)).tw,kf. (4804)
25. orphan\*.tw,kf. (12,712)
26. or/17-25 (78,067)
27. residential facilities/or assisted living facilities/or group homes/ (4561)
28. "complex needs".kw,tw. (973)
29. safeguard\*.tw,kf. (6491)
30. (social care or social worker\*).tw,kf. (9286)
31. exp Social Welfare/or exp Social Work/ (42,897)
32. or/27-31 (60,795)
33. (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*).tw. (1,143,084)
34. exp Child/or Adolescent/or exp Infant/ (1,934,185)
35. 32 and (33 or 34) (30,454)
36. 26 or 35 [child protection] (87,387)
37. 36 and 16 [HIE and child protection] (145)
38. child\* protection information.tw,kf. [named system] (3)
39. 37 or 38 (148)
40. limit 39 to yr = "2000 -Current" (140)

### **Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily Search**

Search date: 29 March 2019.

Date range searched: 1946 to 28 March 2019.

Search strategy same as Ovid MEDLINE.

### **Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 29 March 2019.

Date range searched: 1900 to present.

Indexes: Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index – Science, Conference Proceedings Citation Index – Social Science & Humanities, Emerging Sources Citation Index.

Time span: 2000–19.

### **Search strategy**

- #20 #18 OR #17 (283)
- #19 #18 OR #17 (298)
- #18 TOPIC: (“child\* protection information”) (5)
- #17 #16 AND #8 (294)
- #16 #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 (138,832)
- #15 TS = (“social care” OR “social worker\*”) AND (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) (4719)
- #14 TOPIC: (orphan\*) (23,566)
- #13 TS = ((foster or residential or children\*) NEAR/1 (care or home\*)) (28,852)
- #12 TOPIC: ((foster\* or “looked after”) and child\*) (12,765)
- #11 TS = (“complex needs” OR Safeguard\*) AND (child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) (1968)
- #10 TS = ((child\* or infant\* or baby or babies or toddler\* or adolescen\* or teen\* or youth\* or juvenile\* or pediatric\* or paediatric\*) NEAR/4 (abuse\* or neglect\* or mistreat\* or maltreat\* or vulnerable or “at risk”)) (65,690)
- #9 TOPIC: (child\* NEAR/3 (protect\* or welfare)) (20,386)
- #8 #7 OR #6 OR #5 (42,439)
- #7 TS = (information NEAR/2 shar\*) (28,833)
- #6 TS = (“ information exchang\*”) (12,958)
- #5 #4 AND #3 (1949)
- #4 TOPIC: ((interoperab\* or inter-operab\*)) (27,947)
- #3 #2 OR #1 (238,843)
- #2 TOPIC: (((health or medical or clinical) NEAR/5 (information or record\*)))) (232,870)
- #1 TOPIC: (((electronic NEAR/3 record\*))) (34,280)

## **Evidence review: economies of scope and scale of interoperable networks in health economies**

### **Structured database search**

#### **EMBASE Classic and EMBASE (via Ovid)**

Search date: 10 June 2019.

Date range searched: 1947 to 7 June 2019.

### **Search strategy**

1. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw,kw. (3351)
2. (patient information adj5 (exchang\* or shar\* or network\*)).tw,kw. (338)
3. \*medical information system/ (7541)
4. data interoperability/ (152)
5. or/1-4 (10,865)
6. exp medical record/ (229,767)
7. information system/or exp decision support system/or exp hospital information system/or medical information system/or nursing information system/or exp computerized provider order entry/ (101,938)
8. medical informatics/or nursing informatics/ (20,881)
9. (electronic adj3 record\*).tw. (59,998)
10. ((health or medical or clinical) adj5 (information or record\*)).tw. (381,886)
11. computer system/ (25,497)
12. or/6-11 [health records & systems] (597,968)
13. exp computer network/ (14,592)
14. information dissemination/ (19,867)
15. (network\* or exchange\* or data shar\*).tw. (825,591)
16. (information adj3 (shar\* or distribut\* or disseminat\*)).tw. (21,662)
17. (record\* adj3 (shar\* or distribut\* or disseminat\*)).tw. (3662)
18. (interoperab\* or inter-operab\*).tw. (4017)
19. or/13-18 [networked systems] (874,650)
20. 12 and 19 (40,184)
21. 20 or 5 [Networked IT or HIEs] (46,456)
22. (econom\* adj3 (scope or scale)).tw,kw. (1923)
23. (diseconom\* adj3 (scope or scale)).tw,kw. (68)
24. (efficienc\* adj3 (scope or scale)).tw,kw. (854)
25. or/22-24 (2779)
26. 21 and 25 (28)

### **Health Management Information Consortium (via Ovid)**

Search date: 10 June 2019.

Date range searched: 1983 to present.

### **Search strategy**

1. information exchange/ (349)
2. exp Medical information exchange/ (20)
3. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*)).tw. (110)
4. (patient information adj5 (exchang\* or shar\* or network\*)).tw. (39)
5. or/1-4 (494)
6. exp medical records/ (3194)
7. information technology/ (4873)
8. exp information systems/ (4907)
9. exp informatics/ (311)
10. (electronic adj3 record\*).tw. (1351)
11. ((health or medical or clinical) adj5 (information or record\*)).tw. (10,080)
12. exp computer systems/ (4553)



13. or/6-12 [health records] (21,324)
14. exp information transfer/ (2008)
15. exp computer networks/ (1684)
16. (network\* or exchange\* or data shar\*).tw. (7273)
17. (information adj3 (shar\* or distribut\* or disseminat\*).tw. (1365)
18. (record\* adj3 (shar\* or distribut\* or disseminat\*).tw. (147)
19. (interoperab\* or inter-operab\*).tw. (98)
20. or/14-19 [networked] (11,518)
21. 13 and 20 (3393)
22. 21 or 5 [networked IT, HIE] (3632)
23. (econom\* adj3 (scope or scale)).tw. (153)
24. (diseconom\* adj3 (scope or scale)).tw. (8)
25. (efficienc\* adj3 (scope or scale)).tw,kw. (20)
26. or/23-25 (172)
27. 22 and 26 [Economy of scope in networked systems] (6)

### Ovid MEDLINE and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily

Search date: 10 June 2019.

Date range searched: 1946 to May week 5 2019 and 7 June 2019.

#### Search strategy

1. health information exchange/ (705)
2. ((health information or medical information or clinical information) adj5 (exchang\* or shar\* or network\*).tw,kw. (2816)
3. (patient information adj5 (exchang\* or shar\* or network\*).tw,kw. (269)
4. Health Information Interoperability/ (91)
5. or/1-4 (3587)
6. exp Medical Records/ (139,237)
7. information systems/or decision support systems, clinical/or health information systems/or exp management information systems/ (70,403)
8. medical informatics/or medical informatics applications/or medical informatics computing/or nursing informatics/or public health informatics/ (16,459)
9. exp Decision Making, Computer-Assisted/ (135,429)
10. (electronic adj3 record\*).tw. (31,681)
11. ((health or medical or clinical) adj5 (information or record\*).tw. (246,632)
12. Computer Systems/ (12,876)
13. or/6-12 [health records] (558,899)
14. community network/ (6666)
15. computer communication networks/or local area networks/ (14,149)
16. information dissemination/ (15,405)
17. (network\* or exchange\* or data shar\*).tw. (681,622)
18. (information adj3 (shar\* or distribut\* or disseminat\*).tw. (16,912)
19. (record\* adj3 (shar\* or distribut\* or disseminat\*).tw. (2981)
20. (interoperab\* or inter-operab\*).tw. (3757)
21. or/14-20 [networking systems] (726,237)
22. 21 and 13 (34,476)
23. 22 or 5 [Networked IT systems] (35,007)
24. (econom\* adj3 (scope or scale)).tw,kw. (1438)
25. (diseconom\* adj3 (scope or scale)).tw,kw. (60)
26. (efficienc\* adj3 (scope or scale)).tw,kw. (702)

27. or/24-26 (2151)

28. 23 and 27 [Economy of scope in networked systems] (23)

**Research Papers in Economics (EconPapers, Örebro University Business School)**

Search date: 12 June 2019.

**Search strategy**

JEL Code I\* AND Keywords & title: Economies of scope AND free text: "health information exchange" 0

JEL Code I\* AND Keywords & title: Economies of scope AND free text: "information exchange" 0

JEL Code I\* AND Keywords & title: Economies of scope AND free text inter-operab\* or interoperab\*

JEL Code I\* AND Keywords & title: Economies of scope AND free text "electronic record\* 0  
(also clinical record, patient record medical record

JEL Code I\* AND Keywords & title: Economies of scope AND free text: information technology 0/7

JEL Code I\* AND Keywords & title: Economies of scope AND free text network 0

Repeated above using "economies of scale".

**Scopus (Elsevier)**

Search date: 11 June 2019.

Date range searched: 1823 to present.

**Search strategy**

(((((TITLE-ABS-KEY ("health information exchange")) OR (TITLE-ABS-KEY (("health information" OR "medical information" OR "clinical information" OR "patient information") W/5 (exchang\* OR shar\* OR network\*)))) OR (((TITLE-ABS-KEY (electronic W/3 record\*)) OR (TITLE-ABS-KEY ((health OR medical OR clinical) W/5 (information OR record\*))) OR (TITLE-ABS-KEY (((medical OR nursing OR health) W/2 informatics))) OR (TITLE-ABS-KEY ("information system\*" OR "decision support system\*" OR "computer system\*")))))

AND

((TITLE-ABS-KEY (network\* OR exchang\* OR "data shar\*")) OR (TITLE-ABS-KEY ((information W/3 (shar\* OR distribut\* OR disseminat\*)))) OR (TITLE-ABS-KEY ((record\* W/3 (shar\* OR distribut\* OR disseminat\*)))) OR (TITLE-ABS-KEY (interoperab\* OR inter-operab\*))))

AND

(TITLE-ABS-KEY ((econom\* OR diseconom\* OR efficienc\*) W/3 (scope OR scale))))

AND

(TITLE-ABS-KEY (health\* OR medical OR clinical OR patient OR hospital))

n = 48

**Web of Science Core Collection: Citation Indexes (Clarivate Analytics)**

Search date: 10 June 2019.

Date range searched: 1900 to present.

### Search strategy

- #21 #20 AND #16 (66)
- #20 #19 OR #18 OR #17 (19,781)
- #19 TOPIC: (efficienc\* NEAR/3 (scope or scale)) (6998)
- #18 TOPIC: (diseconom\* NEAR/3 (scope or scale)) (374)
- #17 TOPIC: (econom\* NEAR/3 (scope or scale)) (13,011)
- #16 #15 OR #4 (49,960)
- #15 #14 AND #9 (49,815)
- #14 #13 OR #12 OR #11 OR #10 (2,869,294)
- #13 TOPIC: (interoperab\* or inter-operab\*) (28,397)
- #12 TOPIC: (record\* NEAR/3 (shar\* or distribut\* or disseminat\*)) (11,454)
- #11 TOPIC: (information NEAR/3 (shar\* OR distribut\* OR disseminat\*)) (72,876)
- #10 TOPIC: (network\* OR exchang\* OR "data shar\*") (2,791,494)
- #9 #8 OR #7 OR #6 OR #5 (403,909)
- #8 TOPIC: ("information system\*" or "decision support system\*" or "computer system\*") (170,763)
- #7 TOPIC: ((medical or nursing or health) NEAR/2 informatics) (7345)
- #6 TOPIC: ((health or medical or clinical) NEAR/5 (information or record\*)) (237,499)
- #5 TOPIC: (electronic NEAR/3 record\*) (35,309)
- #4 #3 OR #2 OR #1 (2910)
- #3 TOPIC: ("patient information" NEAR/5 (exchang\* or shar\* or network)) (240)
- #2 TOPIC: (("health information" or "medical information" or "clinical information") NEAR/5 (exchang\* or shar\* or network\*)) (2710)
- #1 TOPIC: ("health information exchange") (854)



## Appendix 2 Paper for nominal group meetings

### SafetyNet:

#### networked information technologies and patient safety (NIHR Health Services and Delivery Research project 16/53/03)

#### Introduction

The meeting is part of an NIHR-funded study, called SafetyNet. Its purpose is to help us to identify how networked information technologies work – specifically, how they can help to improve patient safety.

At the meeting we would like you to comment critically on our initial ideas, which are outlined below, and represented in the diagrams in the Powerpoint file attached to the email. You can reject them, modify them, ‘zoom in’ on key issues and help us to fill in detail, or suggest new ones. We really don’t mind if you don’t like our ideas – that’s what the meeting is for. Equally, if you think particular sequences of events are important, you can help us by explaining why.

#### Background

There are continuing debates about the value of investments in networked IT systems in the NHS. To supporters, the advantages are obvious, and include access to the whole of a patient’s record, and reliable communication with clinicians in other organisations. Yet doubts persist. Clinicians point to poor experiences with ‘clunky’ IT systems, and promised new systems failing to arrive.

In other areas of health care, NIHCE appraisals can help to remove uncertainty about the value of new drugs and procedures. But NIHCE does not review IT investments. Even if it did, it might not be able to help very much, as published evidence is mixed. For example, some clinical trial evidence shows that medicines reconciliation can reduce the frequency of inappropriate prescribing. But other trials indicate no change, or even modest increases in the risks of adverse events. Similarly, studies of electronic health records have found both positive and no effects.

Commentators have offered possible explanations for these results. One is that too many IT systems really are clunky. Another is that academics have undertaken the wrong type of study, or not observed developments for long enough, and have under-estimated the value of systems as a result. Whatever the merits of these explanations, they don't solve the problem. We need a method for identifying the value of investments in networked IT systems that – ideally – is convincing to all sides.

Our focus is on patient safety partly for this reason. There is evidence of both positive and adverse effects associated with IT investments, and we are in a position to investigate both, and shed useful light on current debates. More generally, patient safety is at the heart of the matter. If networked IT systems are shown to help to make care safer, the evidence can be used to argue for investments. If they aren't, we need to understand why.

### **The Realist Synthesis Method**

Our approach starts with the observation that many practitioners and researchers believe that IT systems have effects on patient safety – but we don't understand how and why those effects occur. In most published health service research studies, everything in between the IT system and safe patient care (or an adverse event) is in a 'black box'. This study is designed to open the black box, and show how IT systems change clinicians' working practices, and how they in turn affect the safety of patient care. We believe that there are useful literatures on what happens inside the black box – including software engineering literatures - and it therefore makes sense to undertake a literature review, to establish what we do and don't know.

We are using a literature review method called realist synthesis. The cornerstone of the method, and the reason for arranging the meeting, is that we need to identify the effects on safety that system designers **intend** to achieve. These can be represented in sequences of steps, that link the design and deployment of networked IT systems to safe patient care. As we explain below,

our early work suggests that systems may work in different ways. Accordingly, we have identified several sequences, which we call **initial programme theories**, which we can use to guide our discussion.

We sense that a number of the relevant literatures are large, and we have limited resources. We therefore also need your help to identify **priorities** for the literature searches that we will undertake over the next few months. The main priority might be one of the programme theories, or possibly a key sequence of steps that several theories have in common.

### Initial Programme Theories

The initial programme theories are represented in the diagrams below. On the basis of our reading and thinking to date, we have identified four themes for discussion. They are summarized in the table below. The first three all work by providing clinicians with access to data from IT systems in other organisations: the differences lie in what clinicians do with it. They all involve actively managing patients' risks, and hence ensuring that care is safe and effective.

Co-ordination involves a clinician reviewing a patient's care – perhaps an older frail person's care package – and spotting that some services are not being provided, or that the patient needs a new service. The clinician contacts relevant colleagues, with a view to improving the service to the patient.

We found a number of papers which argue that safeguarding provides an important argument for links between patient records systems. The key idea here is that worrying patterns of use of services can be identified by clinicians – or alerts can be generated by IT systems - and acted upon.

Theme	Key feature	Example	Managing or avoiding risk
Co-ordination	Clinicians use records and networks to co-ordinate with one another	Community nurse reviews elderly person's care package, contacts services that have not been attending	Managing

Non-standard patterns of care/alerts	Systems provide data to alert clinicians	Safeguarding	Managing
Reconciliation	Clinicians access data from 'remote' systems	Medicines reconciliation	Managing and avoiding
Designing out risks	'Whole system' approach to the role of networked IT services	Comprehensive re-design of services	Avoiding

Reconciliation is distinctive because, at least in principle, it does not need to involve more than one clinician. Clinicians can review patient records, including records of – for example - current medications in 'remote' systems, and thereby ensure that patients receive the right medication. The risks of giving them contra-indicated medication is reduced.

The right hand column of the table suggests that reconciliation involves both managing and avoiding risks. The column is there to highlight two distinct ways of making care safer. The first, illustrated by the three examples above, involves actively managing patients' risks. The key idea here is that much health and social care is inherently uncertain, so that it's never going to be possible to know when any particular patient falls ill, or deteriorates. The appropriate response is to set the care system up so that clinicians can respond to patients' problems as they arise.

The second approach involves eliminating risks. The Virginia Mason model, currently being piloted in five English NHS hospitals, is an example of this approach ([improvement.nhs.uk/resources/virginia-mason-institute/](http://improvement.nhs.uk/resources/virginia-mason-institute/)). The starting point is that, while some aspects of care are inherently uncertain, much can be done to eliminate uncertainty for many patients. Our question is: do you think that networked IT services can be designed and deployed in support of an inherently safer care system? The last diagram



By way of illustration, medicines reconciliation can be interpreted as an example of this approach (as well as of actively managing risks). By providing the means to check current medications, and contra-indicated medication, IT systems can be part of a comprehensive approach to eliminating patients' risks.

This line of thinking has been referred to as the development of 'high reliability' organisations, and as the natural end-point of a 'whole systems' approach. It has also been referred to as Safety II. Roughly, Safety I refers to organisations that proactively manage patients' risks, while in Safety II organisations seek to 'design out' those risks as far as possible.

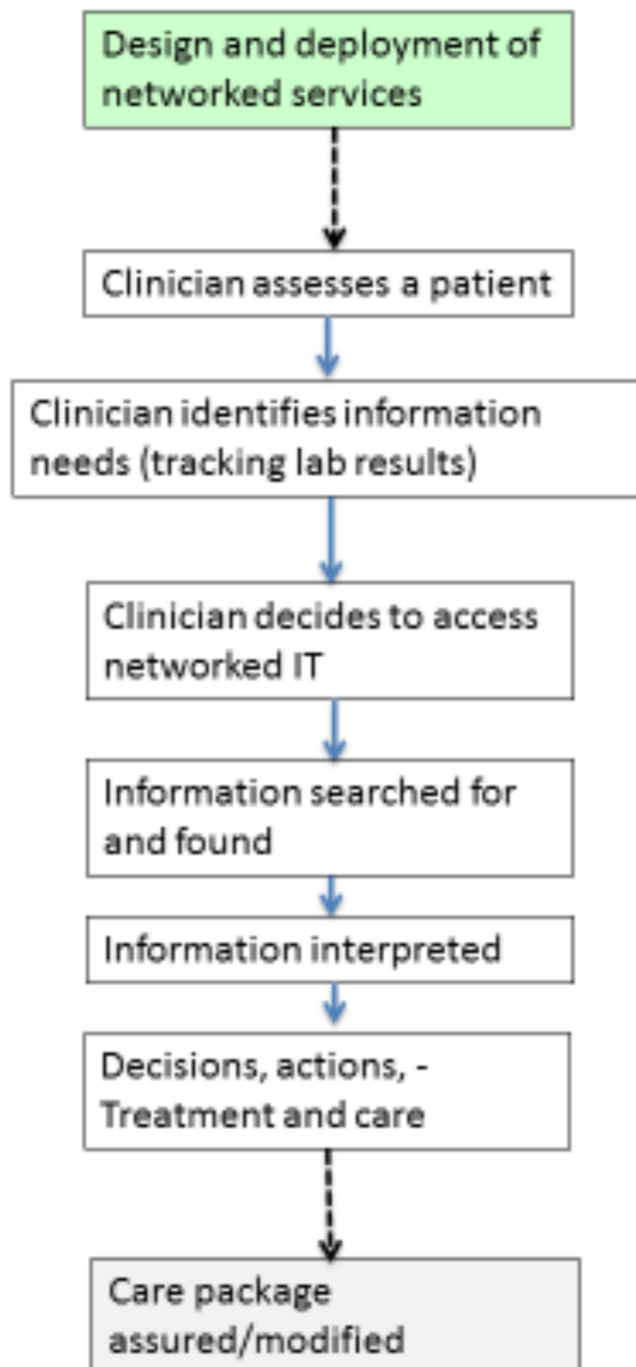
### **Next Steps**

The next step, for us, is to modify the programme theories in the light of your comments, and then use them as the basis for a discussion with national policy makers, and then consultation with frontline clinicians. We will also consult our study patient and public involvement panel. After that we will make a final decision about the theories or parts of theories to focus on. We will send you the final versions of the theories and our search priorities.

We will then design and conduct the searches, for evidence that supports or rejects the selected theories. We will also look for evidence about the events that derail peoples' best intentions – what gets in the way of achieving the intended effects in practice. **We would like to consult you again by email** on two occasions, for your comments on our emerging findings.

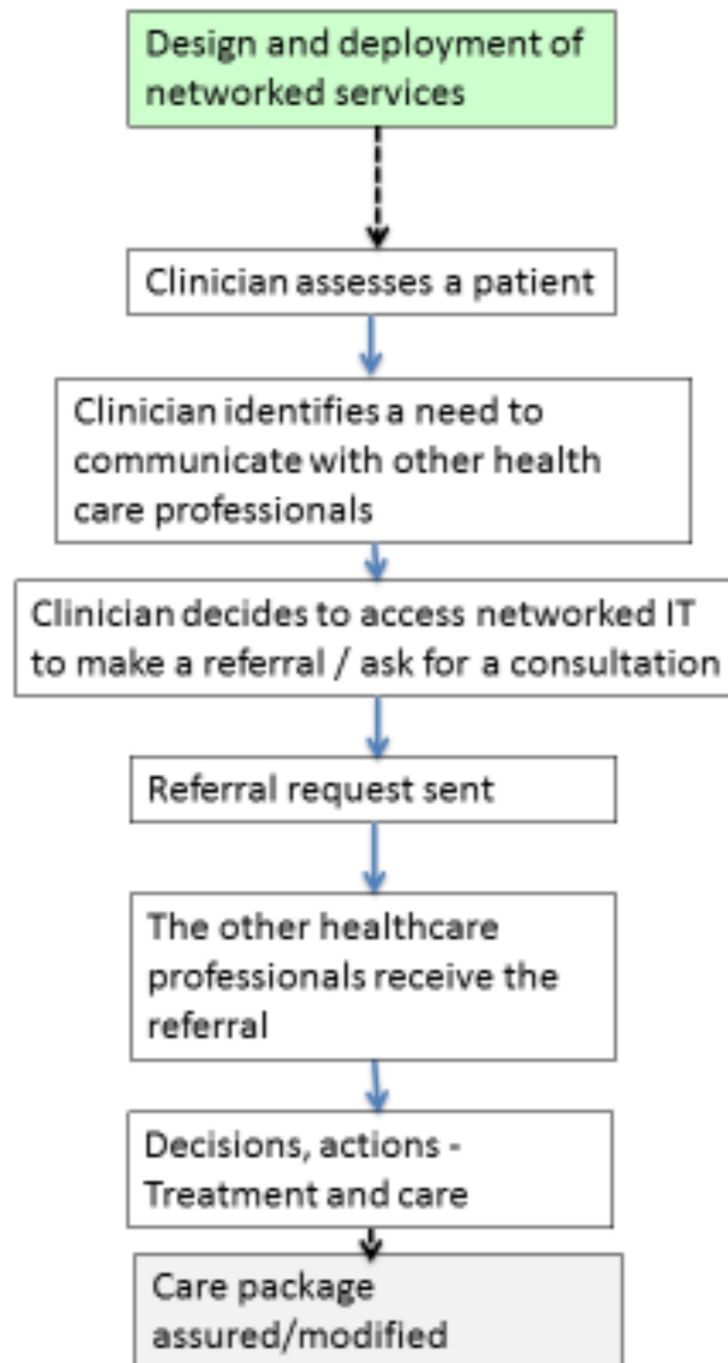
## SafetyNet: Initial Programme Theories

### ACCESS TO INFORMATION

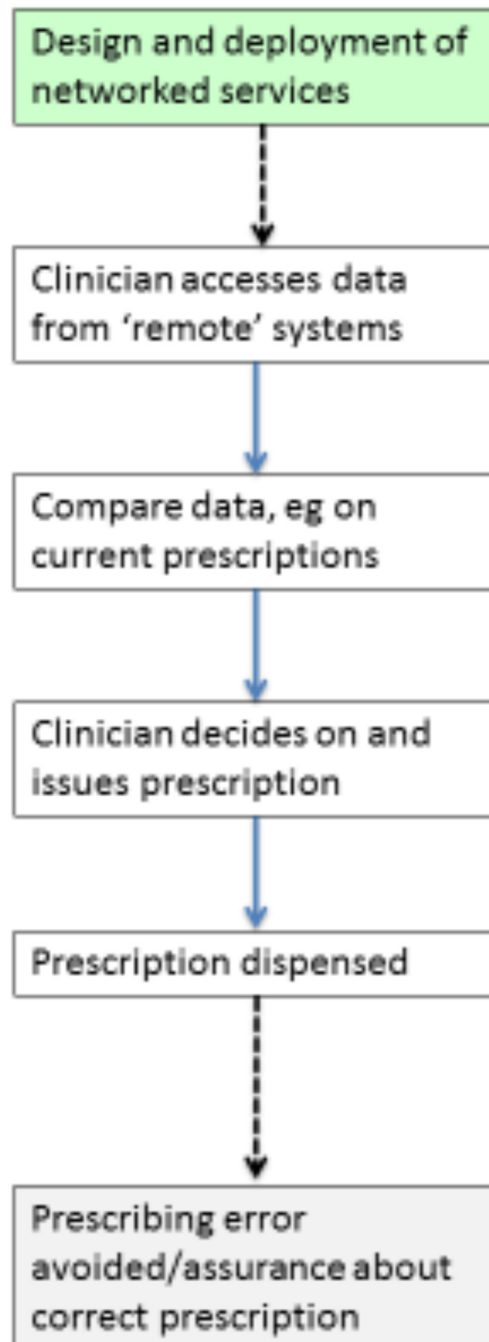


## SafetyNet: Initial Programme Theories

### COMMUNICATION



## RECONCILIATION



# Appendix 3 Feedback paper sent to stakeholders in July 2019

*In confidence*



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## SafetyNet: the effects of interoperable networks on patient safety

### Feedback to stakeholders

#### Background

When we met in June 2018, we asked you for your views on the ways in which interoperable networks might support the delivery of safer treatment and care. Your comments were very helpful, and have substantially shaped our work over the last year. We have now completed our literature review, and would value your comments on our findings. The ways in which you can respond to us, or request more information, are set out at the end of this note.

#### Methods

We have undertaken a systematic literature review, using a method called realist synthesis. As in all realist syntheses, there were two main phases of work. You were part of the first phase. We identified ways in which people – informatics leads, policy makers, leading academics and others – believed that interoperable networks might support safer treatment and care. That is, we were interested in their theories - or their assumptions - about the ways they worked. We used your comments, alongside commentaries in policy documents and articles, to develop a simple ‘model’. This is shown in the diagram below.

In the second phase we undertook literature searches, which were designed to allow us to say whether or not there was evidence to support the model, or indeed evidence that suggested that interoperable networks worked in some other way. The searches focused on evidence about three topics:

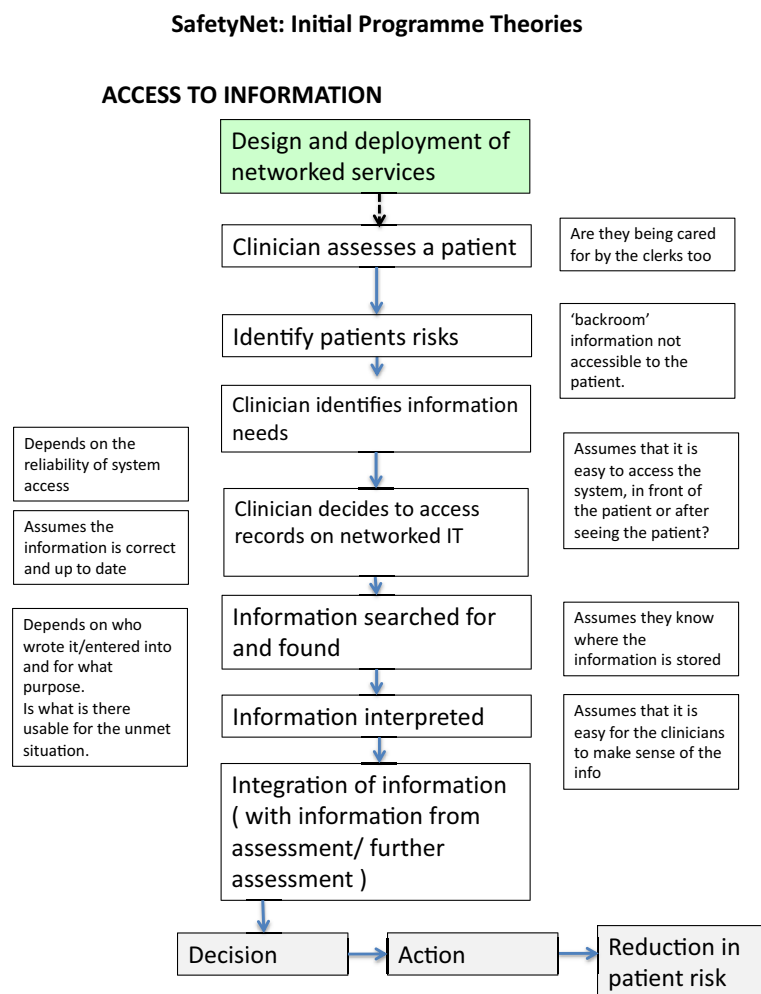
- The co-ordination of services for older people who are living in their own homes, and supported by two or more professionals;
- The reconciliation of medication lists, from different organisations, for older people who are living at home, e.g. people who have just left hospital for home
- Children who are at risk of harm

*In confidence*

For each topic, we searched for evidence about the nature of the problems with services, experiences of using interoperable networks, and changes in patients’ risks associated with the use of networks.

**Results**

The simple model that we developed, and that guided our searches, is in the Figure below. The centre column represents the ideal – a situation where information is seamlessly searched for, found and used by a professional. The columns on either side list issues that might complicate or scupper the ideal.



*In confidence**The co-ordination of services for older people*

We found substantial evidence about the nature and extent of care co-ordination problems. Most of the problems were essentially social or cultural in nature. For example, there were several studies where different healthcare professionals had incompatible beliefs about the kinds of support that older people needed. The problems were attributed to a combination of inter-professional issues – not directly related to technology – as well characteristics of the networks (such as multiple logins) they were using, and the difficulty of locating patient information held on other organisations' servers. We did not find any countervailing studies, which reported 'seamless' use of interoperable networks.

There was limited, and weak, evidence about the effectiveness of interoperable networks in reducing older peoples' risks. The evidence was for networks with limited functionality, typically involving a single application (such as a shared assessment process), and based on the subjective views of users. We did not find any quantitative evidence of effectiveness.

*The co-ordination of medication reconciliation*

Errors in reconciling medication lists, and lists with patients' current medications, are believed to contribute to medication errors, one of the leading causes of adverse events. We found reasonable – rather than extensive - empirical evidence that there is a problem with medication reconciliation. The evidence suggested that the key problem was uncertainty about responsibility for reconciliation on the ground: it was reported to fall between professionals (principally pharmacists, doctors and nurses).

On experiences of using interoperable networks, we found one observational study and seven further 'offline' simulation studies. These focused on the nature of clinicians' cognitive processes when comparing medication lists, and the error rates associated with them. There was less field-based evidence about users' experiences in this domain than in services for older people or child protection services.

There was mixed evidence, of middling quality, about the effectiveness of interoperable networks. Some articles indicated that the use of an interoperable network was associated with a (quantitative) reduction in reconciliation errors. Others reported problems with using systems, resulting in interoperable networks having no effects on reconciliation error rates.

*In confidence*

The variation in the methods and data used mean that it is not possible to combine the results in any useful way.

*Child protection*

The Government is currently promoting the *Child Protection – Information Sharing* programme in England. There is evidence that there are co-ordination problems in child protection services. There is a debate in the academic literature about the nature of those problems. In the context of this synthesis, the key debating point is that some commentators interpret the problems in mechanistic terms – as communication failures – while others argue that the problems reflect more fundamental inter-professional and inter-organisational problems. There is *limited* evidence that users find interoperable networks difficult to use. There is *no* evidence about the effectiveness of interoperable networks in child protection services, defined as a change in childrens' risks of harm.

**Conclusions**

The conclusions from the realist synthesis are that:

- There is good evidence that there are problems with the co-ordination of services in each of the three domains studied;
- There is evidence across the domains that professionals have found interoperable networks difficult to use;
- There is insufficient evidence about the effectiveness of interoperable networks to allow us to establish how and why they affect patient safety.

*Future work*

There are three implications for practice:

- Practitioners, including informatics and information leads, should note the lack of evidence about the effectiveness of interoperable networks, and take steps to monitor the effects of local programmes themselves;
- They should take note of the negative evidence about users' experiences, actively seek to involve users in development programmes, and document and publish requirements and specifications;



*In confidence*

- They should also be aware of the extent to which institutional arrangements, and in particular the challenges of working across professional and organisational boundaries, influence the deployment and use of interoperable networks.

The priorities for future research are:

1. Primary empirical studies of the effectiveness of interoperable networks in health and social care;
2. Primary empirical studies of economies of scope and scale associated with interoperable networks in health and social care;
3. A realist synthesis of evidence about patient's use of digital platforms;
4. More detailed guidance on the design and conduct of realist syntheses, updating current RAMESES guidance.

**Study registration**

The realist synthesis is registered with PROSPERO, number 2017:CRD42017073004

**Funding details**

Funding for this study was provided by the Health Services and Delivery Research programme of the National Institute for Health Research.

**Responding and further information**

We would be very grateful if you could give us your thoughts about these findings. Are they what you expected? Are you surprised by them?

We are happy to receive your comments in any way that is convenient to you – by email ([j.keen@leeds.ac.uk](mailto:j.keen@leeds.ac.uk)), phone or Skype, or in a meeting if you want us to arrange one. We are also happy to provide any further information you would like, including details of our searches and more detailed accounts of our findings.

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# Appendix 4 Interview topic guide



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## Networked Information Technologies and Patient Safety

### Topic guide

1. What do you think of the programme theories in the document we sent you?
2. Are they consistent with your experience as a clinician?
3. If they are, in what ways are they consistent?
4. If they are not, what are the inconsistencies?

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