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Cécile Marie Dupin, G. Borglin

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## **Data integration in mixed- and multiple-methods studies: a systematic review on the methodological framework of ‘following a thread’**

C.M. Dupin RN, MSc, PhD, Assistant Professor, <sup>1</sup> & G. Borglin RN, MSc, PhD, Professor in Nursing <sup>2</sup>

<sup>1</sup> Geneva School of Health Sciences, HES-SO University of Applied Sciences and Arts  
Western Switzerland

<sup>2</sup> Department of Nursing Education, Lovisenberg Diaconal University College, 0456 Oslo,  
Norway

Gunilla Borglin Orcid ID: 0000-0002-7934-6949

### **Corresponding author:**

Cécile-Marie DUPIN (Orcid ID: 0000-0001-6580-6142)

Email: [cecile.DUPIN@univ-amu.fr](mailto:cecile.DUPIN@univ-amu.fr)

## **ABSTRACT**

**Background:** The scope of methodological development and innovation in multi- and mixed methods design is endless and, at times, challenging. The latter is especially true with regards to the integration of data generated through different methods. About a decade ago, Professor Jo Moran-Ellis and her colleagues at the University of Sussex suggested a framework for analytical integration known as “following a thread.” Despite an increased focus within health services research on different perspectives and approaches to successful data integration, the framework’s usability and application have not yet been well described.

**Objectives:** This systematic review aims to integrate and synthesise published accounts of the framework and its applications.

**Design and data sources:** Seven electronic databases were utilised. Included were peer-reviewed scientific papers published in English from 2006–2018. The authors independently screened eligible publications by title and abstract.

**Results:** Thirteen studies were included in our systematic review. One notable finding is that in almost half of the cases ( $n = 6$ ), the framework had been applied as an analytical integration framework in single studies using multiple qualitative methods. Overall, the descriptions and accounts of the framework were sparse and lacked transparency. Accounts of the analytical integration framework could be said to fall within three overarching areas: (1) applications of the framework, (2) justifications for analytical integration, and (3) benefits and shortfalls of the framework.

**Conclusion:** Data integration is often one of the major method steps in multi- and mixed methods designs. To further the future development of methodologically sound frameworks for analytical integration, it is essential that they are sufficiently described so as to ensure validation of the framework’s usability and replicability. “Following a thread” appears to be an promising analytical integration framework, particularly in that it can be applied with the same datatypes as well as between different types of data.

**Keywords:** Analytic integration, Mixed methods research, Moran-Ellis, Multimethod research, Systematic review.

## **Contribution of the paper**

### **What is already known about the topic?**

- Integration of data from different method strands is a core methodological trait of multi- and mixed methods designs.
- Integration of data within multi- and mixed methods designs is still considered a major methodological challenge.
- Thorough and accurate description of the data integration frameworks and/or techniques in use is vital for the development and establishment of relevant and valid analytical integration processes.

### **What this paper adds**

- “Following a thread” shows promise as an analytical integration framework within both multi- and mixed methods designs.
- To further new and underdeveloped data integration frameworks and/or techniques and their methodological accounts requires more detailed and transparent descriptions.
- Despite sparse information, it appears that the framework can be useful both within different types of the same data as well as between different types of datasets.
- Our review of the literature did not, however, identify any studies that had applied the framework to different types of numerical datasets.

## 1. Background

Compared to quantitative and qualitative methods, multi- and mixed methods are relatively new concepts within health-service research. Indeed, within this context, it is fair to suggest that its methods and methodology are still in their infancy (Borglin, 2015), and the scope for methodological development and innovation appears to be vast. One core methodological trait of both these designs is the term *integration*, which can be applied at any point in the research process. Integration is considered intrinsic, but barriers to integration have been identified in both health services and social research (O’Cathain, 2009).

Nevertheless, before further elaboration on the aspect of integration or, more specifically, analytical integration within multi- and mixed method designs, it is important to define the design frame within which the integration is expected to take place. However, to clearly and concisely define multi- and mixed methods studies, we need to take a firm methodological stand. For example, Creswell and Plano Clark (2007) states that the distinction between multi method studies and mixed method studies is that the latter incorporates the collection of *both* qualitative and quantitative data, whilst the first collects *either* quantitative *or* qualitative data. Morse (2003), on the other hand, places the distinction on the *non-integration* versus *integration* of methods used in data collection and analysis. Morse (2003) does not, however, explicitly define mixed methods as a design that incorporates both qualitative and quantitative components but, instead, according to the analytical integration of the datasets. Henceforth in this paper, the terms multi- and mixed method studies and/or design should be understood from the distinctions by Morse (2003).

Taking on a broader perspective on existing methodological debate highlights that in spite of a rising interest in dual methods amongst health services researchers, modest efforts have been made to identify the procedural features of applying these methods (Zhang & Creswell, 2013). According to Maxwell and colleagues (2015), the integration of datasets and their results is intrinsic to both multi- and mixed methods designs but has been for many researchers a difficult goal to achieve. Their sentiment is echoed by Richards et al. (2019), who suggest that researchers might not be aware of existing integration techniques or might not see the value of these, for example, in the context of a randomised controlled trial [RCT]. The process of integrating different datasets is therefore acknowledged by several authors as one of the major challenges with multi- and mixed methods design (Collins & O’Cathain, 2009; O’Cathain, et al., 2010).

Many respond to the challenge of integration by focusing instead on the epistemological issues of combining quantitative and qualitative approaches (Caracelli & Greene, 1993; 1997), often echoing the enduring philosophical and historical tensions that the application of dual methods tends to bring. This is described as the incompatibility thesis (Howe, 1988). Some authors (Uprichard & Dawney, 2019) propose alternative philosophical approaches such as pragmatism or critical realism as a way of resolving some of these tensions. Others simply take a pragmatic approach and propose that answering complex research questions is more important than the chosen method's epistemological departure (O'Cathain et al., 2007; 2009). It is important to note that even others believe that the ability to view the results from separate datasets using different lenses or mental models is more important for integration than the type of paradigm or the type of design (Maxwell et al., 2015)

Setting epistemological issues aside, several strictly theoretical suggestions exist on how to address the challenging question of integration, both in multi- and mixed method studies (Lee & Smith, 2012; Maxwell et al., 2015; O'Cathain et al., 2010; Onwuegbuzie & Teddlie, 2003; Zhang & Creswell, 2013). Despite this, few published papers seem to have taken on the task of offering detailed accounts of the process by which they analysed datasets, nor do they present visual examples of how datasets were or can be integrated (Borglin, 2015). Consequently, very little has been firmly established, and very much is still under debate regarding the process of all levels of integration in multi- and mixed methods studies. This reality leaves the health services researcher with the challenge of integrating, synthesising and understanding numerical- and textual datasets related to the same phenomenon, but which, at times, offers different or contradictory findings. Research conducted within the Medical Research Framework of Complex Interventions (2008) using a mixed methods design helped us to gain insight into the fact that using qualitative studies alongside RCTs can reveal discrepancies between the results of two datasets (Campbell et al., 2003; Moffat et al., 2006; O'Cathain, 2009), such as when people's positive experiences of their health improvements not corresponded with the numbers around improvements in the quantitative datasets (Campbell et al., 2002).

One attractive approach to data integration was put forward by Moran-Ellis and colleagues (2006) and referred to as "following a thread." This technique—a framework for analytical integration—offers the process of integration credibility rather than leaving researchers feeling that they had made things up, and is defined as, "a specific relationship between two

or more methods where the different methods retain their paradigmatic nature but are intermeshed with each other in pursuit of the goal of ‘knowing more’” (Moran-Ellis et al., 2006, p. 51). This framework may encourage researchers to describe their approaches to integration whilst helping them to develop, critique, and improve their technique. Most importantly, it may help researchers to gain deeper understanding from their research (O’Cathain et al., 2010). This technique shows promise for data integration, which occurs when researchers merge two datasets for analysis and for comparison. The value of the framework lies in allowing both a deductive (i.e., testing existing theories) and an inductive analysis (i.e., generating new theories) analysis by upholding the value of the open, exploratory qualitative inquiry whilst integrating the particularities and focus of the quantitative data (Moran-Ellis et al., 2006).

The aim of the proposed analytical framework is to create a constellation of data which can be used to generate a multi-faceted picture of the phenomenon under investigation. The technique was described by Moran-Ellis and colleagues (2006) as consisting of four key steps: (1) The dataset from each method strand is analysed separately, using an analytical method appropriate to that specific dataset within its paradigmatic parameters and emergent findings. The initial analysis aims to identify key themes, categories, or analytical questions requiring further exploration. (2) Depart from the literature and the original research when a particular finding e.g., if an analytical question or a theme from one of the datasets appears promising, it is picked up as a thread to be followed into other method strand datasets. The identification of a promising emergent finding may be sparked by the relationship between it and the overarching research question, or by its resonance with one or more of the other datasets. Whatever the source, a leader in the analysis is established. Grounded in an inductive and/or a deductive approach, this can then be developed through an iterative interrogation of all the datasets. (3) Follow the thread across the other datasets to create a pattern of findings. Categories, codes, and emergent findings identified through the cross-dataset focused iterations are juxtaposed to create a data repertoire. This repertoire is then further analysed to refine and extend the analysis. (4) Finally, the findings from the thread can be synthesised with other threads and analysed with the aim of interweaving the findings that emerged from each dataset, each of which having been picked up in a similar way (Moran-Ellis, et al., 2006).

Some years after the introduction of the framework, Cronin et al. (2008) debated the different ways in which data and methods could be brought together, especially when one design brings together different textual datasets as what happens in multimethod studies. As a result, the issues involved when using mixed methods in a single study were, at that point, left aside. Drawing on data from one of their own research projects, the authors examined the subjects involved when applying an analytical integration to different types of textual datasets i.e., in-depth interviews, narrative interviews, and photo-elicited interviews. Cronin and colleagues (2008) focused particularly on the process of achieving integration across the datasets during the phase of analysis whilst applying their proposed framework, following a thread. They concluded that the application of the framework ensured the preservation of each dataset's integrity and maintained each set's epistemological contribution to the analysis, and they stated that the application of following a thread offered an opportunity to achieve "the generation of an overall analysis which is greater than the sum of the (methodological) parts" (Cronin et al., 2008, p. 584).

In summary, the integration of data from different method strands or within strands is a core methodological trait of multi- and mixed methods designs but is still considered a major methodological challenge. To move forward, a thorough and accurate description of those data integration frameworks and/or techniques in use is vital for the establishment of relevant and valid integration techniques. Moreover, the potential for analytical integration to contribute to generalisable knowledge cannot be realised if the integration is poorly conceived or executed without recognition of the complexity of the task (cf. Richards et al., 2019). Since Moran-Ellis and colleagues had put forward their data framework more than a decade ago, the framework's usability and application have not yet been extensively described. This systematic literature review, therefore, aims at integrating and synthesising published accounts of the framework and its application in published research to date.

## **2. Review objects and questions**

To be able to gain a methodological understanding of the development and application of the technique within health services research, we posed these three questions in respect of the literature under consideration:

1. How is the framework described and applied?
2. What are the reasons given for having applied the framework?
3. What are the described benefits and shortfalls of applying the framework?

### **3. Method**

Established methods for systematic reviews (Centre for Reviews and Dissemination, 2009; The Cochrane Collaboration, 2011) were used to identify eligible studies. We adopted a narrow methodological focus rather than a comprehensive account of a particular research topic (McCrae & Purssell, 2016). The PRISMA-P checklist (Moher et al., 2009) guided the development of this study. An *a priori* protocol was developed based on the PRISMA-P but was not published or registered publicly as registering via PROSPERO requires a clinical domain focus.

#### **3.1 Search strategy**

To ensure a comprehensive search strategy, seven electronic databases of references (PubMed, CINAHL, Psych INFO, Cochrane Library, Web of Science, Johanna Briggs Institute (JBI), British Nursing Index, and BDSF (in French) were systematically searched for studies published between January 1, 2006 (the year Moran-Ellis and colleagues' seminal paper was published) and December 31, 2018. It was decided to limit the review to published peer-reviewed papers. We searched JBI and Cochrane assuming that the framework could be mentioned in published evidence syntheses. Additional manual searches on Google Scholar using forward tracking and searching for papers citing potentially eligible studies and backward tracking in the included studies' reference lists were also applied. The search phrase "Moran-Ellis" was used to search anywhere in the manuscript so as not to limit our searches to title and abstract, and hence fail to identify relevant studies. The first author (CD) conducted these searches.

#### **3.2 Selection of studies**

Studies were included if they (1) were in English, French, or Swedish, (2) were published in a peer-reviewed journal, (3) were published between January 1, 2006, and December 31, 2018, (4) reported primary research, (5) cited, quoted, or reported the 2006 paper by Moran-Ellis and colleagues, and (6) reported applying the technique. Both authors were involved in the selection process independently from each other, and any divergent judgements were solved through discussion.

### **3.3 Data extraction**

The included studies ( $n = 13$ ) underwent a thorough reading before the data extraction was performed. The authors (CD, GB) independently reviewed and extracted the relevant data. Divergent judgements were handled through discussion to reach a consensus. A data extraction protocol was developed and tested on five of the studies by the first author (CD), and accordingly revised thereafter in a joint effort by both authors.

### **3.4 Study quality appraisal**

Included studies were independently assessed by both authors for methodological quality using the mixed methods appraisal tool (MMAT) (Pluye & Hong, 2014). The 2018 version of the MMAT enables reviewers to critically appraise the methodology of a range of designs as it offers appraisal criteria for each method. Disagreements between the authors were again resolved through discussion. Studies were not excluded based on quality assessment as there is little empirical evidence on which to base exclusion decisions in systematic reviews of mixed studies. Instead, it was decided to report on the quality of the included studies.

### **3.5 Data analysis and synthesis**

The data extracted, i.e., text addressing our review questions (reflecting descriptions and accounts of the framework) were cut and pasted into a Word document for the subsequent synthesis. Data was then organised and integrated with the aim being to present a descriptive narrative synthesis. Our intent was to identify and bring together the main, recurrent, or most important issues arising from the body of literature. The themes identified were shaped by the specific review questions (Mays et al., 2005). Thus, both authors engaged in multiple readings of the extracted texts with the particular focus of identifying aspects that addressed our systematic review questions, i.e., accounts reflecting the framework following a thread.

The authors engaged in ongoing, iterative discussions to deepen and extend the integration and syntheses produced. Given that this systematic review addressed how the framework of following a thread had been employed, we extracted data from the included studies' results or findings but focused specifically on the studies' methodological accounts of the framework. Our descriptive narrative will be presented under the following headings: (1) applications of the framework, (2) justification of the analytical integration, (3) described benefits and shortfalls of the framework.

### **3.6 Rigour**

To maintain rigour, we adopted a systematic, transparent approach to the systematic review, and we attempted to use a form of narrative synthesis to generate new insights. The researchers engaged in regular discussions during the entire process to ensure transparency and plausibility.

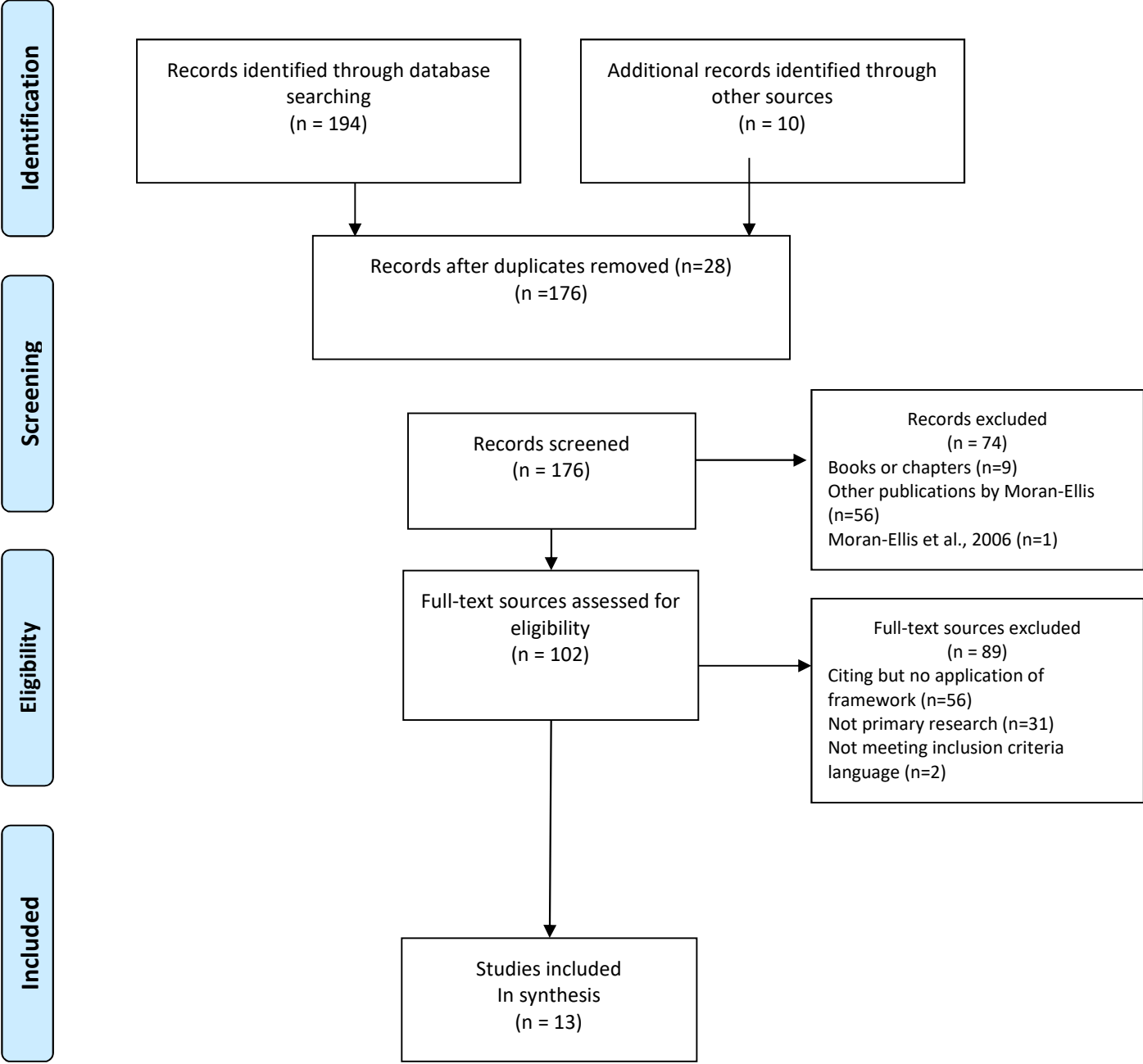
## **4. Results**

### **4.1 Studies included**

In total, 194 studies were identified from the electronic searches, whilst a further 10 studies were identified through manual searching of reference lists, resulting in 204 identified studies. After having checked for duplicates ( $n = 28$ ), 176 studies remained eligible for screening by title and abstract. Based on our inclusion criteria, 74 records were excluded at this stage, leaving 102 studies for full-text reading. After careful reading, a further 89 studies were excluded, resulting in only 13 studies to be included in this systematic review (Figure 1).

----- Insert Figure 1 about here -----

Figure 1. PRISMA flow diagram



The 13 studies included in this systematic review represented five countries: the United Kingdom ( $n = 8$ ), Norway ( $n = 1$ ), Iceland ( $n = 1$ ), Canada ( $n = 2$ ), and the United States of America ( $n = 1$ ). Within the frame of one single study, seven studies had applied a mixed methods design, and six studies had applied a multimethod design. The following areas were covered in these studies: health services research ( $n = 7$ ), humanities research ( $n = 3$ ), public health research ( $n = 1$ ), clinical research ( $n = 1$ ), and medical education research ( $n = 1$ ). Our quality appraisal was conducted using MMAT (Pluye & Hong, 2014), as the majority ( $n = 12$ ) of the studies had addressed at least four of the five areas appraised by the tool. MMAT results indicated high methodological quality for the qualitative study designs, with six studies scoring five out of five points and one study scoring three out of five points. Four of the studies with a mixed methods design scored four out of five points and the remaining three scored five out of five points (Table 1 and Table 2).

**-----Insert Table 1 and Table 2 about here -----**

**Table 1.** Quality appraisal of included mixed method studies

		Study no/author/ year							
		S7. Brennan et al., 2012	S16. Goodman et al., 2012	S22. King et al., 2014	S25. Morrow et al., 2014	S26. Soo et al.,2015	S27. Klinke et al., 2016	S.30 Kinley et al., 2018	
<i>Screenings questions</i>	Are there clear research questions?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
	Do the collected data allow to address the research questions?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Qs1: Qualitative strand	1.1. Is the qualitative approach appropriate to answer the research question?	✓	✓	✓	✓	✓	✓	✓	
	1.2. Are the qualitative data collection methods adequate to address the research question?	✓	✓	✓	✓	✓	✓	✓	
	1.3. Are the findings adequately derived from the data?	✓	✓	✓	✓		✓	✓	
	1.4. Is the interpretation of results sufficiently substantiated by data?		✓	✓			✓	✓	
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?	✓	✓	✓	✓	✓	✓	✓	
Qs4: Quantitative strand	4.1. Is the sampling strategy relevant to address the research question?	✓	✓	✓	✓	✓	✓	✓	
	4.2. Is the sample representative of the target population?	✓	✓	✓	✓	✓		✓	
	4.3. Are the measurements appropriate?	✓	✓	✓	✓	✓	✓	✓	
	4.4. Is the risk of nonresponse bias low?		✓	✓				✓	
	4.5. Is the statistical analysis appropriate to answer the research question?	✓	✓	✓	✓		✓	✓	
Qs5: Mixed- method	5.1. Is there an adequate rationale for using a mixed method design to address the research question?		✓	✓				✓	
	5.2. Are the different components of the study effectively integrated to answer the research question?	✓	✓	✓	✓	✓	✓	✓	
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	✓	✓	✓	✓	✓	✓	✓	
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	✓	✓	✓	✓	✓	✓	✓	
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	✓	✓	✓	✓		✓	✓	
<b>Score:</b>		12	15	15	12	9	12	15	

**Table 2.** Quality appraisal of included multimethod studies

		Study no/author/ year						
		S8. Broad, 2015	S11. Descartes, 2007	S13. Eggebó, 2012	S14. Gibson et al., 2012	S15. Gibson et al., 2010	S29. Gove et al., 2017	
<i>Screenings questions</i>	Are there clear research questions?	Yes	Yes	Yes	Yes	Yes	Yes	
	Do the collected data allow to address the research questions?	Yes	Yes	Yes	Yes	Yes	Yes	
Questions: Qualitative strand	1.1. Is the qualitative approach appropriate to answer the research question?	Yes	Yes	Yes	Yes	Yes	Yes	
	1.2. Are the qualitative data collection methods adequate to address the research question?	Yes	Yes	Yes	Yes	Yes	Yes	
	1.3. Are the findings adequately derived from the data?	Yes	Yes	Yes	Yes	Yes	Yes	
	1.4. Is the interpretation of results sufficiently substantiated by data?	No	Yes	No	Yes	Yes	Yes	
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?	Yes	Yes	No	Yes	Yes	Yes	
<b>Score:</b>		4	5	3	5	5	5	

## 4.2 Applications of the framework

### 4.2.1 Mixed methods studies

Seven of the 13 studies had applied a mixed methods design (Brennan et al., 2012; Godman et al., 2012; King et al., 2014; Morrow et al., 2014; Soo et al., 2015; Klinke et al., 2016; Kinley et al., 2018). Four of these employed a convergent mixed methods design (King et al., 2014; Morrow et al., 2014; Soo et al., 2015; Kinley et al., 2018), and two applied a concurrent mixed methods design (Godman et al. 2012; Klinke et al., 2016), whilst the final study applied a sequential mixed methods design (Brennan et al., 2012).

#### *Origin of data*

The origin of data used for integration varied. For example, textual data was collected through a variety of interview types such as semi-structured interviews (Brennan et al., 2010; Godman et al., 2012; Kinley et al., 2018), electronic and face-to-face interviews (King et al., 2014), interviews (Morrow et al., 2014), qualitative interviews (Soo et al., 2015), and self-written narrative reflections (Klinke et al., 2016). In two studies, qualitative data was also collected through observations (King et al., 2014; Klinke et al., 2016), whilst one study collected additional qualitative data with the help of activity logs (Kinley et al., 2018). Numerical data were mainly described as originating from self-reported questionnaires (Godman et al., 2012; King et al., 2014; Morrow et al., 2014; Soo et al., 2015; Kinley et al., 2018) or from standardised measures (Brennan et al., 2012; Klinke et al., 2016). Some of the studies collected both textual and numerical data at more than one point in time (Brennan et al., 2012; King et al., 2014; Morrow et al., 2014; Klinke et al., 2016). No substantial rationale could be identified in the description of their design for the use of repeated data collection points.

#### *Data treatment*

Naturally, how the collected textual data was treated differed, and in four of the mixed methods studies qualitative data analysis software (i.e., NVivo, Atlas.ti<sup>®</sup>, and the Soft System Methodology (SSM) mnemonic CATWOE) was used in the described textual analysis (Brennan et al., 2010; Godman et al., 2012; Morrow et al., 2014; Kinley et al., 2018). The most commonly utilised textual analysis was varying types of thematic analysis (King et al., 2014; Morrow et al., 2014; Soo et al., 2015). However, one study (Soo et al., 2015) offered an account of an initial analysis process in which they searched for emerging themes and conceptual categories, only proceeding with a content analysis of their transcribed data

material later. The remaining studies described having used a single textual analysis such as constant comparison (Brennan et al., 2012), content analysis (Klinke et al., 2016), or template analysis (Kinley et al., 2018). In a majority of cases, the quantitative method strands mainly offered descriptive numerical data such as frequencies, scores, mean scores, and standard deviations (Brenna et al., 2012; King et al., 2014; Soo et al., 2015; Kinley et al., 2018). However, in three of the studies, the numerical data collected was described as having been analysed with the support of a hierarchical series of regression models (Godman et al., 2012), multivariate logistic regression models (Morrow et al., 2014), and non-parametric statistics (Klinke et al., 2016).

#### *Descriptions of following a thread*

Throughout the seven mixed methods studies, the details offered in their descriptions of analytical integration (i.e., following a thread) ranged from some detailed and relatively transparent accounts (King et al., 2014; Klinke et al., 2016) to more or less non-existent accounts of the framework, with an emphasis on the latter (Brennan et al., 2010; Godman et al., 2012; Morrow et al., 2014; Soo et al., 2015; Kinley et al., 2018).

Some commonalities were found in the studies' description of following a thread, which could be interpreted as meaning that they had all clearly utilised two phases in the process of analysis. In a majority of the studies, the first phase always described how textual and numerical data were analysed separately (Brennan et al., 2010; Godman et al., 2012; King et al., 2014; Morrow et al., 2014; Soo et al., 2015; Kinley et al., 2018). However, the studies differed in their descriptions of the second phase. Some studies simply gave accounts of checking emerging themes from the qualitative data strand against participants' individual numerical responses, i.e., checking within individual cases (Brennan et al., 2010), or of comparing analysed textual and numerical data for differing and/or consistent themes (Soo et al., 2015). Others described how they followed a thread (Godman et al., 2012) or followed emerging concepts (Kinley et al., 2018) from the textual data into the numerical data.

The opposite approach was also found, i.e., key areas identified in the numerical data being used to structure a back-and-forth process in which the numerical and textual analyses informed each other (Morrow et al., 2014). Only two out of the seven studies offered a more detailed account of their analytical integration process, i.e., how textual and numerical data were brought together by following a thread (King et al., 2014; Klinke et al., 2016). Both

studies described how they had rigorously combined their textual and numerical data through the use of a mixed methods matrix. One of these studies (King et al., 2014) described how data was first combined and analysed, leading to the development of integrated themes. These themes were then incorporated in a subsequent step of analysis that looked at how the data interacted, which was described as following a thread. Meanwhile, the other study (Klinke et al., 2016) described how the findings from both method strands were individually summarised and then compared whilst searching for discrepant and consistent themes (Table 3).

**----- Insert Table 3 about here -----**

**Table 3.** Overview of extracted data from the included mixed method studies (n=7)

Studies & areas:	Applications of the framework	Justification of the framework	Benefits and shortfalls of the framework
<p>S7. Brennan et al., 2012. Health Service Research</p>	<p>“Using the analytic approach of ‘following a thread’ (Moran-Ellis et al., 2006), results from the standardised measures informed the development of theoretical insights into the qualitative data; interesting findings from the quantitative measures were added to the qualitative analysis through memo writing, and emerging themes were tested using case studies of individual participant responses to the quantitative measures. Results are presented together with the responses to the standardised measures intertwined with the grounded theory analysis where they clarify the themes” (p. 818).</p>	<p>“The mixed methods approach adopted in this research integrated the data in the phase of analysis (Moran-Ellis et al. 2006). Once the phase of data collection was complete, the data were conceptually positioned alongside, and each data source was analysed in order to identify key themes (Moran-Ellis et al. 2006). The themes identified within each data type were followed, and this cross-referencing was used to create a theme-map with the aim of interlinking the findings as they emerged from each data set” (p.1062).</p>	<p>“Although the integration of quantitative data with the qualitative analysis is the strength of this study, the findings from the standardised measures serve only to situate the included cohort of siblings. Reference has been made to normative scores for the included measures but this study did not include a comparison group of siblings of children without illness” (p. 822).</p> <p>“The strengths of this approach allow ‘an inductive lead to the analysis, preserving the value of the open, exploratory, qualitative inquiry but incorporating the focus and specificity of the quantitative data’ (Moran-Ellis et al. 2006: 54)” (p.1062).</p>
<p>S16. Goodman et al., 2012. Health Service Research</p>	<p>“We pursued our qualitative and quantitative research components in parallel [a concurrent mixed-method design], aiming to integrate these research strands when designing our methods, analysing our data, and interpreting our results. In the methods stage, this integration involved using initial qualitative findings to design our conceptual model for statistical analysis and to suggest additional lines of enquiry. At the analysis stage this involved pursuing key themes between datasets, an approach described by Moran-Ellis et al. (2006) as following a thread” (p.1931).</p>	<p>“We thereby attempted to achieve a ‘genuinely integrated ‘mixed-method study, allowing our quantitative and qualitative findings to talk to each other and construct a negotiated account of what they mean together (Bryman, 2007: 21)” (p. 1931).</p>	<p>To address this aim by integrating qualitative and quantitative data, seeking thereby to strengthen our inferences and expand the scope of our research” (p.1930).</p>
<p>S22. King et al., 2014. Health Service Research</p>	<p>“We engaged in data transformation using two techniques: “following a thread” and the “mixed methods matrix”. We engaged in these two techniques in a fluid manner, going back and forth over a series of meetings from a more macro approach (following a thread) to a more micro approach (mixed methods matrix). We were looking for evidence of big picture themes within individual case analyses, and also at how the individual case analyses informed the big picture themes. In an iterative and fluid manner, an integrated interpretation of the data was generated, in the form of integrated themes combining the richness and insights provided by the quantitative and qualitative data, considered together” (p.1629).</p> <p>“We adopted what Hanson et al. describe as a “concurrent triangulation” approach, in which quantitative and qualitative data were collected at the same time, with equal weight given to each. Unlike mixed methods designs that only integrate qualitative and quantitative findings post data collection and analysis, we engaged in integration throughout the research process [20], including at the level of the research design and during data collection, analysis and interpretation. For example, data collection procedures were changed to ensure that questions for the final interview captured the emerging SEAS constructs, and the SEAS administration was changed to ensure youth understanding, based on qualitative observations. Of most relevance to this article, the data were combined and analysed together during the data analysis stage, leading to the development of integrated themes” (p.1627).</p>	<p>“In following a thread, data are initially analysed following the qualitative and quantitative lines of inquiry, and the overarching themes and questions that emerge are then incorporated into a secondary analysis to look at how the data interact; In contrast, the mixed methods matrix approach provides a comprehensive picture of each individual’s experience in a particular activity setting, by examining both qualitative and quantitative data on a case-by-case basis” (p.1627).</p> <p>“It is important for researchers to explicitly state their rationale and theoretical approach to mixed methods research [24]. We took the view that the complexity of understanding youth’s participatory experiences requires multiple methods for fuller exploration [25]. To maintain epistemological congruency [26], we adopted a descriptive exploratory approach for the overarching study [21], which guided both qualitative and quantitative methodologies. Although the SEAS and qualitative data for each participant were collected simultaneously, the SEAS data described the participant’s experience at that specific time, while the qualitative data explored experiences in greater detail, both in the activity setting and other activity settings in general. The combination of qualitative and quantitative approaches in our study provides” (p.1627)</p>	<p>“The process of integrated data analysis is outlined in Figure 1. The top half of the figure shows the initial separate analyses of quantitative and qualitative data, with the findings subsequently used to identify ‘threads’ for the integrated analysis. As shown in the figure box labelled ‘integrated analysis’, we conducted a cross case analysis by following these threads, in which both the overall quantitative findings and overall qualitative themes were used to query the case-by-case data. The common themes that arose were reviewed for applicability to the individual cases” (p.1629).</p> <p>“Our study indicates that quantitative tools can help to situate qualitative data, whereas qualitative approaches can “animate” quantitative data (i.e. help to interpret, provide broader perspectives, and illuminate assumptions). The combined use of both methods can generate specific, novel and in-depth knowledge about a topic of inquiry, as shown in the present findings. We obtained a deeper understanding of the results, which assisted in identifying questions for further research” (p.1633)</p>

**Table 3.** Continued; overview of extracted data from the included mixed method studies (n=7)

<b>Studies &amp; areas:</b>	<b>Applications of the framework</b>	<b>Justification of the framework</b>	<b>Benefits and shortfalls of the framework</b>
<b>S25.</b> Morrow et al., 2014. <i>Public Health</i>	<i>“For this article, an iterative approach is used to integrate survey and qualitative analysis and interpretation (Moran-Ellis et al.). After an initial analysis of both data sets separately, key areas where adolescents reported injuries were identified from the survey” (p.69).</i>	<i>“The key areas broadly structured a two-way process whereby survey and qualitative analysis informed each other, to acquire a deeper understanding of socio-demographic risk factors and potential long-term health consequences injuries within the living contexts of the adolescents” (p.69).</i>	<i>“Both components make equal and independent contributions to the understanding of the realities of adolescent injuries, in an attempt to integrate the methods and not merely combine them” (Greene et al., 1989; Clarke, 2003) (p.69).</i>
<b>S26.</b> Soo et al., 2015. <i>Medical Education</i>	<i>A mixed methods approach was used in the analysis. This combined approach included thematic analysis of student narratives and a 19-item questionnaire both of which are discussed in detail below. Results from the thematic analysis of narratives and the questionnaires were each individually summarized and then compared by all four authors looking for both discrepant and consistent themes. In keeping with a following a thread method (Moran-Ellis et al. 2006)” (p.144).</i>	No data available answering the review question.	<i>“The mixed methods approach with questionnaire and thematic analysis of the written narratives demonstrates similar findings, indicating that the additional questionnaire responses would be unlikely to alter the conclusions of this study” (p.157).</i>
<b>S27.</b> Klinke et al., 2016. <i>Clinical Research</i>	<i>“Connection of the quantitative and qualitative data took place during data analysis by (1) presenting data in a mixing matrix which enabled a comprehensive overview of individual cases, and (2) ‘following threads’ to build a connection between the quantitative and qualitative datasets” (p.2434).</i>	<i>“A mixed method complementary approach was used, which is ideally suited when exploring neglect from multiple perspectives. The collection of quantitative and qualitative data took place concurrently and the data were merged during interpretation. In combining the data, equal weight was attached to quantitative and qualitative elements” (p.2431)</i>	<i>By using a mixed method design we were able to link contextual and unique encounters of neglect and to gauge the clinical usefulness of conventional neglect measurement. The use of this method had an additional, unexpected benefit in emphasizing the value and necessity of combining quantitative and qualitative strategies when evaluating neglect in the chronic stages following a stroke” (p.2441).</i>
<b>S30.</b> Kinley et al., 2018. <i>Health Service Research</i>	<i>“The quantitative data were analysed first, followed by the qualitative data. Integrating the total data set then occurred through ‘following a thread’ (Moran-Ellis et al., 2006). Any additional concepts emerging from the qualitative data were followed back within the quantitative data, the intention being to generate further knowledge by looking for evidence of resonance across findings (Moran-Ellis et al., 2006). The facilitator-specific data emerging from the initial data analysis is reported here” (p.4).</i>	<i>“A mixed-methods study was undertaken owing to the complex nature of the research focus (Farquhar et al., 2011; 2013), the need to ensure fidelity and enable complementarity” (Denzin, 1970). (p.2).</i>	<i>“Undertaking a mixed-methods study alongside the CRCT enabled that aspect of the implementation of the intervention to be explored” (p.2).</i>

#### 4.2.2 Multimethod studies

The remaining six studies included in this review applied different qualitative methods within a single study design (Broad, 2015; Descartes, 2007; Eggebö, 2012; Gibson et al., 2010; Gibson et al., 2012, Gove et al., 2017). Two of these studies were guided by an explicit set of philosophical assumptions with classic designs such as grounded theory (Broad, 2015) and ethnography (Descartes, 2007). The remaining studies could be categorised as having utilised a generic qualitative design (Gibson et al., 2010; Gibson et al., 2012) including short term fieldwork (Eggebö, 2012) and secondary analyses (i.e., the re-analysis of qualitative data already collected in a previous study) (Gove et al., 2017).

##### *Origin of data*

The origin of data used for integration also varied within the six multimethod studies. For example, textual data was collected through a variety of procedures, i.e., individual interviews and focus groups (Descartes, 2007), interviews and observational field notes from practice meetings (Eggebö, 2012), and semi-structured telephone interviews (Gove et al., 2017). Three of the studies collected three or more different types of data. In these instances, data could consist of interviews, pre-sentence reports, or quantitative risk assessments (Broad, 2015). Others described a variety of techniques collected concurrently, including play and puppets, the draw and write method together with interviews, and an activity day (Gibson et al., 2010). One study used visual storytelling techniques, as well as scrapbook and diaries containing drawings and photos as interview stimuli, field notes, and in-depth interviews with parents, and reflective interviews with children (Gibson et al., 2012).

##### *Data treatment*

The most common analysis amongst the qualitative designs was some type of thematic analysis (Broad, 2015; Gibson et al., 2010; Gibson et al., 2012), whilst one study positioned data within an analytical grounded theory framework (Broad, 2015). Two studies described having utilised an analytical approach similar to Moran-Ellis and colleagues' description (2006) of following a thread (Descartes, 2007; Eggebö, 2012). These latter two did not describe any other qualitative data analysis techniques. One study conducted a secondary analysis, i.e., a framework analysis including a manifest and latent content analysis (Gove et al., 2017). As expected, all data were tape-recorded and transcribed before the analysis was conducted.

### *Descriptions of following a thread*

Throughout the six qualitative studies, the descriptions of the following a thread ranged from some detailed and relatively transparent accounts (Broad, 2015, Gibson et al., 2012) to more sparse accounts of how the framework had been applied (Descartes, 2007; Eggebö, 2012; Gibson et al., 2010; Gove et al., 2017). For example, Gove et al. (2017) described it as conducting the analysis by using an analytical question, i.e., following a thread, which offered support for the researchers constructing a coding framework to be analysed for latent and manifest content.

The two studies (Broad, 2015; Gibson et al., 2012) that were deemed to offer a more detailed account of their application of the framework also described a type of a two-step analysis process similar to the process described earlier for mixed methods studies. In one of these studies (Broad, 2015), each data source was first described so as to be conceptually positioned alongside the others in order to identify key themes. These were then cross-referenced and a theme map was created with the aim of interlinking findings as they emerged, i.e., following a thread. In the first step of the study by Gibson et al. (2012), the thematic analysis was done in dyads (parents and children) to develop a coding framework and themes. In the second step, all datasets underwent a process of integrated analysis, allowing the researchers to follow threads and seek out differences and similarities. A 2010 study by Gibson et al. also offered some brief accounts of a two-step analysis process. Here, the researchers first created and examined codes, themes, and categories before elaborating on key themes and exploring changes in need and preferences as a thread across all themes through the process of iterative integration.

Two studies (Descartes, 2007; Eggebö, 2012) described having analysed data solely by following a thread and offered two different accounts of the process. **In the first** (Descartes, 2007), the authors described how categorised data from the interviews had been compared with data from focus groups and field notes. However, neither the process of categorising interview data nor the analysis of focus group data or field note data were described (Descartes, 2007). In the second (Eggebö, 2012), the authors described how they first searched for different themes and topics in the interviews, and then went on to analyse the field notes by picking up the themes found in the interviews and following those threads (Table 4).

----- **Insert Table 4 about here** -----

**Table 4.** Overview of extracted data from the included multimethod studies (n=6)

Studies & areas:	Applications of the framework	Justification of the framework	Benefits and shortfalls of the framework
<p>S8. Broad, 2015. Humanities Research</p>	<p><i>“Once the phase of data collection was complete, the data were conceptually positioned alongside, and each data source was analysed in order to identify key themes (Moran-Ellis et al. 2006). The themes identified within each data type were followed, and this cross-referencing was used to create a theme-map with the aim of interlinking the findings as they emerged from each data set” (p.1062).</i></p>	<p>No data available answering the review question.</p>	<p><i>The strengths of this approach allow ‘an inductive lead to the analysis, preserving the value of the open, exploratory, qualitative inquiry but incorporating the focus and specificity of the quantitative data’ (Moran-Ellis et al. 2006: 54) (p.1062).</i></p>
<p>S11. Descartes, 2007. Humanities Research</p>	<p><i>“Each method we used provided different kinds of information that contributed to our final analyses. Our analytic approach was similar to that of Moran-Ellis et al. (2006), who also had multiple data sets generated via several methods. They called their strategy “following a thread”: “We picked an analytic question or theme in one dataset and followed it across the others (the thread) to create a constellation of findings which can be used to generate a multi-faceted picture of the phenomenon” (p. 54).</i></p>	<p><i>“This use of ethnography to augment quantitative data can be labelled a combination of methods (Moran-Ellis et al., 2006). Ethnography also can be integrated with quantitative methods. Here, different methods “are given equal weight, and are orientated to a common goal or research question and are, therefore, necessarily interdependent” (Moran-Ellis et al., 2006, p. 52). Moran-Ellis et al. (2006) cited Kelle (2001) as an example of integration. Kelle used quantitative data to provide evidence of structurally based gender bias in a workplace and a linked set of qualitative data to show how the discrimination operated at the individual level” (p. 23 -24).</i></p> <p><i>The ethnographic research discussed previously sought to explain the phenomena under study through giving on-the-ground perspectives and in so doing, generated hypotheses and theories about family processes in specific environmental and cultural contexts. Most were not integrated methodologically, where, as defined by Moran-Ellis et al. (2006), that would indicate two methods being given roughly equal emphasis in the research process” (p.26).</i></p> <p><i>“Our final analysis of how research participants listened to and interpreted Dr. Laura drew on information from the individual interviews, focus group interviews, and ethnographic observation, weaving them together to provide the type of multifaceted picture described by Moran-Ellis et al. (2006)” (p.30).</i></p>	<p><i>“This use of ethnography to augment quantitative data can be labeled a combination of methods (Moran-Ellis et al., 2006). Ethnography also can be integrated with quantitative methods. Here, different methods are given equal weight, and are orientated to a common goal or research question and are, therefore, necessarily interdependent” (Moran-Ellis et al., 2006). (p. 52).</i></p>
<p>S13. Eggebö, 2012. Humanities Research</p>	<p><i>“The analytical focus was developed through the process of data analysis. Analysing the different types of data, I used a strategy resembling what Moran-Ellis et al. (2006) have described as ‘following a thread’: I worked inductively, searching for different themes and topics across interviews, and emotions and ethics appeared to be one common concern. Then, analysing the field notes, I picked up these themes from the interviews, and followed this ‘thread’ “(p.306).</i></p>	<p><i>In order to ‘create a constellation of findings which can be used to generate a multi-faceted picture of the phenomenon’ (Moran-Ellis et al., 2006: 54)” (p.306).</i></p>	<p><i>“The research design did not include a specific focus on ethics, emotions and emotional management. Rather, this analytical focus was developed through the process of data analysis” (p.306).</i></p>

**Table 4.** Continued; Overview of extracted data from the included multimethod studies (n=6)

Studies & areas:	Applications of the framework	Justification of the framework	Benefits and shortfalls of the framework
<p><b>S14.</b> Gibson et al., 2012. Health Service Research</p>	<p><i>“The coding process followed 2 stages: open and focused coding, with data analysis undertaken independently by the 3 researchers. They read scrapbooks/diaries and interview transcripts to become familiar with the range, depth, and diversity of data. Transcripts were analyzed individually and in pairs (child and parent), and notes were made on significant points. Codes were attached to segments of data by each researcher, and a summary of what the child/parent was describing was noted. A coding framework was developed through team analysis and used to recode each of the transcripts using focused coding. The codes were discussed and refined and used to generate themes. The discussion continued until no further themes emerged; any differences were resolved during discussion. Once data sets had been analysed in pairs, they were brought together through a process of integrated analysis” (p.268).</i></p>	<p><i>“This allowed the research team to follow a thread and actively seek out similarities and differences, within and between children and parent dyads” (p268).</i></p>	<p>No data available answering the review question.</p>
<p><b>S15.</b> Gibson et al., 2010. Health Service Research</p>	<p><i>“Two levels of data analysis were undertaken, one to create and examine codes, themes and categories; the second to elaborate on one key theme linked to the purpose of the study (i.e., exploring changes in needs and preferences across ages) as a ‘thread’. This thread was examined across all other themes to create a multi-faceted picture of the phenomenon (Moran-Ellis et al., 2006). Data analysis was based on an inductive thematic analysis approach (Coffey and Atkinson, 1996). Data were initially analysed within the defined age groups associated with each data collection method, then brought together into six key themes through a process of iterative integration (Moran-Ellis et al., 2006).” (p.1400).</i></p>	<p><i>“This allowed the research team to follow the main thread, how chronology affected needs and preferences, and actively seek out similarities and differences within and between the six themes generated from the integration of data sets” (p.1401).</i></p>	<p>No data available answering the review question.</p>
<p><b>S29.</b> Gove et al., 2017. Health Service Research</p>	<p><i>“Following a thread is a research approach whereby an analytic question or theme in one dataset is selected and followed (the thread) “to create a constellation of findings which can be used to generate a multi-faceted picture of the phenomenon” (Moran-Ellis et al., 2006, p. 54, see also Moran-Ellis et al., 2004). In this study, a sub-set of qualitative data was used, which comprised all data that had been coded in the initial study (Gove et al., 2015) as reflecting an aspect of stigma (based on the predetermined categories derived from the literature). The analytic question serving as the thread was “in what way do GPs perceive people with dementia as failing to reciprocate and/ or consider such perceptions to be present among the general public/wider society?” (p.952).</i></p>	<p><i>“It was found that perceptions reflecting lack of reciprocity frequently reflected other aspects of stigma (based on the pre-determined categories in the coding framework) such as labeling, loss of social status, and discrimination, but were, in addition, coded separately to reflect specifically “lack of reciprocity. Triggered by this finding, all the authors followed up this thread by further analysis to determine in what way the concept of lack of reciprocity was reflected in GPs’ perceptions of dementia as a stigma” (p.952).</i></p>	<p><i>“Following the thread of lack of reciprocity across the data reflecting perceptions of dementia as a stigma confirmed that GPs perceive people with dementia to some extent failing to reciprocate and believe that they are perceived as failing to reciprocate by the general public wider society. This analysis also provided a more complete picture of the stigma of dementia” (p.957).</i></p>

### **4.3 Justification of the analytical integration**

All of the studies that conducted a mixed methods design offered the expected justification for integration, with the exception of Kinley et al. (2018). In the studies conducted with a sequential (Brennan et al., 2012) or concurrent mixed methods design (Godman et al., 2012; Klinke et al., 2016), the rationale for the integration of method strands was that of addressing a gap or facilitating and advancing the present state of knowledge. Three of the studies that used a convergent mixed methods design (King et al., 2014; Morrow et al., 2014; Soo et al., 2015) described their rationale for the integration of method strands as complementary.

Of the seven mixed methods studies included, only three offered a reason for applying analytical integration by following a thread. Brennan et al. (2012) described how the framework had allowed and informed the development of theoretical insights into the qualitative data. In the study by Godman et al. (2012), the framework had been used to accomplish a true integrated mixed methods study, resulting in findings, and constructing an account of what they meant together. Kinley et al. (2018) described having applied the framework to look for evidence of the resonance across findings as a way to generate further knowledge (Table 3).

The justifications for using the approach amongst the multimethod studies ranged from none at all (Broad, 2012, Gibson et al., 2012) to those invoking the possibility of giving the different method strands equal weight (Descartes, 2007). Some studies (Eggebö, 2012; Gibson et al., 2010; Gove et al., 2017) simply quoted Moran-Ellis et al. (2006), stating that their aim was “to create a constellation of findings which could be used to generate a multifaceted picture of the phenomenon” (p. 54) without offering any further details (Table 4).

### **4.4 Described benefits and shortfalls of the framework**

Amongst the seven studies conducted with a mixed methods design, only one (King et al., 2014) described what could be interpreted as potential benefits of applying the method of following a thread, i.e., that integrated themes went beyond initial standalone quantitative and qualitative findings. The majority of the remaining studies described (mainly very briefly) the benefits of having conducted a mixed methods study per se (Brennan et al., 2012; Godman et al., 2012; King et al., 2014; Morrow et al., 2014; Soo et al., 2015, Klinke et al., 2016), with no further descriptions of their analytical integration process. The described benefits of their

chosen design included: quantitative measures recognised a context for validating and interpreting parts of the qualitative data (Brennan et al., 2012); the design providing various enrichments (King et al., 2014); new insights (Morrow et al., 2014); quantitative and qualitative data being complementary (Godman et al., 2012; Soo et al., 2015); and the provision of a more complete picture (Klinke et al., 2016). One of the studies (Kinley et al., 2018) offered no description at all of the benefits or shortfalls, either for the applied mixed methods design or for the analytical integration of data sources (Table 3).

Amongst the six studies conducted with multimethod design, only Broad (2015) described some benefits of having used the framework of following a thread, explaining that it allowed for an inductive hint at the analysis whilst simultaneously maintaining the value of the qualitative data at the same time as including the focus of the quantitative data. The remaining five studies (Descartes, 2007; Eggebö, 2012; Gibson et al., 2010; Gibson et al., 2012; Gove et al., 2017) did not offer any accounts of the benefits or shortfalls of having used analytical integration by following a thread (Table 4).

#### **4. Discussion**

With regards to the application of the frameworks, our findings imply that there is a small but recently increasing number of published studies asserting that they have applied the framework (Moran-Ellis et al., 2006), all the more so in that the majority of the studies included were published in 2012 or later, with the exception of Descartes, which was published in 2007. Considering that the framework was first introduced more than a decade ago, our findings imply that it has not been taken much further than when it was initially introduced. It would, therefore, appear that the health services research community's general engagement in the methodological development or validation of frameworks and/or techniques for analytical integration is weak (Östlund et al., 2011).

Regardless of the choice of study design (i.e., mixed methods or multimethod), the framework applied in nine of the studies (Brennan et al., 2012; Descartes, 2007; Eggebö, 2013; Gibson et al., 2010; Godman et al., 2012; Gove et al., 2017; Kinley et al., 2018; Morrow et al., 2014; Soo et al., 2015) did not offer a sufficiently rich or transparent account of how the framework had actually been applied. Others (Brown et al., 2015) corroborate our findings that methodological reporting within the health services field leaves room for improvement. One notable finding was that of our 13 identified and included studies, only seven involved a

mixed methods design (Brennan et al., 2012; Goodman et al., 2012; King et al., 2014; Kinley et al., 2018; Klinke et al., 2016; Morrow et al., 2014; Soo et al., 2016), whilst six could be classified as having used a multimethod design, i.e., different qualitative approaches within a single study (Broad, 2015; Descartes, 2007; Eggebö, 2013; Gibson, et al., 2010; Gibson, et al., 2012; Gove et al., 2017). Our initial anticipation was that we would identify applications of the framework mainly in relation to studies conducted with a mixed methods design, considering the design's focus of resolving tensions between the qualitative and quantitative methodological movements (Burke Johnson & Onwuegbuzie, 2004). Since the development of following a thread, a methodological development has emerged to adapt the technique to studies involving different qualitative sets of data (Cronin et al., 2008). However, the technique in the studies included here has not been applied on or between numerical data alone.

Another interesting finding relates to the descriptions of how the framework had been applied in combination with other integration techniques (Gibson et al., 2010; King et al., 2014; Klinke et al., 2016). King (2014), for example, used a matrix of integration. However, whilst multi- and mixed methods designs allow researchers to be creative, the justification for applying more than one analytical integration framework and/or technique has been found to be underdeveloped (Uprichard & Dawney, 2019). This is despite the fact that regardless of study design, methodological quality plays an important part in producing robust research findings that can inform clinical practice and health policy (Halcomb, 2018). The use of specific techniques or tools such as a matrix could reflect the need to translate the framework into instruments or techniques which can help researchers to apply the framework across several complex steps of data integration. One reason for the limited use of the framework may perhaps be the lack of methodological guidance (cf. Richards et al., 2019). Further research into such approaches is needed in order to develop suggestions on how to facilitate and improve the conduct and reporting of the data integration stage in multi- and mixed methods studies.

The most prominent justification for the use of the framework was that it enhanced verification and confidence in the data and that it allows for complexity in order to attain an explanatory theoretical level of findings. Six of the multi-method studies (Morse, 2003; 2009) included used different qualitative methods to examine the pieces that we would otherwise not be able to see or might overlook, as each qualitative method is focused on a particular level of

knowledge. Be that as it may, none of them offered a reference for their choice of interview technique, and in many cases, no information was given about the research question or the actual interview question(s). More remarkable still was that none of the multimethod studies included quoted Cronin et al. (2008), which, to our knowledge, offers the first description from the original source of how the framework can be applied within and between different types of qualitative data.

Mixed methods research is an emerging area with a growing amount of interest across several disciplines and has been particularly popular in the areas of applied social research and evaluation (Cameron, 2009). Qualitative and quantitative designs have made important contributions to the understanding of people's experiences from different perspectives. A recognition of their intricacies results in the need for innovative approaches that use mixed methods to address complex research questions rather than adopting a particular approach (Larkin et al., 2014). In two of the mixed methods studies, the qualitative strand had priority (King et al., 2014; Soo et al., 2015). It is therefore known that qualitative methods offer a preferred method for research design "when little is known about the topic, when the research context is poorly understood, when the boundaries of the domain are ill-defined, when the phenomenon is not quantifiable, [or] when the nature of the problem is murky" (Morse, 2003.p 833). Researchers must nevertheless also discuss the synergy gained by integrating sequentially qualitative and quantitative methods (Guetterman et al., 2015). Neither the purpose nor the rationale for conducting mixed methods studies was always clearly stated. This finding supports results from Beck and Harrison (2016) in appraising mixed methods nursing studies where very few addressed the paradigm used in the research.

## **6. Study limitations and strengths**

Our narrow methodological focus for this systematic review can be considered a limitation. However, by developing the study in accordance with the PRISMA-P checklist (Moher et al., 2009) and by following established methods (Centre for Reviews and Dissemination, 2009; The Cochrane Collaboration, 2011) for systematic reviews, we hope to have mitigated this possible limitation.

Our findings also need to be evaluated from the perspective of our search strategy, that is, phrase searching "Moran-Ellis." Phrase searching has been found to decrease the number of results whilst making the result more relevant. We aimed at not limiting the retrieval of

records with possible phrase variations. Consequently, quotation marks were used, but the phrase was not enclosed in double quotes or truncated in our searches (cf. Salvador-Oliván et al., 2019). Despite this, we cannot exclude the possibility to have missed identifying studies of relevance for the application of the framework.

Our inclusion criteria can be judged to have supported the identification of relevant studies as did the inclusion of studies published in English, French, and Swedish. Eligible studies meeting the inclusion criteria were critically considered and discussed. For the purpose of this review, included studies citing Moran-Ellis et al. (2006) had to contain some text describing how the framework had been applied (Tables 3 and 4). The process of both authors independently reviewing, reading, extracting, and analysing data can be interpreted as strengthening the findings of this systematic review. Not having a third person to solve divergences could be viewed as a weakness; however, as both authors are experienced in mixed methods designs as well in different qualitative and quantitative designs, we suggest that this possible limitation was partially counteracted.

In regards to the critical appraisal of included studies in this systematic review, it was surprising that the majority of the studies could be assessed as being of high quality following the MMAT criteria (Tables 1 and 2). This is despite the overall methodological accounts offered in the studies only generally vaguely being reported and/or justified. Taking a closer look at the MMAT criteria from this perspective reveals that the majority of the criteria are made up of terms such as appropriateness and adequacy. This raises the question about the level of each individual criterion and its overall sensitivity to methodological quality. Detailed descriptions of integration and/or frameworks for integration should perhaps be considered a reasonable quality criterion in critical appraisals for multi- and mixed method studies, particularly as the importance of being able to critically appraise integration is well known (Bazeley, 2009; Brown et al., 2015; Moran-Ellis et al., 2006).

Extracting and interpreting data will always be based on the researcher's subjective views and judgements and thus offers conceivable limitations. However, the piloting of the data extraction protocol, its focused structure towards the review questions, together with the authors' methodological experience within the area are believed to have supported an unambiguous work process (cf. France et al., 2014). Since the interpretative elements in a systematic review could be viewed as subjective, Grant and Both (2009) suggest that the results should be viewed as a starting point for further evaluation and not as an endpoint in

itself. Therefore, the pragmatic validity (Tobiano et al., 2018) of this systematic review could be said to be supported by the ample examples of data (Tables 3 and 4) together with the contextual information about included studies, which will allow the readers to judge the relevance of our findings for themselves.

## **7. Conclusion**

Analytic integration in multi- and mixed methods research is a crucial step in harnessing quality research outcomes. Integration facilitates interdependent roles for qualitative and quantitative perspectives or within perspectives, generating stimulating hypotheses regarding the research issue. Given the significance of integration in this type of research, it is concerning that the topic has yet to receive proper attention from researchers, as evidenced by the inadequate depth of descriptions of integration. Discussion of integration amongst researchers appears necessary in order to learn about the impact of the use of a certain framework and in order to unfold the epistemological value of available frameworks and further develop them. Those discussions could also consider whether the framework of following a thread may be applicable to mixed methods reviews as well, i.e., to the integration of already-aggregated research data from various qualitative sources or from qualitative and quantitative sources.

The slow rise in the use of the follow-the-thread framework could reflect increasing popularity of both multi- and mixed methods research, as could the fact that more of these study designs are being funded (Dupin et al., 2014; Plano Clark, 2010) and subsequently accepted for publication. Our study corroborates the finding that research teams need to make further efforts to maximise the quality and completeness of their descriptions of reporting. Citing key methodological texts is not a guarantee of high-quality reporting, neither is the absence of these in citation lists an indicator of poor reporting. We should remain open to a novel use of the framework so long as the methods are transparent, but we asked ourselves at what point an adaptation of an approach becomes another approach entirely. The existence of applications claimed as such that it did not, in fact, follow the approach could potentially damage the reputation of the framework and make it less likely that users of evidence syntheses (cf. France et al., 2014) would deploy it.

## **DECLARATIONS**

**Competing interest:** The authors declare that they have no competing interests.

**Consent to publish:** Not applicable

**Availability of data and materials:** The dataset for this study is available from the corresponding authors on reasonable request.

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**Author contributions:** CMD and GB were responsible for the inception and design of the study. They were both also responsible for the data acquisition and for drafting the initial manuscript. They both performed the data analysis. In addition, both authors were responsible for the critical revision of the paper and added important intellectual content. All authors read and approved the final manuscript.

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