

Benefits of End-User Involvement in Project Management for Health Information System  
Projects:  
A Scoping Review

by

Laura Johnson  
BA, University of Northern British Columbia, 2010

A Project Submitted in Partial Fulfillment  
of the Requirements for the Degree of

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in the School of Health Information Science

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## **Supervisory Committee**

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### **Supervisory Committee**

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## Abstract

**Background:** Effective project management is crucial to successfully implement new health information systems (HIS). End-users ultimately determine the success of projects. Past literature illustrates a lack of adequate and continual end-user involvement in these projects.

**Objective:** The objective of this study was to review the evidence-based literature for the benefits of involving end-users throughout the entire continuum of the project management process for HIS projects. This scoping review examines the volume and quality of evidence-based literature on this topic.

**Methods:** A scoping review based on the methodological framework identified by Arskey and O'Malley (2005) was completed using the following stages: identifying the research question, identifying relevant studies, completing the study selection, charting of the data, and collating, summarizing and reporting of the results. Summaries include characteristics of the literature (i.e., type of findings, project methodology, and project management focus area), methodological quality assessment (RATS, STROBE, Delphi Survey Technique, and JBI Critical Appraisal checklists), and findings of the review as it relates to the study objective. Data was analysed using Microsoft Excel.

**Results:** A total of 27 articles were included in this study (23 qualitative and four quantitative). End-users were directly involved in 96.30% (n=26) of the articles. Nine (34.62%) articles indicated involvement in multiple phases (two or more), followed by maintenance (26.92%; n=7), implementation (15.38%; n=4), design and development (11.54%; n=3), not specified (7.69%; n=2), and analysis and requirements (3.85%; n=1). Of these 26 articles, 19.23% (n=5) noted a positive perception by end-users of their involvement while 7.69% (n=2) noted a negative perception. Recommendations from the studies regarding end-user involvement in the Systems Development Life Cycle (SDLC) varied. Four (14.81%) articles indicated involvement in the entire project life cycle (all 5 phases), 62.97% (n=17) of the articles indicated involvement in multiple phases (4 or less), 11.11% (n=3) in implementation, 7.41% (n=2) in design and development, and 3.70% (n=1) in analysis and requirements. Recommendations for end-user involvement in project management phases showed that 14.81% (n=4) of the articles indicated involvement in three phases, 48.15% (n=13) in two phases, and 37.04% (n=10) in one phase (25.93% (n=7) in plan and 11.11% (n=3) in execute). Measured outcomes indicated 22.22% (n=6) design factors, 18.52% (n=5) implementation factors, 14.81% (n=4) for both experiences/perceptions and system/mobile app, 11.11% (n=3) for both design/implementation factors and engagement, and 7.41% (n=2) system use/acceptance. Study measurements for qualitative studies indicated 78.26% (n=18) did not specify any definitions, while 21.74% (n=5) provided definitions relating to end-user involvement. Study measurements for quantitative studies indicated 75% (n=3) used questionnaire and 25% (n=1) did not specify. Definition of project success was only specified in 11.11% (n=3) of the articles. Twenty-five (92.59%) of the articles indicated end-user involvement being essential and having a positive impact on the project. Nine (33.33%) of the articles stated that end-user involvement correlated directly to the success of the project. There were three major themes across the 25 articles that noted end-user involvement as being essential: (1) ownership of solution (56%; n=14), (2) involvement is fundamental (28%; n=7), and (3) involvement early in the project (16%, n=4).

**Conclusion:** There is still a gap in the literature and future studies must focus on identifying both the benefits of end-user involvement in HIS projects and the association of their involvement with project/system success. The major gaps include a lack of quantitative studies and an absence of measurements and/or definitions of end-user involvement and project success.

**Keywords:** Project management process, end-user involvement, health information system, healthcare

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Laura Johnson

## **1. Introduction**

As healthcare continues to rapidly evolve, so too does the potential of the health information technology (HIT) that supports it. Projects to implement HIT are rapidly spun up and introduced throughout healthcare settings, often leaving little time to examine how effective the project management process is at completing successful implementations of HIT. More than 50% of electronic health record (EHR) implementation projects either fail to implement the EHR or the EHR fails to be properly utilized (Gesulga, Berjame, Moquiala, & Galido, 2017). These failures often occur due to a lack of pre-implementation activities, organizational readiness, and user technical or computer skills, which often results in user and staff resistance (Gesulga et al., 2017). The project management process needs a greater focus on user adoption to address the issues raised by failed HIT implementations. No matter how good an HIT innovation may be, the benefits of using it are ultimately up to the users themselves. “New technology is often developed and evaluated from an organizational point of view”, which results in users only being involved in the final stage of implementation (Bernsetin, McCreless, & Côté, 2007, p.22). End-user involvement throughout the entire continuum of the project management process must be reviewed and evaluated in order to determine when, where, and how it can be most effective to increase the successful use of HIT.

Past research shows that a lack of adequate and continual end-user involvement is the largest single factor in the failure of information technology projects and healthcare is no exception (Chrimes, 2018). End-user involvement, particularly in the design and implementation processes, will help to better identify user needs in order to create health information systems (HIS) that are more beneficial and useful to healthcare organizations and their staff. As the pendulum shifts to involve end-users who were not traditionally involved in project

management, questions arise on how to best utilize healthcare end-users throughout this process. In order to develop better and more acceptable HIT, end-user involvement is essential. Understanding the challenges and opportunities related to end-user involvement is a necessity for project managers to develop appropriate strategies for increasing the benefits of their involvement (Zowghi, da Rimini, & Bano, 2015).

This study looks at all stages of the project management process, including project initiation, planning, execution, monitor and control, and close. It is expected that the literature will show different time points against each of the project management phases, with more focus on the planning (design) and execution (implementation) areas. Additionally, this study will illustrate any trends or themes regarding unique but successful styles of end-user involvement in the project management process.

## **1.1 Definitions**

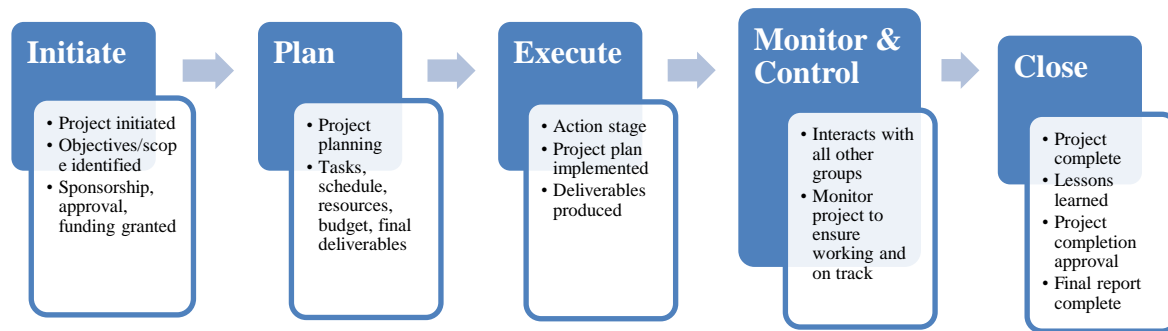
There are numerous terms that need to be defined to help form a base understanding for this study. These terms include project management, the project management process, project methodologies, the software development lifecycle (SDLC), research type, study design and methods, and EHR versus electronic medical record (EMR).

### **1.1.1 Project Management**

As stated by the Project Management Institute (PMI), a project is both “temporary in that it has a defined beginning and end in time, and therefore defined scope and resources” and “unique in that it is not a routine operation, but a specific set of operations designed to accomplish a singular goal” (“What is project management,” n.d., para. # 1 and 2). Project management is “the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements” (“What is project management,” n.d., para. # 5).

### **1.1.2 The Project Management Process**

The project management process falls into five categories: initiate, plan, execute, monitor and control, and close (“What is project management,” n.d.). These five process groups make up the project lifecycle and as each one is completed, it triggers the next process group to begin. Initiate covers when a project is initiated, objectives and scope are identified, and sponsorship, approval, and funding are granted. Planning is where all the project planning occurs, including identifying project tasks, schedule, resources, budget, and final deliverables. Execute is the action stage where the project plan is implemented and deliverables are produced. Monitor and control is the only group that interacts with all four other groups whereas the other groups are completed in sequential order. During this phase, everything within the project is monitored to ensure it is working and on track. Lastly, close is when the project is deemed to be complete, lessons learned are accumulated, project completion approval is retrieved, and the final report is completed. Figure 1 summarizes the project management process groups and their associated tasks. The project management body of knowledge includes ten areas: integration, scope, time, costs, quality, procurement, human resources, communications, risk management, and stakeholder management (“What is project management,” n.d.). The above terms, processes, and knowledge areas are the base of project management and what all project managers are expected to follow throughout each project.



*Figure 1: Project Management Process Groups and Tasks*

### 1.1.3 Project Methodologies

A methodology is a “system of practices, techniques, procedures and rules used by those who work in a discipline. Lean practices, Kanban, and Six Sigma are examples of methodologies” (“Methodology,” n.d., para. # 1). Other project methodologies include agile, scrum, and waterfall. The two primary project methodologies tend to be waterfall and agile. Waterfall is the traditional approach that uses deliberate and controlled planning methods; once a phase is complete, it is not revisited (Uikey & Suman, 2012). According to Uikey and Suman (2012), the traditional project management style has limitations when working in dynamic development environments, which healthcare can be included in as it is considered a complex adaptive system (CAS). A CAS is a “system that displays properties such as emergent behaviours, non-linear processes, co-evolution, requisite variety, and simple rules” (Kuziemsky, 2016, p.5). Healthcare is classified as a CAS as the “various elements such as care delivery, education, and policy consist of a series of interacting parts that work in non-linear and evolving ways” (Kuziemsky, 2016, p.5). Healthcare has to constantly adapt to change as these dynamic events often unfold in unpredictable and unique ways. When following the traditional or waterfall approach, every detail must be planned before being executed. This primarily only works if the major requirements are frozen at the initial phase, which is rarely the case with HIS

projects, and makes managing changes in the later phases quite difficult (Uikey & Suman, 2012). Scope creep is common across all projects, including healthcare, which does not allow the major requirements to be “frozen” as is required for the traditional project management approach. Waterfall is the default methodology often used in healthcare projects, though agile is starting to take notice particularly on the software development side.

Agile, on the other hand, follows enhanced software development concepts to produce faster and better completion of the project (Uikey & Suman, 2012). Agile is said to be well suited for projects where the “value is clear, customer and teams collaboratively participate throughout the lifecycle of the project, the customer and the teams are correlated, and incremental product development is possible” (Uikey & Suman, 2012, p.386). Agile is more open and flexible towards changing requirements, design ideas, and value contribution with its two basic features being speed and communication (Larusdottir et al., 2018).

#### 1.1.4 Software Development Lifecycle (SDLC)

As HIS projects are typically software related, one must understand the SDLC. The SDLC consists of five phases: (1) analysis and requirements, (2) design and development, (3) test, (4) implementation, and (5) maintenance (“Systems development life cycle,” 2017). Figure 2 summarizes the SDLC phases.

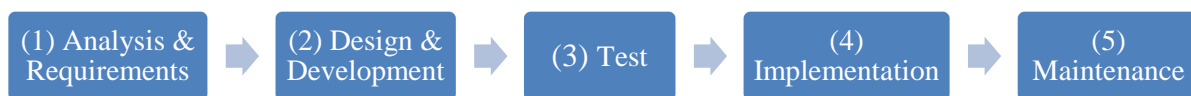


Figure 2: Software Development Lifecycle (SDLC) Phases

### **1.1.5 Research Type**

Studies were assessed to identify their research type as either qualitative, quantitative, or mixed method. A qualitative study “examines the experiences and beliefs of people from their own perspective” and methods like in-depth interviews (open-ended questions), focus groups, and observation are often used with analysis to identify underlying themes (“CASP Checklists,” n.d., para. # 3). Qualitative often asks the how and why questions with researchers being an integral part of the data; without their active participation, no data would exist (McLeod, 2019, “Qualitative Research, Key Features” section). A quantitative study on the other hand “gathers data in a numerical form which can be put into categories, or in rank order, or measured in units of measurement. This type of data can be used to construct graphs and tables of raw data” (McLeod, 2019, “Quantitative Research” section). Quantitative often asks the what, when, and where questions and is carried out through experiments, controlled observations, questionnaires, surveys, and close-ended interviews (McLeod, 2019). A study that uses both quantitative and qualitative methods is considered to be a mixed methods study.

### **1.1.6 Study Design & Method**

A study should refer to a particular study design, along with varying methods used to carry out the investigation and analysis for that particular study. A study design “refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby, ensuring you will effectively address the research problem” (“Research Guides: Organizing Your Social Sciences Research Paper: Types of Research Designs,” n.d., para. # 1). The study design is a plan to answer a research question. Examples of study designs include cross-sectional, quasi-experimental, Delphi study, phenomenology, case study, participatory design, and user-centred design. A method, on the other hand, is defined as “the

tool used to answer your research question” or, in other words, how you will collect the data (Brookshier, 2018, “Method” section). Examples of methods include interviews, surveys, questionnaires, case studies, and focus groups.

A large variety of methods can be used when analysing end-user involvement in HIS projects. There are three major study designs that one must understand with regards to end-user involvement in HIS projects: user-centred design, user co-design, and participatory design. User-centred design involves studying “the user’s perspectives and experiences to ensure the product is useful and usable to them” through usability testing or observation; this method provides the least amount of user control (Tang, Lim, Mansfield, McLachlan, & Quan, 2018, p.90). User co-design allows “the designer and users [to] design the product together” through design meetings with prototypes and simulation; this method provides more user control (Tang et al., 2018, p.91). Participatory design has “the user [as] an active participant in design and has a strong voice in decision-making, driving the innovation while the design facilitates the creative process” through the use of design games and participatory design methods; this method provides the most user control (Tang et al., 2018, p. 91).

### **1.1.7 EHR versus EMR**

As both the EHR and EMR are detailed in the results of this study, it is important to note the difference between them. An EHR “refers to the systems that make up the secure and private lifetime record of a person’s health and health care history” whereas an EMR is “an office-based system that enables a health care professional, such as a family doctor, to record the information gathered during a patient’s visit” (“Understanding EHRs, EMRs and PHRs,” n.d., para. # 1 and 2). Typically in Canada, an EHR is the acute care hospital system, while an EMR is the physician office system.

## **1.2 Objective**

The objective of this study was to review the evidence-based literature for the benefits of involving end-users throughout the entire continuum of the project management process for HIS projects. This scoping review determined the volume and quality of evidence-based literature on this topic.

## **1.3 Research Question**

The research question for this study is: What is known from the existing literature on the benefits of end-user involvement for HIS projects throughout the entire continuum of the project management process? By framing the question in this manner, the study will look at all stages of project management to determine what the literature indicates, as well as the type of end-user involvement that can be integrated into the SDLC for HIS projects. The review will focus on the volume and quality of evidence-based literature that is returned to determine the current state of literature on this topic.

## **1.4 Review Questions**

The following questions were used as part of the review.

1. When and where have the studies been occurring?
2. What types of findings are available in the literature?
3. What research type, study designs, and methods are used in the literature?
4. What project methodology does the literature focus on?
5. What project management focus area does the literature focus on? How does this relate to the SDLC?
6. What type of HIS' are the foci of the published literature?

7. What are the actual findings (i.e. benefits) within the literature within relation to end-user involvement and project management outcomes?

## 2. Method

This study follows the same methodological framework as identified by Arskey and O'Malley (2005) for scoping reviews. "The method adopted for identifying literature in a scoping study needs to achieve in-depth and broad results. ... [As such,] the scoping study method is guided by a requirement to identify all relevant literature regardless of study design" (Arskey & O'Malley, 2005, p.8). A scoping review examines the extent, range, and nature of research activity; determines the value of undertaking a full systematic review; summarizes research findings; and identifies research gaps in the existing literature (Arskey & O'Malley, 2005). The reviewer followed the PRISMA guidelines for reporting – scoping review extension (also known as PRISMA-ScR or Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping review) as a checklist when creating this study. This checklist (Figure 3) was based on the one illustrated by Tricco et al. (2018). This study will summarize the relevant literature, while also identifying any gaps. The selected methodological approach is the most suitable as there is a need for in-depth and broad results to identify all relevant literature. A scoping review can be used to help determine the amount of evidence-based literature that is available regarding the benefits of end-user involvement throughout the project management process. The stages of this framework include identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarizing, and reporting the results (Arskey & O'Malley, 2005).

Table. PRISMA-ScR Checklist		
Section	Item	PRISMA-ScR Checklist Item
<b>Title</b>	1	Identify the report as a scoping review.
<b>Abstract</b>		
Structured summary	2	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.
<b>Introduction</b>		
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.
<b>Methods</b>		
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).
Summary measures	13	Not applicable for scoping reviews.
Synthesis of results	14	Describe the methods of handling and summarizing the data that were charted.
Risk of bias across studies	15	Not applicable for scoping reviews.
Additional analyses	16	Not applicable for scoping reviews.
<b>Results</b>		
Selection of sources of evidence	17	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.
Characteristics of sources of evidence	18	For each source of evidence, present characteristics for which data were charted and provide the citations.
Critical appraisal within sources of evidence	19	If done, present data on critical appraisal of included sources of evidence (see item 12).
Results of individual sources of evidence	20	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.
Synthesis of results	21	Summarize and/or present the charting results as they relate to the review questions and objectives.
Risk of bias across studies	22	Not applicable for scoping reviews.
Additional analyses	23	Not applicable for scoping reviews.
<b>Discussion</b>		
Summary of evidence	24	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.
Limitations	25	Discuss the limitations of the scoping review process.
Conclusions	26	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.
<b>Funding</b>	27	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.

Figure 3: PRISMA-ScR Checklist for Scoping Reviews. Reproduced from “PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation,” by A.C. Tricco, E. Lillie, W. Zarin, K.K. O’Brien, H. Colquhoun, D. Levac, . . . S.E. Straus, 2018, *Annals of Internal Medicine*, 169, p. 471. Copyright 2018 American College of Physicians. Reprinted with permission.

## 2.1 Search Strategy

Identifying relevant studies is critical to ensure that all relevant primary studies are included. The reviewer utilized the University of Victoria's librarian service to help identify relevant key words and databases to search for the best results for the scoping review. From this discussion, an initial search strategy was identified and later executed through the university library's Summon service to provide a discovery search layer. Based on these initial results, the reviewer then refined the search strategy to only include those studies applicable to healthcare and HIS projects, along with further refining the search terms themselves.

The main keywords used were: project management process; project management; user involvement or participation; user-centred or user-centered design; patient involvement or participation; and health care or healthcare. These keywords were then put together in a variety of formats, with a total of eighteen separate searches made on each database. Table 1 details the final search strategy that was used for each of the eighteen searches on each database. The final search strategy was applied to the following electronic databases: ACM Digital Library, IEEE xplore Digital Library, CINAHL Complete (EBSCO), and Medline. The reference management tool Zotero was used to help manage the number of bibliographical references found (Zotero, 2019, version 5.0.73).

Search Number	Search Terms	Criteria Match
1	"project management process" AND ("user involvement" OR "user participation") AND (healthcare OR "health care")	Matches all criteria
2	"project management process" AND ("user centered design" OR "user centred design") AND (healthcare OR "health care")	
3	"project management process" AND ("patient involvement" OR "patient participation") AND (healthcare OR "health care")	

Search Number	Search Terms	Criteria Match
4	"project management process" AND ("user involvement" OR "user participation")	Removes "healthcare" match
5	"project management process" AND ("user centered design" OR "user centred design")	
6	"project management process" AND ("patient involvement" OR "patient participation")	
7	"project management" AND ("user involvement" OR "user participation") AND (healthcare OR "health care")	Removes "process" match
8	"project management" AND ("user centered design" OR "user centred design") AND (healthcare OR "health care")	
9	"project management" AND ("patient involvement" OR "patient participation") AND (healthcare OR "health care")	
10	"project management" AND ("user involvement" OR "user participation")	Removes "process" and "healthcare" match
11	"project management" AND ("user centered design" OR "user centred design")	
12	"project management" AND ("patient involvement" OR "patient participation")	
13	"project plan*" AND ("user involvement" OR "user participation")	Looks at specific project management process area without healthcare
14	"project design*" AND ("user involvement" OR "user participation")	
15	"project implement*" AND ("user involvement" OR "user participation")	
16	"project execut*" AND ("user involvement" OR "user participation")	
17	"project clos*" AND ("user involvement" OR "user participation")	
18	"project management process"	Looks simply at project management process (for specific databases)

Table 1: Final Search Strategy

## 2.2 Review Screening and Selection

A four-step review selection strategy was conducted by: 1. use of the specified search parameters; 2. identification of duplicate articles for quick removal; 3. application of the specified inclusion criteria to complete an initial screening; and 4. full review to determine article suitability. In step one, the specified search parameters detailed in Table 1 were applied to each specified electronic database. The searches were completed between April 17, 2019 and May 4, 2019.

In order to eliminate studies that did not address the central research question, inclusion criteria were applied to the originally identified studies. As per Arskey and O'Malley (2005), these criteria are often devised post hoc, based on the increasing familiarity with the literature, which can then be applied to all citations to determine their relevance. The inclusion criteria used in this scoping review included: written in English; project management focused; end-user involvement; healthcare; and HIS projects. A log of all included and excluded articles was kept in Microsoft Excel; this log contained the database name, search number, article title, if it should be included, why it was excluded, and the identification number for the full data review (Microsoft Excel, 2013, Version 15.0.5127.1000). Table 2 contains a sample of the inclusion/exclusion log (as there was a total of 2,089 articles to review, the entire table can be found as an attachment in Appendix C).

Database	Search #	Article Title	Include ?	If no, why?	ID (For Review)
ACM DL	4	An empirical study to design an effective agile project management framework	Yes		1
ACM DL	8	Activity-based computing for medical work in hospitals	No	No user involvement	n/a

Database	Search #	Article Title	Include ?	If no, why?	ID (For Review)
ACM DL	10	Problems and challenges of user involvement in software development: an empirical study	Yes		3
ACM DL	10	An empirical study to design an effective agile project management framework	No	Duplicate	n/a
ACM DL	10	Making a difference: a survey of the usability profession in Sweden	Yes	Not healthcare though	4
CINAHL	4	End-user involvement in a systematic review of quantitative and qualitative research of non-pharmacological interventions for attention deficit hyperactivity disorder delivered in school settings: reflections on the impacts and challenges	No	Duplicate	n/a
CINAHL	4	Critical Success Factors for Integrated Library System Implementation in Academic Libraries: A Qualitative Study	No	Not healthcare, HIS	n/a
CINAHL	4	Five constants of information technology adoption in healthcare	No	Duplicate	n/a
CINAHL	4	Experiences of multidisciplinary development team members during user-centered design of telecare products and services: a qualitative study	No	No project process, HIS	n/a
CINAHL	8	Design of a Mobile Application for Transfusion Medicine...16 World Congress of Medical and Health Informatics: Precision Healthcare Through Informatics (MedInfo2017) was held in Hangzhou, China from August 21st to 25th, 2017	Yes		36
CINAHL	8	Fostering a chronic care strategy in the Basque country through the evaluation of health care providers	No	Duplicate	n/a
CINAHL	8	User-centred design of integrated eHealth to improve patients' activation in transitional care	No	Duplicate	n/a

Database	Search #	Article Title	Include ?	If no, why?	ID (For Review)
CINAHL	10	A federated collaborative care cure cloud architecture for addressing the needs of multi-morbidity and managing poly-pharmacy (c3-cloud project)	No	No project process (project not complete, describing what will be done)	n/a
CINAHL	10	A patient-led approach to product innovation in patient education and wound management	No	Duplicate	n/a
CINAHL	10	A technical solution to improving palliative and hospice care	Yes		38
CINAHL	10	An Internet-based collaboration intervention for personal recovery: How did service users and providers address and align expectations about collaboration?	No	No project process	n/a
CINAHL	10	Analysis of how people with intellectual disabilities organize information using computerized guidance	No	No project process	n/a
CINAHL	10	Building consensus on user participation in social work: A conversation analysis	No	No project process	n/a
IEEE	10	A Framework for Requirements Engineering in End-User Computing	No	No project process	n/a
IEEE	10	A Living Lab model for user driven innovation in urban communities	No	No project process	n/a
IEEE	10	Agile development as a change management approach in software projects: Applied case study	No	No HIS	n/a
IEEE	10	Agile Development at Scale: The Next Frontier	No	No project process, user involvement	n/a

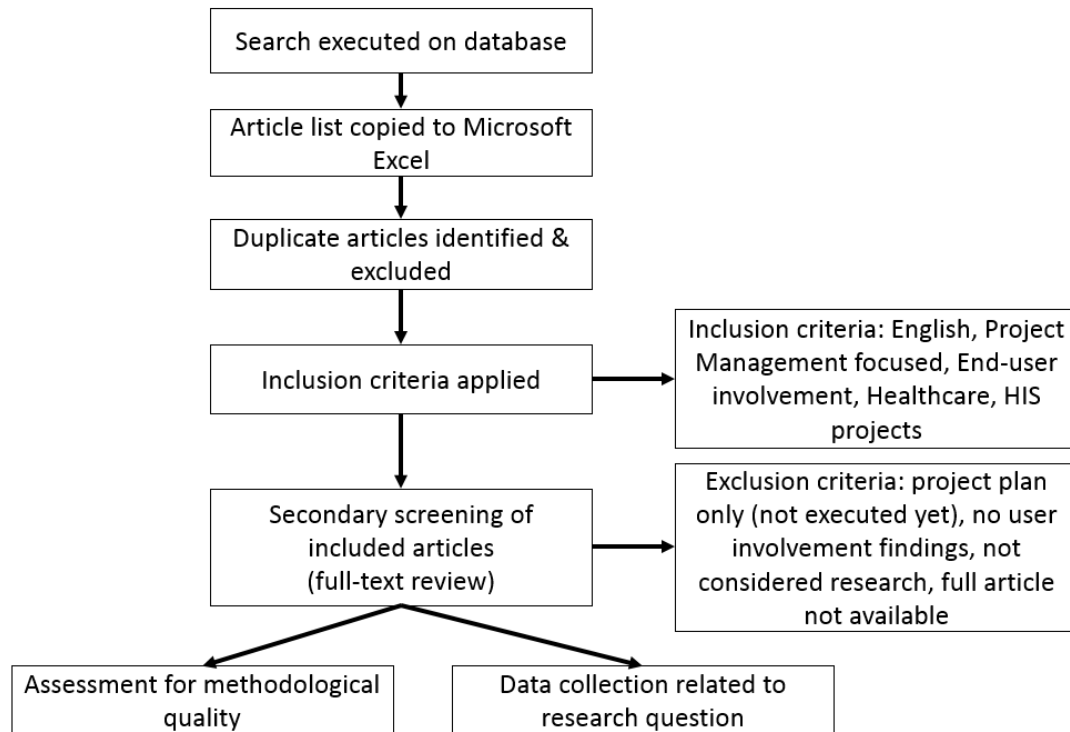
Database	Search #	Article Title	Include ?	If no, why?	ID (For Review)
Medline	10	23 h Model' for breast surgery: an early experience	No	No project process, HIS	n/a
Medline	10	Involving older people in research: methodological issues	No	Duplicate	n/a
Medline	10	Appointed by young people - a qualitative study on young patients recruiting hospital staff in Denmark	No	No project process, HIS	n/a
Medline	10	End-user involvement in a systematic review of quantitative and qualitative research of non-pharmacological interventions for attention deficit hyperactivity disorder delivered in school settings: reflections on the impacts and challenges	No	Duplicate	n/a

Table 2: Inclusion/Exclusion Sample Log

After each search was executed on a specific database, the article result list was copied into Microsoft Excel. A conditional formatting rule was placed on the article title column to highlight any cells with duplicate values – this allowed the reviewer to easily identify duplicate articles as the searches progressed throughout each database. Once the duplicate articles were noted, the reviewer then applied the inclusion criteria to all remaining citations. A copy of all articles that met the inclusion criteria was stored in Zotero for later review (Zotero, 2019, version 5.0.73).

Of the articles that matched the inclusion/exclusion criteria, a secondary screening was applied which included a full review of each article. The secondary screening did identify a small number of articles that were excluded based on information obtained from the full-text article. These articles were excluded based on not containing end-user involvement findings, only being a project plan (project not executed yet), not being considered research (theoretical paper, no

results or questions), and the full-text article not being available. During the secondary screening (or full-text review), review of each article was done using two methods: 1. assessment for methodological quality based on scoping review guidelines and 2. collection of data that directly related to the research question. Figure 4 below details the review screening and article selection process.



*Figure 4: Review Screening and Selection Process*

### **2.3 Assessment of Methodological Quality**

To assess the methodological quality, each article was reviewed using a guideline based on the study being classified as qualitative, quantitative, or mixed methods. For qualitative studies, a qualitative research review guideline known as RATS (Relevance, Appropriateness, Transparency, and Soundness) was used (Clark, Godlee, & Jefferson, 2003). This guideline looks at the relevance of the study question, appropriateness of the qualitative method, transparency of the procedures, and soundness of the interpretative approach. Figure 5 details the

RATS guideline used for this study. For quantitative studies, a quantitative checklist appropriate to the study design was used. The quantitative checklists included the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) for cross-sectional studies, Research Guidelines for the Delphi Survey Technique, and the JBI (Joanna Briggs Institute) Critical Appraisal Checklist for Quasi-Experimental Studies (Hasson, Keeney, & McKenna, 2000; “Critical Appraisal Tools,” n.d.; Strobe Initiative, 2014). Figures 6-8 detail the three quantitative checklists.

### ■ Qualitative research review guidelines – RATS

ASK THIS OF THE MANUSCRIPT	THIS SHOULD BE INCLUDED IN THE MANUSCRIPT	✓
<b>R Relevance of study question</b> Is the research question interesting? Is the research question relevant to clinical practice, public health, or policy?	Research question explicitly stated Research question justified and linked to the existing knowledge base (empirical research, theory, policy)	
<b>A Appropriateness of qualitative method</b> Is qualitative methodology the best approach for the study aims? <i>Interviews:</i> experience, perceptions, behaviour, practice, process <i>Focus groups:</i> group dynamics, convenience, non-sensitive topics <i>Ethnography:</i> culture, organizational behaviour, interaction <i>Textual analysis:</i> documents, art, representations, conversations	Study design described and justified e.g., why was a particular method (i.e., interviews) chosen?	
<b>T Transparency of procedures</b> <i>Sampling</i> Are the participants selected the most appropriate to provide access to type of knowledge sought by the study? Is the sampling strategy appropriate?	Criteria for selecting the study sample justified and explained <i>theoretical:</i> based on pre conceived or emergent theory <i>purposive:</i> diversity of opinion <i>volunteer:</i> feasibility, hard-to-reach groups	
<i>Recruitment</i> Was recruitment conducted using appropriate methods? Is the sampling strategy appropriate? Could there be selection bias?	Details of how recruitment was conducted and by whom Details of who chose not to participate and why	
<i>Data collection</i> Was collection of data systematic and comprehensive? Are characteristics of the study group and setting clear? Why and when was data collection stopped, and is this reasonable?	Method (s) outlined and examples given (e.g., interview questions) Study group and setting clearly described End of data collection justified and described	

<p><i>Role of researchers</i></p> <p>Is the researcher (s) appropriate? How might they bias (good and bad) the conduct of the study and results?</p>	<p>Do the researchers occupy dual roles (clinician and researcher)?</p> <p>Are the ethics of this discussed? Do the researcher(s) critically examine their own influence on the formulation of the research question, data collection, and interpretation?</p>	
<p><i>Ethics</i></p> <p>Was informed consent sought and granted?</p> <p>Were participants' anonymity and confidentiality ensured?</p> <p>Was approval from an appropriate ethics committee received?</p>	<p>Informed consent process explicitly and clearly detailed</p> <p>Anonymity and confidentiality discussed</p> <p>Ethics approval cited</p>	
<p><b>S Soundness of interpretive approach</b></p> <p><i>Analysis</i></p> <p>Is the type of analysis appropriate for the type of study? <i>thematic: exploratory, descriptive, hypothesis generating framework: e.g., policy constant comparison/grounded theory: theory generating, analytical</i></p> <p>Are the interpretations clearly presented and adequately supported by the evidence?</p> <p>Are quotes used and are these appropriate and effective?</p> <p>Was trustworthiness/reliability of the data and interpretations checked?</p>	<p>Analytic approach described in depth and justified</p> <p><i>Indicators of quality:</i> Description of how themes were derived from the data (inductive or deductive)</p> <p>Evidence of alternative explanations being sought</p> <p>Analysis and presentation of negative or deviant cases</p> <p>Description of the basis on which quotes were chosen</p> <p>Semi-quantification when appropriate</p> <p>Illumination of context and/or meaning, richly detailed</p> <p>Method of reliability check described and justified</p> <p>e.g., was an audit trail, triangulation, or member checking employed? Did an independent analyst review data and contest themes? How were disagreements resolved?</p>	
<p><i>Discussion and presentation</i></p> <p>Are findings sufficiently grounded in a theoretical or conceptual framework?</p> <p>Is adequate account taken of previous knowledge and how the findings add?</p> <p>Are the limitations thoughtfully considered?</p> <p>Is the manuscript well written and accessible?</p>	<p>Findings presented with reference to existing theoretical and empirical literature, and how they contribute</p> <p>Strengths and limitations explicitly described and discussed</p> <p>Evidence of following guidelines (format, word count)</p> <p>Detail of methods or additional quotes contained in appendix</p> <p>Written for a health sciences audience</p>	
		?
<p>Are <b>red flags</b> present? these are common features of ill conceived or poorly executed qualitative studies, are a cause for concern, and must be viewed critically. They might be fatal flaws, or they may result from lack of detail or clarity.</p>	<p><i>Grounded theory:</i> not a simple content analysis but a complex, sociological, theory generating approach</p> <p><i>Jargon:</i> descriptions that are trite, pat, or jargon filled should be viewed sceptically</p> <p><i>Over interpretation:</i> interpretation must be grounded in "accounts" and semi-quantified if possible or appropriate</p> <p><i>Seems anecdotal, self evident:</i> may be a</p> <p>superficial analysis, not rooted in conceptual framework or linked to previous knowledge, and lacking depth</p> <p><i>Consent process thinly discussed:</i> may not have met ethics requirements</p> <p><i>Doctor-researcher:</i> consider the ethical implications for patients and the bias in data collection and interpretation</p>	

The RATS guidelines modified for BioMed Central are copyright Jocelyn Clark, BMJ. They can be found in Clark JP: **How to peer review a qualitative manuscript**. In *Peer Review in Health Sciences*. Second edition. Edited by Godlee F, Jefferson T. London: BMJ Books; 2003:219-235

*Figure 5: RATS Guideline for Qualitative Reviews. Reproduced from "How to Peer Review a Qualitative Manuscript," by J.P. Clark, F. Godlee, and T. Jefferson, 2003, Peer Review in Health Sciences, 2, p. 2019-235. Copyright 2003 John Wiley and Sons. Reprinted with permission.*

**Table 1**  
The STROBE Statement—checklist of items that should be addressed in reports of observational studies.

	Item number	Recommendation
Title and Abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rational	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8 <sup>a</sup>	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
Results		
Participants	13 <sup>a</sup>	(a) Report the numbers of individuals at each stage of the study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive	14 <sup>a</sup>	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential data confounders (b) Indicate the number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (e.g., average and total amount)
Outcome data	15 <sup>a</sup>	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results.
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based.

<sup>a</sup> Give such information separately for cases and controls in case-control studies, and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies. Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Separate versions of the checklist for cohort, case-control, and cross-sectional studies are available on the STROBE Web site at <http://www.strobe-statement.org/>.

*Figure 6: STROBE Checklist for Cross-Sectional Studies. Reproduced from “Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and Elaboration,” by the Strobe Initiative, 2014, International Journal of Surgery, 12, p. 1501. Copyright 2014 Creative Commons Attribution License. Reprinted with permission.*

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Research problem:	Clearly defined
Research rationale:	Topic and method justification
Literature review:	Topic understudy
Methodology:	Data collection: clear explanation of the Delphi method employed Rounds: number employed, outline of each Sample: experts selection process and characteristics described in detail Reliability and validity issues identified Statistical interpretation: guidelines for the reader Ethical responsibilities: towards 'expert' sample and research community
Data Analysis:	Response rate for each round Round 1: presentation of total number of issues generated Round 2: presentation of results indicating the strength of support Further rounds (if applicable): presentation of results
Discussion : and conclusions	Issue of consensus Interpretations of consensus gained/not gained Direction of further research leading from conclusions
Appendices:	Copy of each round questionnaire illustrated.

*Figure 7: Research Guidelines for the Delphi Survey Technique.* Reproduced from “Research Guidelines for the Delphi Survey Technique,” by F. Hasson, S. Keeney, and H. McKenna, 2000, *Journal of Advanced Nursing*, 32, p. 1009. Copyright 2008 John Wiley and Sons. Reprinted with permission.

### JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer \_\_\_\_\_ Date \_\_\_\_\_

Author \_\_\_\_\_ Year \_\_\_\_\_ Record Number \_\_\_\_\_

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the participants included in any comparisons similar?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was there a control group?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes of participants included in any comparisons measured in the same way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal:    Include     Exclude     Seek further info

Comments (Including reason for exclusion)

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*Figure 8:* JBI Critical Appraisal Checklist for Quasi-Experimental Studies. Reproduced from “Critical Appraisal Tools,” by The Joanna Briggs Institute, 2017, from <https://joannabriggs.org/research/critical-appraisal-tools.html>, p. 3. Copyright 2017 CASP UK. Reprinted with permission.

The data collated from the assessment of methodological quality was then grouped into broader quality concept areas to allow consistent analysis across all articles. Table 3 details what

questions per checklist were listed within each general category, which was then used as part of the data analysis.

	<b>RATS</b>	<b>STROBE (Cross-Sec)</b>	<b>JBI (Quasi)</b>	<b>Delphi</b>
	<b>Question Numbers</b>			
<b>Abstract &amp; Introduction</b>				
Conceptualize research question	1, 2	2, 3	None	1, 2
<b>Methods Evaluation</b>				
Study Design	3	1a, 4	1	4
Participants and Setting	4, 5, 6, 8	5, 6, 10	2, 3	6
Data Collection	7, 9	7, 8, 11	4	4, 5, 7
Data Analysis	16, 17, 18	12a, 12b, 12c, 12d, 12e	5, 9	8
<b>Results Analysis</b>				
Conceptually meets guideline	None	13a, 13b, 13c, 14a, 14b, 15, 16a, 16b, 16c, 17	6, 7, 8	10, 11, 12, 13
<b>Discussion</b>				
Conceptually meets guideline	19	18, 20, 21	None	14, 15, 16
Limitations	20	19	None	None
Ethics	13, 14, 15	None	None	9

*Table 3: Categories for Assessment of Methodological Quality*

Furthermore, a rating of completeness was applied to each of the articles. To determine the articles percentage for rating of completeness, the total of that article's yes values were divided by the total number of categories that applied to the same article (as listed in Table 3). If an article had none listed under one of the categories, then it was removed from the total number of categories calculation. For example, an article that had two yes values and met eight of the categories (as one was listed as none) earned a 25% rating of completeness.

## 2.4 Data Collection

A descriptive-analytical method was taken to chart the data from the selected studies. Descriptive analytics is used as a preliminary stage of data processing to create a summary of

historical data to yield useful information and then prepare that data for further analysis (“What is descriptive analytics,” n.d.). It looks to see what is currently recorded in the study in relation to the research objective.

The data was charted into a spreadsheet in Microsoft Excel and included a combination of general and specific information from each study (Microsoft Excel, 2013, Version 15.0.5127.1000). The data extracted included: study title; author(s); year of publication; country published in; country research conducted in; aims/purpose; research type, study design, and methods; type of findings (evidence-based or opinion-based); project management process phase (entire process, initiate, plan, design, execute, close); end-user involvement findings; healthcare related; type of HIS; project methodology (i.e. time boxing); lessons learned; and any other key findings as they related to this study. Figure 9 outlines the data collection information. No new studies published after May 4, 2019 were included in the analysis.

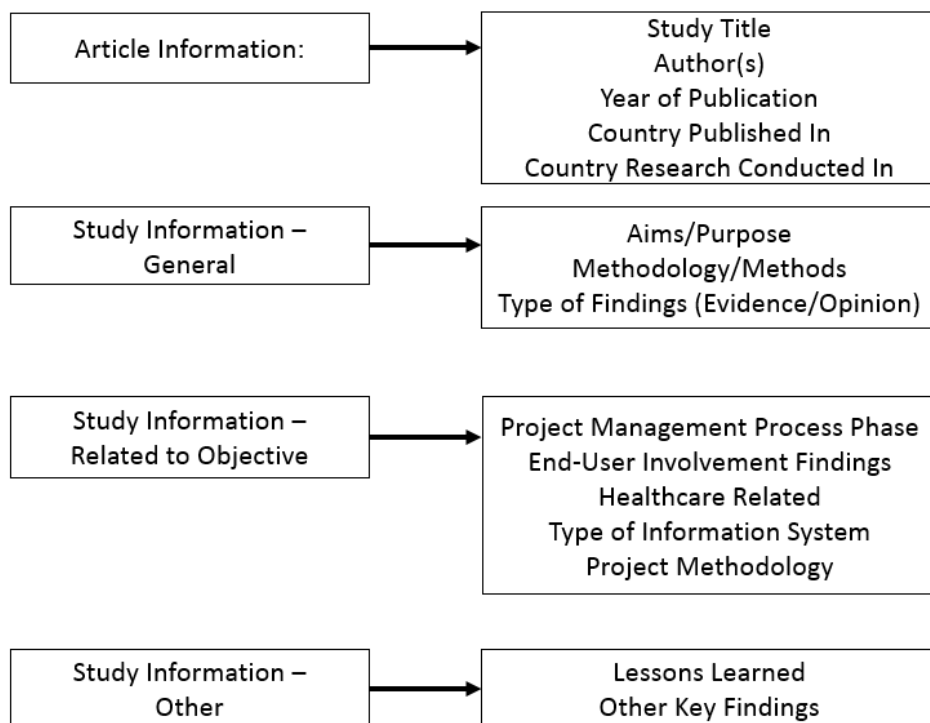


Figure 9: Data Collection Information

## 2.5 Data Analysis

Data analysis included collating and summarizing the recorded results into reportable and synthesised results. Characteristics of each study were recorded and included where the studies were published, where research was conducted, what method was used, type of findings (evidence or opinion-based), etc.

The reviewer followed the University of Victoria's definition of primary and secondary sources in order to define which articles were evidence-based versus opinion-based. Recommendations presented in an evidence-based primary article were considered evidence-based, while those presented in secondary articles were considered opinions. Articles were considered a primary source if they "offer[ed] first-hand accounts or direct evidence responsive to the research question" and utilized methods including questionnaires, interviews, surveys, case studies, systematic reviews, and user-centred design ("Primary or secondary sources," n.d., "Primary Sources" section). Articles were considered a secondary source if they "comment[ed] on or analyzed[ed] texts, oral communications, artifacts, or archives of primary sources and utilized methods including summaries, literature review, or no stated method ("Primary or secondary sources," n.d., "Secondary Sources" section). Literature reviews were considered secondary opinion-based articles unless they were used in combination with another method (i.e. case study) and then were considered primary evidence-based articles.

Pre-determined categories were applied to the data charting. Categories included: the types of findings; research type, study design, and methods; project methodology; project management process; relation to the SDLC; type of HIS studied; and overall quality of the evidence. These categories helped to organize the present study's end recommendations beyond the project phases. A consistent approach was taken for reporting the findings of each study,

which allowed for comparisons across the literature to not only identify these stated categories, but also any gaps in the evidence and/or literature itself.

Further data analysis was done to identify the relationship between end-user involvement and project management outcomes. Data were identified from all articles based on the reported outcomes, measurements, type of analysis, measurement or definition of success, if end-user involvement had a positive impact on the project, and if end-user involvement correlated directly to the success of the project. Outcomes reported what the study hoped to achieved, whether that was implementation of a specific system or identifying key factors for end-user adoption. Measurements were defined based on the study being categorized as qualitative or quantitative. Measurements in qualitative studies were recorded as definitions of specific terms like end-user involvement, end-user acceptability, and successful integration, while quantitative studies defined what instruments were used within the study. Type of analysis reported what type of data analysis was used within the study to tie the measurements to the outcomes. The measurement or definition of success looked to analyse if the study indicated how they measured success (either through a measurement or definition). The remaining two items looked to analyse if the study specifically indicated that end-user involvement would have a positive impact on the project and if end-user involvement correlated directly to the success of their project.

To allow for analysis of end-user involvement, outcomes for the phases of project management and SDLC were associated together. The Initiate and Close phases of project management do not correlate to an SDLC phase. The Plan phase correlates to (1) analysis and requirements, (2) design and implementation, and (3) test of the SDLC phases. The Execute phase correlates to (4) implementation of the SDLC phases. The Monitor and Control phase correlates to (5) maintenance of the SDLC phases. Table 4 summarizes this association.

<b>Project Management Phase</b>	<b>SDLC Phase</b>
Initiate	None
Plan	(1) Analysis and requirements (2) Design and development (3) Test
Execute	(4) Implementation
Monitor and Control	(5) Maintenance
Close	None

*Table 4: Correlation between Project Management and SDLC Phases*

### 3. Results

#### 3.1 Review Inclusion and Exclusion

The results of the four-step review selection strategy are detailed in Table 5.

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
ACM Digital Library	1	17-Apr-19	0	0	0	0
	2	17-Apr-19	0	0	0	0
	3	17-Apr-19	0	0	0	0
	4	17-Apr-19	1	0	1	1
	5	17-Apr-19	1	0	0	1
	6	17-Apr-19	0	0	0	0
	7	17-Apr-19	0	0	0	0
	8	17-Apr-19	1	0	1	0
	9	17-Apr-19	0	0	0	0
	10	17-Apr-19	9	2	0	7
	11	17-Apr-19	26	3	22	1
	12	17-Apr-19	0	0	0	0
	13	17-Apr-19	1	1	0	0
	14	17-Apr-19	2	0	1	1
	15	17-Apr-19	0	0	0	0
	16	17-Apr-19	0	0	0	0
	17	17-Apr-19	0	0	0	0
	18	17-Apr-19	18	3	13	2
<b>TOTALS (ACM DL)</b>			<b>59</b>	<b>9</b>	<b>37</b>	<b>13</b>
IEEE xplore Digital Library	1	26-Apr-19	0	0	0	0
	2	26-Apr-19	0	0	0	0
	3	26-Apr-19	0	0	0	0
	4	26-Apr-19	0	0	0	0
	5	26-Apr-19	0	0	0	0
	6	26-Apr-19	0	0	0	0
	7	26-Apr-19	0	0	0	0
	8	26-Apr-19	0	0	0	0
	9	26-Apr-19	0	0	0	0
	10	26-Apr-19	39	1	29	9
	11	26-Apr-19	70	21	49	0
	12	26-Apr-19	0	0	0	0
	13	26-Apr-19	6	4	2	0

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
	14	26-Apr-19	0	0	0	0
	15	26-Apr-19	2	0	2	0
	16	26-Apr-19	1	0	1	0
	17	26-Apr-19	0	0	0	0
	18	27-Apr-19	208	5	203	0
<b>TOTALS (IEEE)</b>			<b>326</b>	<b>31</b>	<b>286</b>	<b>9</b>
CINAHL Complete (EBSCO)	1	20-Apr-19	20	0	14	6
	2	20-Apr-19	3	3	0	0
	3	20-Apr-19	74	14	53	7
	4	20-Apr-19	37	20	13	4
	5	20-Apr-19	13	5	6	2
	6	20-Apr-19	140	78	59	3
	7	20-Apr-19	45	20	22	3
	8	20-Apr-19	12	7	4	1
	9	21-Apr-19	228	84	143	1
	10	21-Apr-19	103	61	39	3
	11	21-Apr-19	29	25	4	0
	12	21-Apr-19	440	310	129	1
	13	21-Apr-19	112	34	74	4
	14	21-Apr-19	229	70	153	6
	15	21-Apr-19	136	96	40	0
	16	21-Apr-19	13	10	3	0
	17	21-Apr-19	29	21	8	0
	18	21-Apr-19	Too large (2508)	N/A	N/A	N/A
<b>TOTALS (CINAHL)</b>			<b>1663</b>	<b>858</b>	<b>764</b>	<b>41</b>
Medline	1	4-May-19	0	0	0	0
	2	4-May-19	0	0	0	0
	3	4-May-19	0	0	0	0
	4	4-May-19	0	0	0	0
	5	4-May-19	0	0	0	0
	6	4-May-19	0	0	0	0
	7	4-May-19	4	1	3	0
	8	4-May-19	0	0	0	0
	9	4-May-19	5	2	3	0
	10	4-May-19	7	4	3	0
	11	4-May-19	3	3	0	0
	12	4-May-19	6	4	2	0

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
	13	4-May-19	0	0	0	0
	14	4-May-19	0	0	0	0
	15	4-May-19	0	0	0	0
	16	4-May-19	0	0	0	0
	17	4-May-19	0	0	0	0
	18	4-May-19	16	0	16	0
<b>TOTALS (Medline)</b>			<b>41</b>	<b>14</b>	<b>27</b>	<b>0</b>
<b>Full Text Articles Reviewed</b>						<b>63</b>

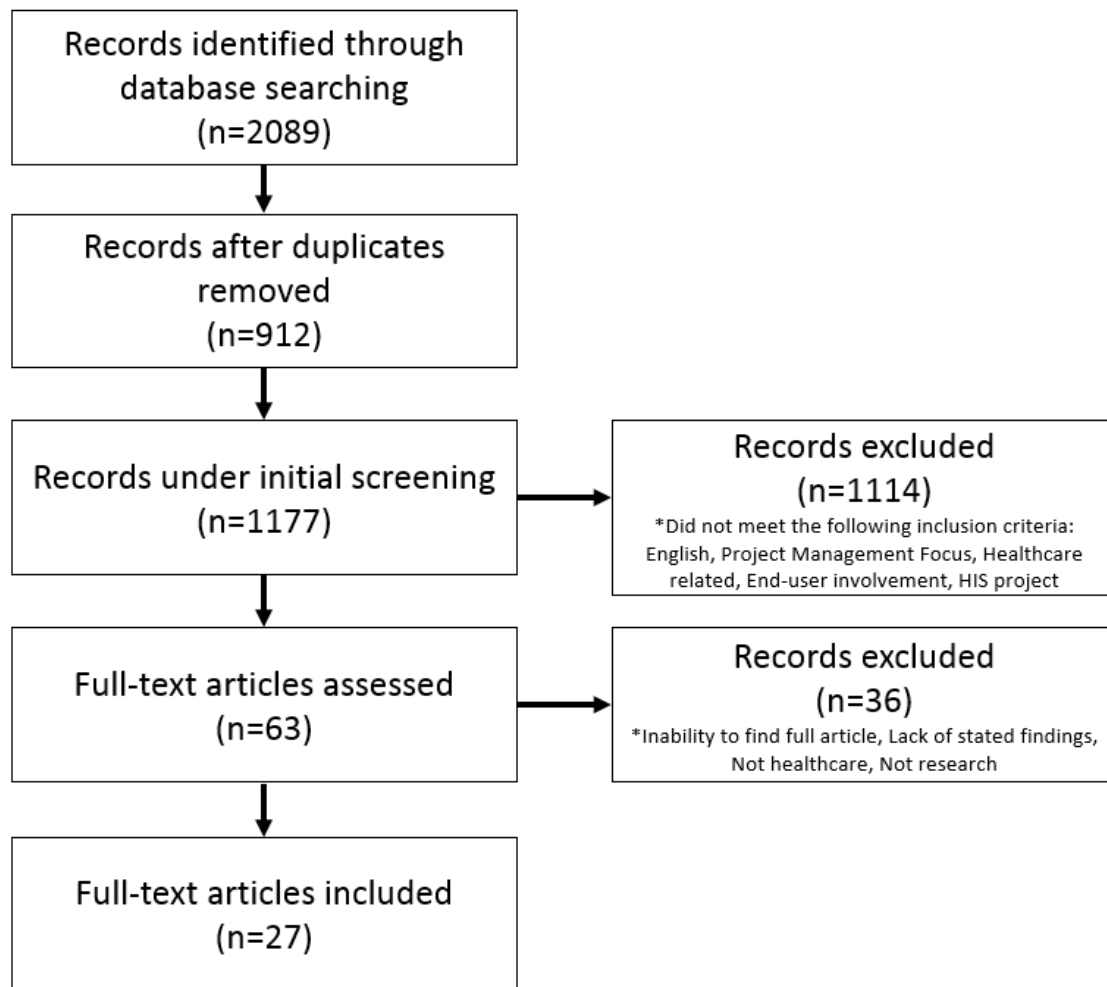
Table 5: Detail of search parameter and results

In total, there were 2,089 citations returned from all four databases. There were 59 citations obtained using ACM Digital Library, 326 citations obtained using IEEE xplore Digital Library, 1,663 citations obtained using CINAHL Complete (EBSCO), and 41 citations obtained using Medline. In step two, identification of duplicate articles was completed to remove any duplicate citations. There were nine duplicates removed from ACM Digital Library, 31 duplicates removed from IEEE xplore Digital Library, 858 duplicates removed from CINAHL Complete (EBSCO), and 14 duplicates removed from Medline for a total of 912 duplicates. The total number of records remaining for initial screening was 1,177.

In step three, the specified inclusion criteria were applied. The title and abstract were examined to determine if 1. the article was written in English; 2. had a project management focus; 3. was healthcare related; and 4. included both end-user involvement and HIS projects. There were 37 citations excluded from ACM Digital Library, 286 excluded from IEEE xplore Digital Library, 764 excluded from CINAHL Complete (EBSCO), and 27 excluded from Medline.

Sixty-three records remained for step four's full-text review (also referred to as secondary screening). In step four, a full-text review was completed to determine the article's suitability to

this study. Upon this review, a further 36 articles were excluded (three articles based on the inability to find a copy of the full article, nine articles due to a lack of stated findings or details relevant to this study, 14 articles not actually being healthcare related, and 10 articles not considered to be research). Appendix B details the 36 articles that were excluded. In total, the results of 27 articles were included for this study. Figure 10 describes a summary of the review selection strategy completed for this scoping review.



*Figure 10: Flow Indicating Search and Screening Performed*

### 3.2 Characteristics of the Literature

Various literature characteristics were recorded for each of the studies. These characteristics included when the study was published, where the study was published, what country the research was conducted in, type of findings (primary/secondary, evidence/opinion), research type, study design, methods used, project methodology followed, project management focus area, SDLC phase(s), and type of HIS studied. All results reported in this study are based on both the primary and secondary sources (as only one secondary source was identified, it was included in all result reporting).

#### 3.2.1 General Characteristics of the Studies

##### *Year of Publication*

Of the 27 articles, 62.96% (n=17) were published in the last five years (2014 to present) and 77.78% (n=21) were published in the last ten years (2009 to present). The remaining 25.93% (n=7) were published between the years 2000 and 2008. Years 2014 to 2017 had the highest number of articles published with six in 2016, three in 2015, and three in both 2014 and 2017. Table 12 in the Tables section details these results.

##### *Country Published In*

Of the 27 articles, 66.67% (n=18) were published in the United States and 18.52% (n=5) were published in the United Kingdom. The remaining 14.81% (n=4) were published in a variety of countries including Austria, Cameroon, China, and Sweden. Table 13 details these results.

<b>ID</b>	<b>Country Published In</b>	<b>Country Where Research Conducted</b>
16	USA	Not Stated
17	USA	UK
18	USA	Canada
19	USA	USA
22	USA	Not Stated – Assume USA
23	USA	Canada
24	USA	USA

<b>ID</b>	<b>Country Published In</b>	<b>Country Where Research Conducted</b>
25	USA	USA
26	USA	Not Stated
27	USA	UK
28	USA	Sweden
29	USA	Canada
30	UK	European Union
31	USA	Netherlands
32	UK	Norway
33	USA	USA
36	China	Argentina
38	USA	USA
39	UK	UK
40	UK	Scotland
42	Austria	Austria
43	UK	Canada
45	USA	Canada
47	USA	Canada
48	Cameroon	Cameroon
50	USA	New Zealand
51	Sweden	Sweden

*Table 13: Data Results Charting (Country Published In & Where Researched Conducted)*

### ***Country Research Conducted In***

Table 13 above details these results. Of the 27 articles, 11.11% (n=3) did not specify which country the research was conducted in, though one is assumed to be the United States. Researched was conducted mostly in Canada and the United States with 22.22% (n=6) occurring in Canada and 18.51% (n=5) occurring in the United States. The United Kingdom had 11.11% (n=3) of articles, while Sweden had 7.41% (n=2) of articles. The remaining eight articles had research conducted in a variety of countries with one each at 3.70% (n=1): Argentina, Austria, Cameroon, European Union, Netherlands, New Zealand, Norway, and Scotland. Figures 11 and 12 summarize these results in a data chart – one details the countries while the other details the same results by continent.

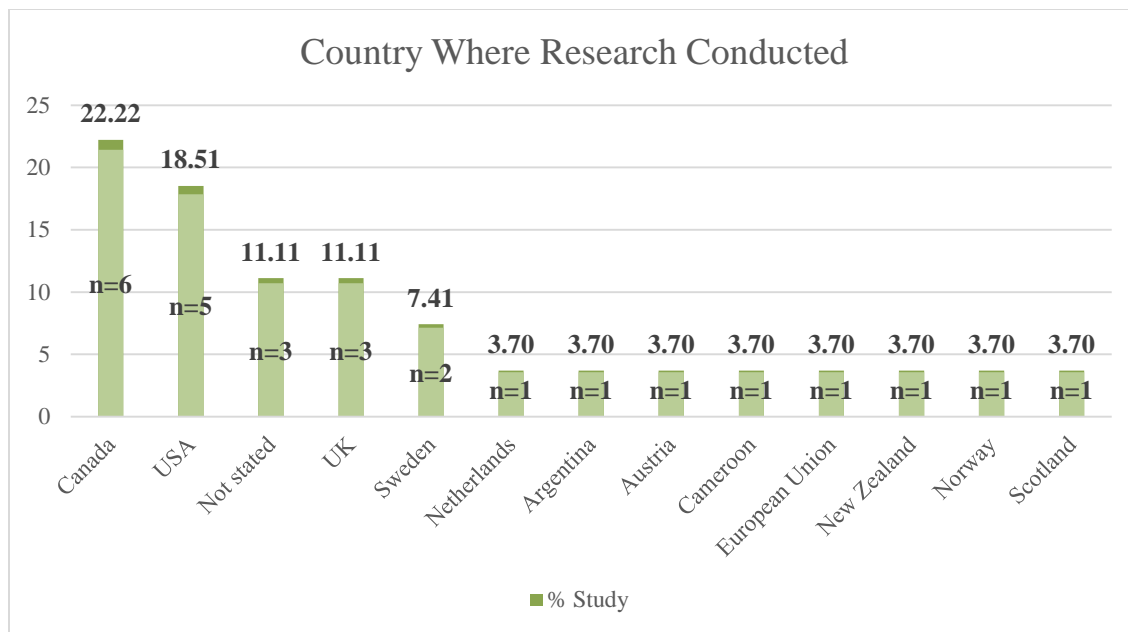


Figure 11: Data Chart – Country Where Research Conducted

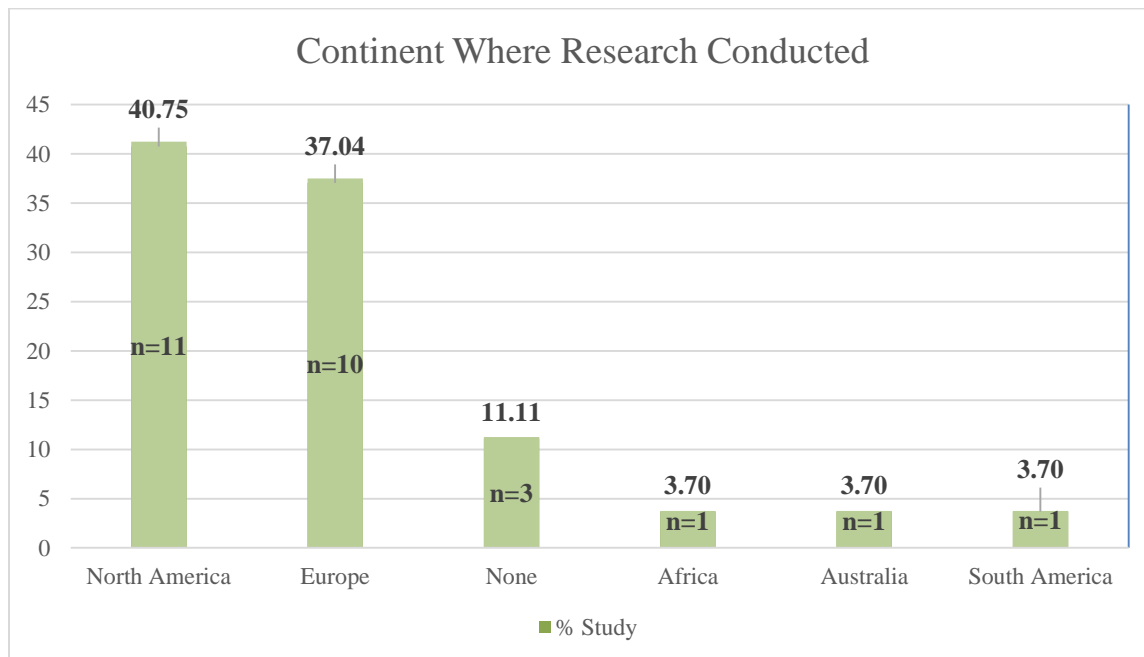


Figure 12: Data Chart – Continent Where Research Conducted

### 3.2.2 Types of Findings

Of the 27 articles, 96.30% (n=26) were assessed as primary sources (evidence-based) while the one remaining article (3.70%) was assessed as a secondary source (opinion-based).

Table 14 details these results.

<b>ID</b>	<b>Primary or Secondary</b>	<b>Type of Findings</b>
16	Primary	Evidence
17	Primary	Evidence
18	Primary	Evidence
19	Primary	Evidence
22	Primary	Evidence
23	Primary	Evidence
24	Primary	Evidence
25	Secondary	Opinion
26	Primary	Evidence
27	Primary	Evidence
28	Primary	Evidence
29	Primary	Evidence
30	Primary	Evidence
31	Primary	Evidence
32	Primary	Evidence
33	Primary	Evidence
36	Primary	Evidence
38	Primary	Evidence
39	Primary	Evidence
40	Primary	Evidence
42	Primary	Evidence
43	Primary	Evidence
45	Primary	Evidence
47	Primary	Evidence
48	Primary	Evidence
50	Primary	Evidence
51	Primary	Evidence

*Table 14: Data Results Charting (Type of Findings)*

### 3.2.3 Research Type, Study Design, and Methods

Of the 27 articles, 85.19% (n=23) were assessed as qualitative studies, while 11.11% (n=3) were assessed as quantitative studies. The remaining one article (3.70%) was assessed as a

mixed method study. The single secondary source was assessed within the qualitative study grouping, while the mixed method study was included in the quantitative grouping, unless specifically stated otherwise. Figure 13 summarize these results in a data chart. Table 15 details all results in this section.

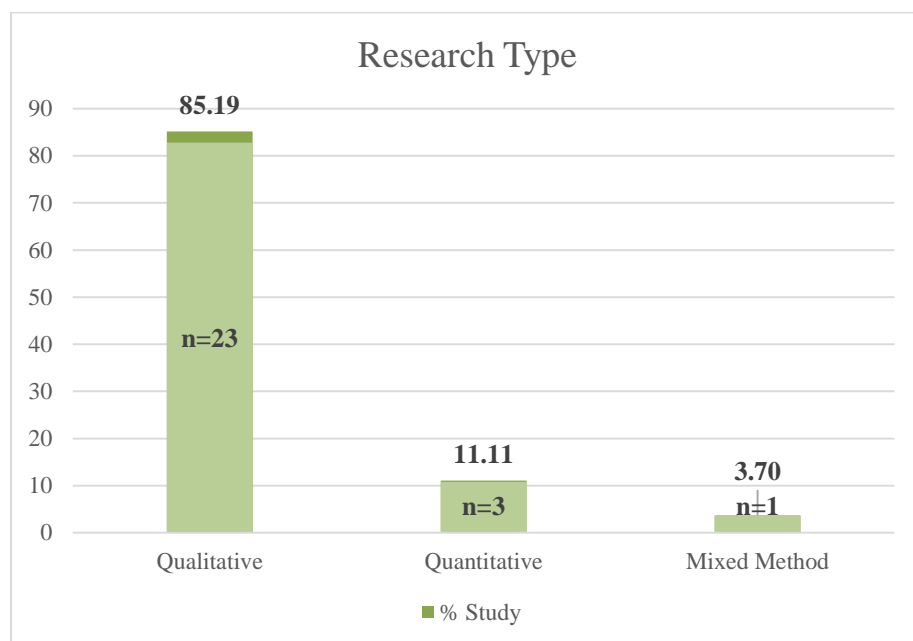


Figure 13: Data Chart – Research Type

ID	Research Type	Study Design	Method
16	Qualitative	User-centred	Interview Workshop Observation
17	Mixed Method	Cross-sectional	Workshop Questionnaire
18	Quantitative	Delphi Study	Questionnaire
19	Qualitative	Case Study	Interview Workshop
22	Qualitative	Case Study	Workshop
23	Qualitative	Case Study	Interview
24	Qualitative	Phenomenology	Interview
25	Qualitative	Phenomenology	Focus Group Observation Workshop

ID	Research Type	Study Design	Method
26	Qualitative	Participatory	Focus Group
27	Qualitative	Participatory	Workshop
28	Qualitative	Case Study	Interview
29	Qualitative	User-centred	Workshop
30	Qualitative	User-centred	Semi-structured interview
31	Qualitative	Case Study	Semi-structured interview
32	Qualitative	Case Study	Interview
33	Quantitative	Cross-sectional	Questionnaire
36	Qualitative	User-centred	Interview
38	Qualitative	User-centred	Interview
39	Qualitative	Participatory	Questionnaire Interview Focus Group
40	Qualitative	Participatory User-centred	Workshop
42	Qualitative	User-centred	Interview
43	Qualitative	Participatory	Semi-structured interview Observation
45	Quantitative	Quasi-experimental	Survey *assumed*
47	Qualitative	Participatory User-centred	Observation Workshop
48	Qualitative	Case Study	Observation Interview
50	Qualitative	Case Study	Focus Group
51	Qualitative	Participatory	Observation

*Table 15: Data Results Charting (Research Type, Study Design, Method)*

Of the 23 qualitative studies, 34.78% (n=8) followed a case study design, while another 30.43% (n=7) followed a participatory design. Another 34.78% (n=8) followed a user-centred design, while the remaining 8.70% (n=2) followed a phenomenology design. These percentages total greater than 100 as some studies used multiple designs. The study design was different amongst all three quantitative studies. Of the three quantitative studies, the cross-sectional,

Delphi, and quasi-experimental designs were each used. The study design of the one mixed methods study followed a cross-sectional design.

Of the 27 articles, all specified a data collection method. Across the qualitative studies, interview was the top method used, appearing 14 times throughout the articles. This was followed closely by workshops which appeared eight times, observations which appeared six times, focus groups were used four times, and questionnaire was used one time. Nine studies used more than one method within their study. Across the three quantitative studies, questionnaires were used twice. It is assumed that one study used a survey, though the data collection method was not specifically stated. The mixed method study used a combination of a workshop and questionnaire.

### 3.2.4 Project Methodology

Of the 27 articles, 88.89% (n=24) did not specify the project methodology that was followed. One may assume this would indicate the use of the traditional waterfall approach, but there was no clear indication within the articles themselves. The remaining three articles specifically stated the project methodology that was followed. Of those three articles, 7.41% (n=2) followed agile and 3.70% (n=1) followed lean. Figure 14 summarizes these results in a data chart. Table 16 details these results.

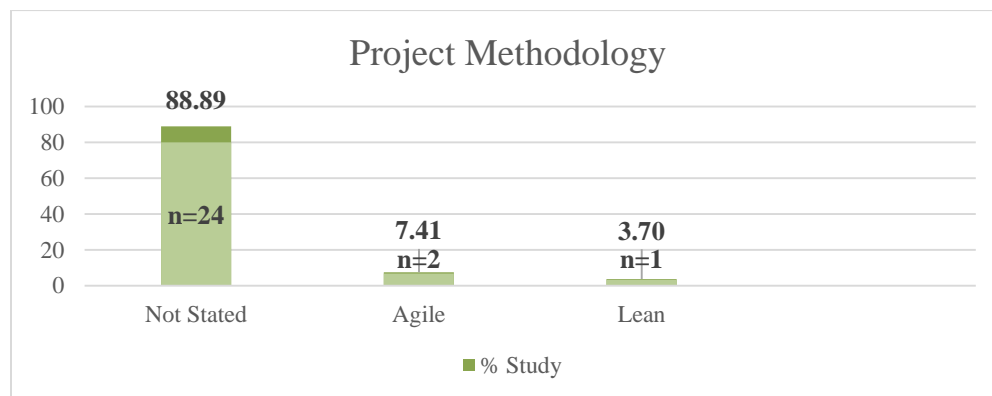


Figure 14: Data Chart – Project Methodology

<b>ID</b>	<b>Project Methodology</b>
16	Not specified
17	Not specified
18	Not specified
19	Not specified
22	Lean
23	Not specified
24	Not specified
25	Not specified
26	Not specified
27	Not specified
28	Not specified
29	Not specified
30	Not specified
31	Not specified
32	Not specified
33	Not specified
36	Agile
38	Not specified
39	Not specified
40	Not specified
42	Not specified
43	Not specified
45	Not specified
47	Agile
48	Not specified
50	Not specified
51	Not specified

*Table 16: Data Results Charting (Project Methodology)*

### **3.2.5 Project Management Process & SDLC Phase**

#### **3.2.5.1 Project Management Processes**

The project management processes fall into five categories: initiate, plan, execute, monitor and control, and close (“What is project management,” n.d.). Of the 27 articles, 14.81% (n=4) included all five areas, 11.11% (n=3) focused on three areas (plan, execute, and monitor/control), and 18.52% (n=5) focused on two areas (four focused on plan and execute while one focused on initiate and plan). The remaining articles either focused on one area

(40.75%; n=11) or did not specify the focus area (14.81%; n=4). Of the 11 articles that focused on one area, eight focused on the planning area, two focused on the execute area, and one focused on the monitor/control area. Initiate was included in 18.52% (n=5) of the articles, 74.07% (n=20) included Plan, 48.15% (n=13) included Execute, 29.63% (n=8) included Monitor/Control, and 14.81% (n=4) included Close. Figure 15 summarizes these results in a data chart. Table 17 details these results.

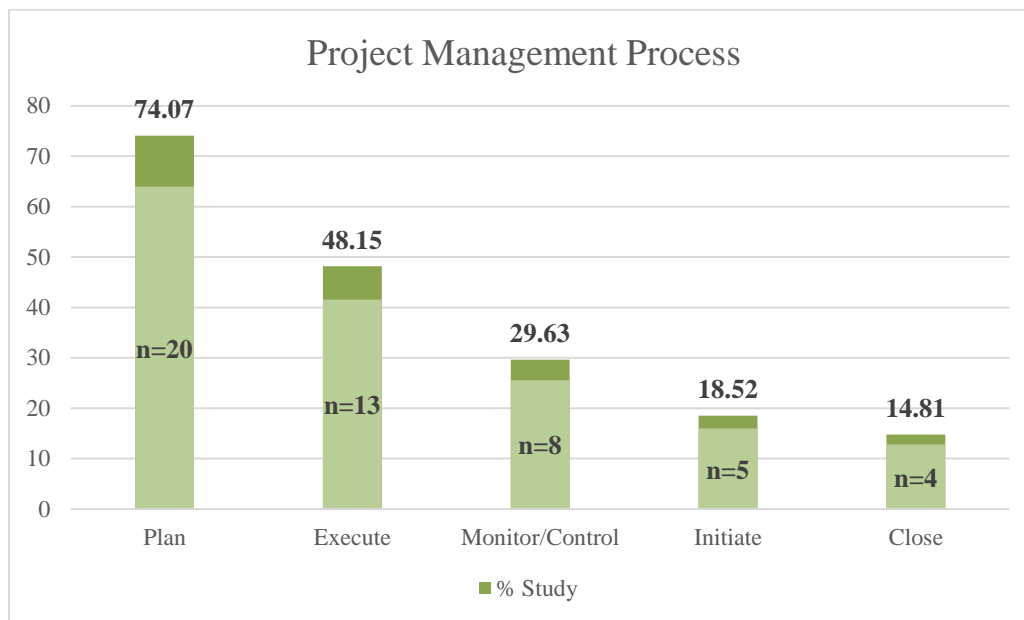


Figure 15: Data Chart – Project Management Process

ID	Project Management Process
16	Plan Execute
17	Plan Execute
18	Execute
19	All
22	Plan
23	Not specified
24	Not specified
25	Plan Execute

ID	Project Management Process
26	Plan Execute Monitor/Control
27	Plan
28	Execute
29	Plan
30	Plan
31	Not specified
32	Not specified
33	All
36	Plan Execute
38	Plan
39	Plan
40	Plan
42	All
43	Initiate Plan
45	All
47	Plan Execute Monitor/Control
48	Monitor/Control
50	Plan Execute Monitor/Control
51	Plan

*Table 17: Data Results Charting (Project Management Process)*

### 3.2.5.2 Software Development Lifecycle Processes

The SDLC consists of five phases: (1) analysis and requirements, (2) design and development, (3) test, (4) implementation, and (5) maintenance (“Systems development life cycle,” 2017). Of the 27 articles, 3.70% (n=1) did not provide a clear indication of which phase of the SDLC they would fall under. None of the 27 articles indicated all five phases of the SDLC, while 25.93% (n=7) indicated four phases of the SDLC (six articles for the first four phases and one article for all phases except test). Three phases of the SDLC were indicated in 7.41% (n=2) of the articles (one for phases 2, 3, and 4 and one for phases 1, 2, and 4). Two

phases of the SDLC were indicated in 22.22% (n=6) of the articles (four for phases 1 and 2; one for phases 1 and 4; and one for phases 2 and 4). One phase of the SDLC was indicated in 40.74% (n=11) of the articles (two for phase 1; three for phase 2; three for phase 4; and three for phase 5). Table 18 details these results.

Of the 26 articles that did specify the SDLC phase, 57.69% (n=15) included (1) analysis and requirements, 65.38% (n=17) included (2) design and development, 26.92% (n=7) included (3) test, 53.85% (n=14) included (4) implementation, and 15.38% (n=4) included (5) maintenance. Figure 16 summarizes these results in a data chart.

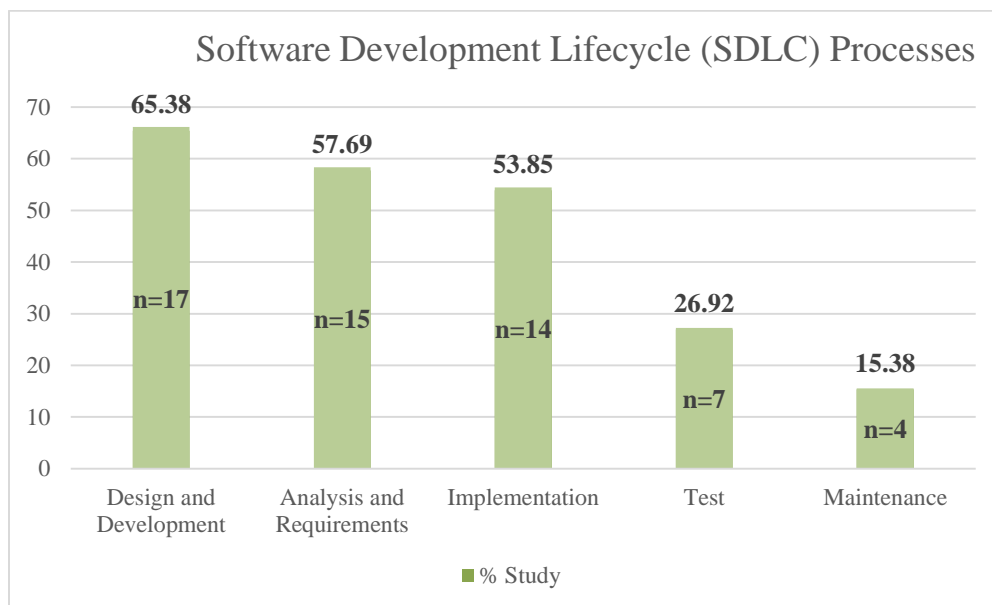


Figure 16: Data Chart – Software Development Lifecycle (SDLC) Processes

ID	SDLC
16	Design & Development Implementation
17	Design & Development Test Implementation
18	Implementation
19	Analysis & Requirements Design & Development

<b>ID</b>	<b>SDLC</b>
	Test Implementation
22	Analysis & Requirements Design & Development
23	Not specified
24	Implementation
25	Analysis & Requirements Design & Development Implementation
26	Analysis & Requirements Design & Development Implementation Maintenance
27	Analysis & Requirements Design & Development
28	Analysis & Requirements Implementation
29	Analysis & Requirements
30	Analysis & Requirements Design & Development
31	Maintenance
32	Maintenance
33	Maintenance
36	Analysis & Requirements Design & Development
38	Design & Development
39	Design & Development
40	Design & Development
42	Analysis & Requirements Design & Development Test Implementation
43	Analysis & Requirements

ID	SDLC
45	Analysis & Requirements Design & Development Test Implementation
47	Analysis & Requirements Design & Development Test Implementation
48	Implementation
50	Analysis & Requirements Design & Development Test Implementation
51	Analysis & Requirements Design & Development Test Implementation

*Table 18: Data Results Charting (SDLC)*

### **3.2.6 Type of HIS**

The type of identified HIS varied throughout the 27 articles. All HIT was specified in 3.70% (n=1) of the articles, EHRs were specified in 14.82% (n=4) of the articles, HIS' were specified in 7.41% (n=2) of the articles, and EMR and picture archiving and communication system (PACS) were both specified in one article (3.70%; n=1 respectively). The remaining 66.67% (n=18) of the articles all varied with the type of HIS and included systems like patient self-management, integrated care pathway, clinical decision support system (CDSS), wound management, resource management, mobile application, and telemedicine. Figure 17 summarizes these results in a data chart. Table 19 details these results.

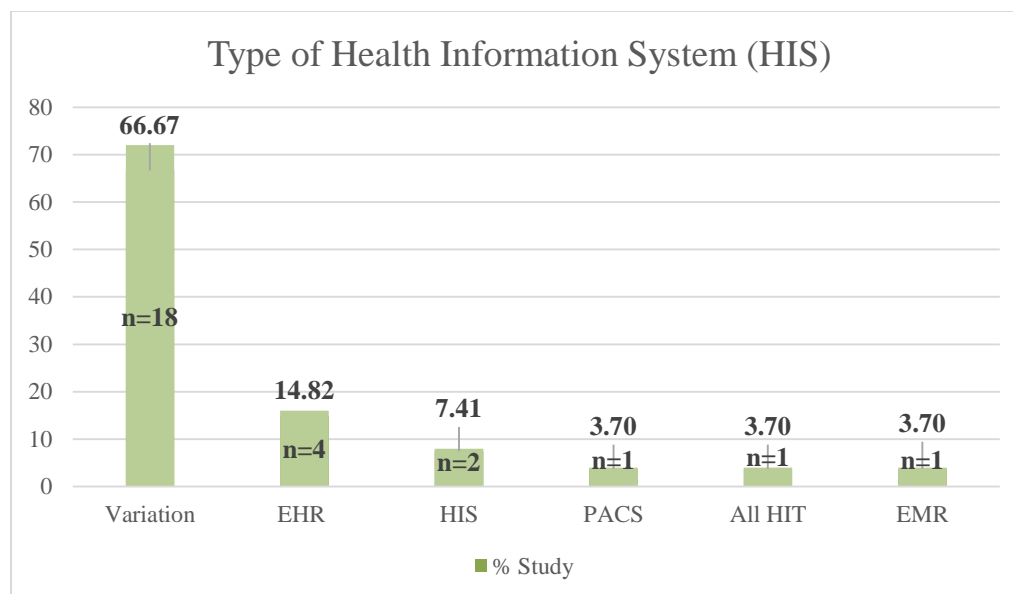


Figure 17: Data Chart – Type of Health Information System (HIS)

ID	Type of HIS
16	Patient self-management
17	Integrated care pathway
18	EHR
19	Depression Management Decision Support Tool (DM-DST)
22	Electronic notification system (part of design for new surgical tower)
23	Referral for total knee replacement surgery
24	Family Centered Rounds (FCR) Checklist
25	HIS
26	Resource management system (Nurse Managers)
27	Wound management
28	Medication administration
29	Mobile app (Lupus)
30	Liver patient management ICT system
31	EHR
32	Treatment plan system (Lifecare eRoom)
33	Healthcare management systems (HMS)
36	Mobile app (Blood transfusion)
38	EMR
39	Health Risk Appraisal for Older People (HRAO)
40	Text message scheduling system
42	Smart home technologies and systems (for Active and Assisted Living)
43	All health technology
45	PACS
47	Interprofessional clinical communication and collaboration platform (Care Connector)

ID	Type of HIS
48	EHR
50	EHR
51	HIS

Table 19: Data Results Charting (Type of HIS)

### 3.3 Assessment of Methodological Quality

Each of the reviews included an assessment for methodological quality based on qualitative or quantitative guidelines and collection of data that directly related to the research question. The reviewer used the following guidelines: RATS (qualitative studies), STROBE (cross-sectional studies), Delphi Survey Technique (Delphi studies), and JBI Critical Appraisal (Quasi-Experimental studies). Tables 6-10 located in the Tables section detail a summary of the assessment for each of the reviews based on its designated guideline.

To allow conceptual analysis across all articles, the assessment of the methodological quality of the studies was done based on broader concept areas. Questions within each checklist were listed under broader concept areas, as previously detailed in Table 3.

	RATS	STROBE (Cross-Sec)	JBI (Quasi)	Delphi
<b>Abstract &amp; Introduction</b>				
Conceptualize research question	1, 2	2, 3	None	1, 2
<b>Methods Evaluation</b>	-	-	-	-
Study Design	3	1a, 4	1	4
Participants and Setting	4, 5, 6, 8	5, 6, 10	2, 3	6
Data Collection	7, 9	7, 8, 11	4	4, 5, 7
Data Analysis	16, 17, 18	12a, 12b, 12c, 12d, 12e	5, 9	8
<b>Results Analysis</b>	-	-	-	-
Conceptually meets guideline	None	13a, 13b, 13c, 14a, 14b, 15, 16a, 16b, 16c, 17	6, 7, 8	10, 11, 12, 13
<b>Discussion</b>				

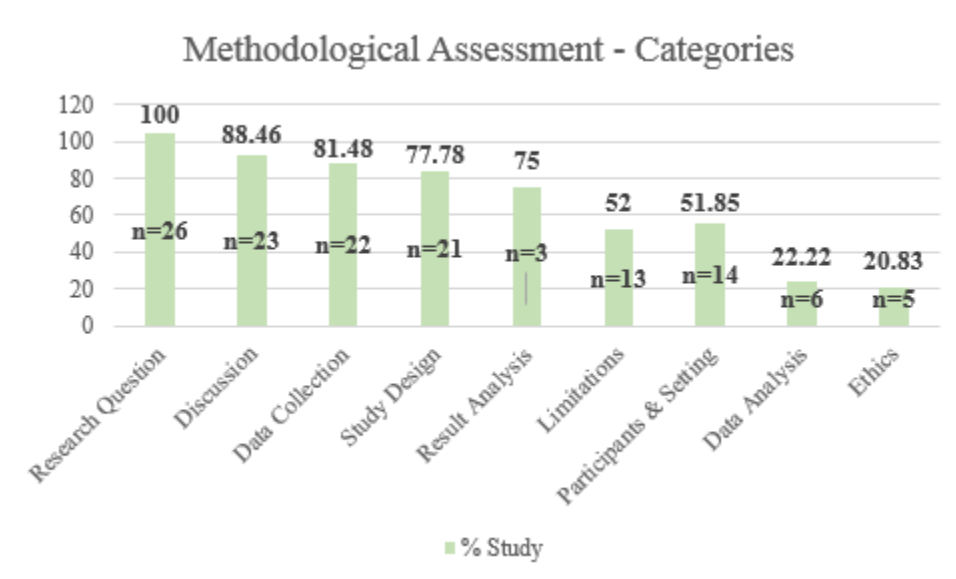
	<b>RATS</b>	<b>STROBE (Cross-Sec)</b>	<b>JBI (Quasi)</b>	<b>Delphi</b>
Conceptually meets guideline	19	18, 20, 21	None	14, 15, 16
Limitations	20	19	None	None
Ethics	13, 14, 15	None	None	9

*Table 3: Categories for Assessment of Methodological Quality*

If the guideline did not have an item that fit within the category, it was indicated as none in the table and removed from that item of analysis. If there were multiple items listed from a specific guideline under one concept area, the majority of responses was used to determine if the article met the requirements for that concept area. For example, one article indicated both a yes and no for the two items listed under that concept area; it is marked as meeting the requirements as it is 50% positive.

All (n=26) of the articles conceptualized the research question (note: one article was removed from the research question analysis as it was marked as none in the table). In the methods section, the study design, participants and setting, data collection, and data analysis areas were assessed. Study design was clearly indicated in 77.78% (n=21) of the articles. Participants and setting were clearly detailed in 51.85% (n=14) of the articles. The data collection was accurately detailed in 81.48% (n=22) of the articles. The data analysis was accurately detailed in 22.22% (n=6) of the articles. Seventy-five percent (n=3) of the articles conceptually met the guidelines for their result analysis (note: all 23 qualitative articles were removed from the result analysis as they were marked as none in the table; analysis was covered under the methods section in the RATS guideline). For the discussion, 88.46% (n=23) of the articles conceptually met the guidelines (note: one article was removed from the discussion analysis as it was marked as none in the table). Fifty-two percent (n=13) of the articles clearly indicated limitations of their study (note: two articles were removed from limitations analysis as

they were marked as none in the table). Human research ethics considerations were noted in 20.83% (n=5) of the articles (note: three articles were removed from ethics analysis as they were marked as none in the table). Figure 18 summarizes these results in a data chart.



*Figure 18:* Data Chart – Methodological Assessment: Categories

Each article was then rated for completeness, as previously detailed in the Methods section. The rating of completeness was calculated by dividing the total of the article's yes values by the total number of categories that applied to the same article (as listed in Table 3). Figure 19 summarizes these results. Only five studies were 100% complete. Completeness ranged from 20% to 100% with the majority of studies (n=20) being at least 50% complete.

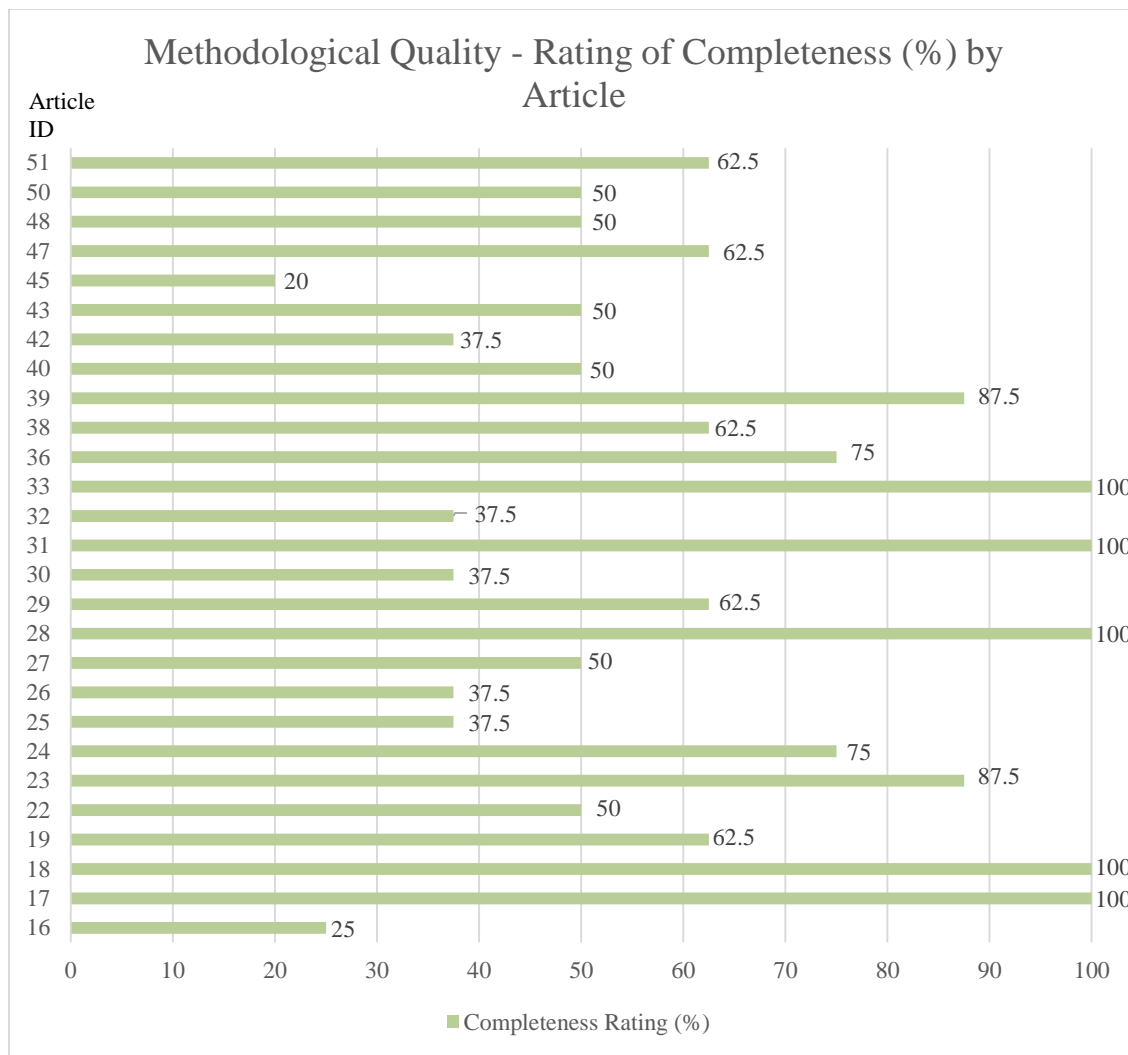


Figure 19: Data Chart – Methodological Assessment: Rating of Completeness (%) By Article

### 3.4 Findings of the Review

#### 3.4.1 End-User Involvement within the Studies

This section provides the details of the end-user involvement within the studies, particularly SDLC involvement and end-users’ perceptions of their involvement in the project.

Table 20 details these results.

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
16	eHealth solutions require successful implementation with the healthcare processes - personnel need to feel ownership of the solution to perceive it as effective.	Yes	Not specified	Not specified
17	User involvement is fundamental to success of any project, including integrated care pathway. Should be constructed with whole research group, including users.	Yes	Not specified	Positive
18	One of the ten decision making factors specific to EHR implementation in Canada is the participation of end-users in implementation strategy	Yes	Implementation	Positive
19	Use of iterative, cross-stakeholder interaction with research team acting as coordinator for cumulative information between stakeholder groups resulted in final product that met needs of stakeholder groups and produced a decision support tool that is both clinically accurate and culturally appropriate	Yes	Design and Development Testing Implementation Maintenance	Not specified
22	Lean tools and methods valuable to help establish buy-in and consensus among stakeholders	Yes	Analysis and Requirements Design and Development	Not specified
23	Initial participation among stakeholders was a challenge. Confusion around stakeholder expectations was an unanticipated consequence. Three most common areas of difficulty were change readiness, communication, and participation. Deliberate efforts must be made before and during implementation process to maximize stakeholder readiness, participation, and uptake while mitigating unanticipated consequences.	Yes	Implementation	Negative

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
24	Stakeholder representatives performed critical functions in collaboration process. Involvement of parent representative was essential	Yes	Implementation	Not specified
25	Lack of integration among groups involved in design and implementation results in a loss of trust by end users. Lack of user involvement is one of the reasons for implementation failures.	No	N/A	N/A
26	Users were heavily involved in design process which allowed project to be successful. Allowed designers to tailor system to users' responsibilities, work process, and needs for information and decision support.	Yes	Design and Development	Not specified
27	Patient and caregiver participation in product development process brings benefits to understanding issues important to them, which results in a more successful product	Yes	Analysis and Requirements Design and Development	Positive
28	Staff and front line managers had low power of influence and mostly assumed role of recipients of ICT system. Purpose and decisions on why change was initiated was unclear. Lack of management of project and who was responsible for what.	Yes	Analysis and Requirements Implementation	Negative
29	Success of method attributed to leveraging a range of respectful collaboration and contribution approaches	Yes	Analysis and Requirements	Not specified
30	Technology developers had no direct contact with end users (patients) during project and relied heavily on the clinical expert partners to convey user needs. Clinicians were essential in defining user needs, but clinical background and lack of end user needs engineering methodologies represented a challenge.	Yes	Design and Development	Not specified

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
31	Factors that impeded implementation included insufficient involvement of nurses and physicians and a lack of time	Yes	Maintenance	Not specified
32	Success factors: leveraging enthusiasts during implementation phase and early involvement of stakeholders. Barriers: resistance to change and insufficient buy-in.	Yes	Maintenance	Not specified
33	High level of user conflict during system development/implementation likely leads to user system avoidance. To increase HMS usage, user participation in system development/implementation process is important. Users will strive for better communication with developers if they believe they can influence the development and get the system they want.	Yes	Maintenance	Not specified
36	Cannot create a representative tool without user participation in task (i.e. user-centred design). This makes it easier to learn, simpler to use, and gains good acceptance and perception of utility by users.	Yes	Analysis and Requirements Design and Development	Not specified
38	Provided feedback in terms of system's usability and usefulness	Yes	Maintenance	Not specified
39	Older people able to take action in their health by adding their perspectives on social dimensions of health and well-being into the tool	Yes	Maintenance	Not specified
40	Close collaboration between developer and paediatrician throughout cycle of design and evaluation resulted in a reliable, valid and acceptable prototype which was easily implemented into routine practice	Yes	Design and Development Testing Maintenance	Not specified
42	Active involvement of representatives of all relevant user groups and other stakeholders in all phases of the project was a major challenge.	Yes	Analysis and Requirements Design and Development	Not specified

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
	Involvement of end user organizations is crucial for access to expert knowledge and to ensure they can be actively involved in all phases of the project. Use of participatory approach during requirements phase was successful and helped prioritize services according to actual user needs.		Testing Implementation	
43	Promote patient participation in three stages of health technology assessment	Yes	Analysis and Requirements Design and Development	Not specified
45	User involvement in PACS planning, training, technical support, and rollout of pilot projects was a key success factor. Non-technical factors also need to be recognized and resolved.	Yes	Analysis and Requirements Implementation	Positive
47	User-centred design effective in informing design of new modules, but inefficient in obtaining iterative feedback for enhancements due to resource intensiveness and difficulty of scheduling with busy clinicians to obtain timely feedback necessary for rapid agile software development cycles. This gap was addressed by using participatory design and user co-design methods. Through participatory design, physician and nursing leads embedded as part of core design and played key role in design decision making. Used in tandem with co-design and critical to success of project where adoption was easily achieved.	Yes	Design and Development	Positive
48	End user involvement and capacity building should have been carried out at the early stages of system development	Yes	Implementation	Not specified

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
50	End users of the technologies must be involved in every stage of the process - from software development from choice of hardware to enabling technologies to perform all of the required nursing tasks	Yes	Maintenance	Not specified
51	Use of participatory design increases possibility that development results in a system that the stakeholder group needs, approves of, and will use	Yes	Maintenance	Not specified

*Table 20: Data Results Charting (End-User Involvement within the Studies)*

Of the 27 articles, 96.30% (n=26) involved end-users within their study, while one single article did not (this article still spoke to end-user involvement in their results, it just did not actually include end-users within the study referenced in the article itself). Of the 26 articles that did involve end-users directly within the study, 7.69% (n=2) did not specify where and how the end-users were involved. One article (3.85%) included end-users in the analysis and requirements phase while three articles (11.54%) included end-users in the design and development phase. Four articles (15.38%) included end-users in the implementation phase while seven articles (26.92%) included end-users in the maintenance phase. The remaining nine articles (34.62%) included the end-users in multiple phases of the project. Figure 20 summarizes these results in a data chart (the nine articles are listed under Multiple Phases). The phases within these nine articles in which the end-users were involved varied. Both analysis and requirements and design and development appeared seven times, testing appeared three times, implementation appeared four times, and maintenance appeared two times.

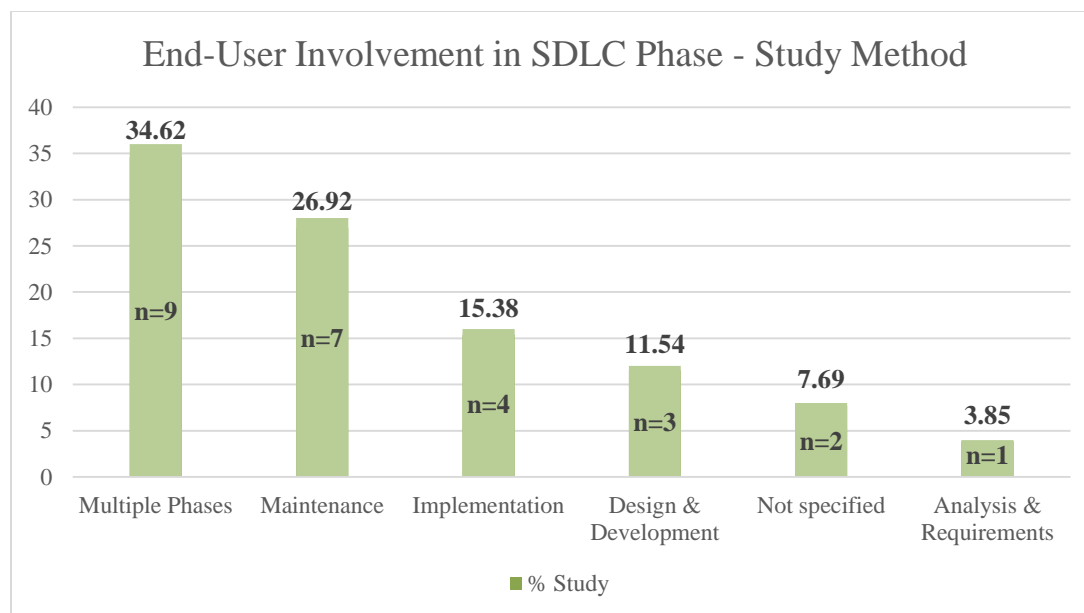


Figure 20: Data Chart – End-User Involvement in SDLC Phase – Study Method

Of the 26 articles where end-users were involved in the study, 73.08% (n=19) did not report any perceived perceptions from the end-users of their involvement. For the remaining eight articles, 19.23% (n=5) noted a positive perception by the end-users of their involvement while 7.69% (n=2) noted a negative perception.

### 3.4.2 End-User Involvement Recommendations in the Studies

This section provides the recommendations (or results) of the studies regarding end-user involvement, particularly involvement in the SDLC and project management phases. Table 21 details these results. This differentiates from the previous section as the recommendations or results of the article differed from how end-users were actually involved within their studies (i.e. they involved end-users in one phase but later recommended to involve them in another phase). Table 4 detailed the correlation between the project management phase and the SDLC phase, which will also be used within these results. As two of the project management phases do not correlate to an SDLC phase (Initiate and Close), none of the articles indicated that the end-users should be involved throughout the entire project management process.

<b>ID</b>	<b>User involvement findings</b>	<b>Where and how should users be involved (results)?</b>
16	eHealth solutions require successful implementation with the healthcare processes - personnel need to feel ownership of the solution to perceive it as effective.	Design and Development Implementation
17	User involvement is fundamental to success of any project, including integrated care pathway. Should be constructed with whole research group, including users.	Implementation
18	One of the ten decision making factors specific to EHR implementation in Canada is the participation of end-users in implementation strategy	Implementation
19	Use of iterative, cross-stakeholder interaction with research team acting as coordinator for cumulative information between stakeholder groups resulted in final product that met needs of stakeholder groups and produced a decision support tool that is both clinically accurate and culturally appropriate	Project lifecycle
22	Lean tools and methods valuable to help establish buy-in and consensus among stakeholders	Analysis and Requirements Design and Development
23	Initial participation among stakeholders was a challenge. Confusion around stakeholder expectations was an unanticipated consequence. Three most common areas of difficulty were change readiness, communication, and participation. Deliberate efforts must be made before and during implementation process to maximize stakeholder readiness, participation, and uptake while mitigating unanticipated consequences.	Implementation
24	Stakeholder representatives performed critical functions in collaboration process. Involvement of parent representative was essential	Design and Development Implementation
25	Lack of integration among groups involved in design and implementation results in a loss of trust by end users. Lack of user involvement is one of the reasons for implementation failures.	Analysis and Requirements Design and Development Implementation
26	Users were heavily involved in design process which allowed project to be successful. Allowed designers to tailor system to users' responsibilities, work process, and needs for information and decision support.	Project lifecycle
27	Patient and caregiver participation in product development process brings benefits to understanding issues important to them, which results in a more successful product	Analysis and Requirements Design and Development

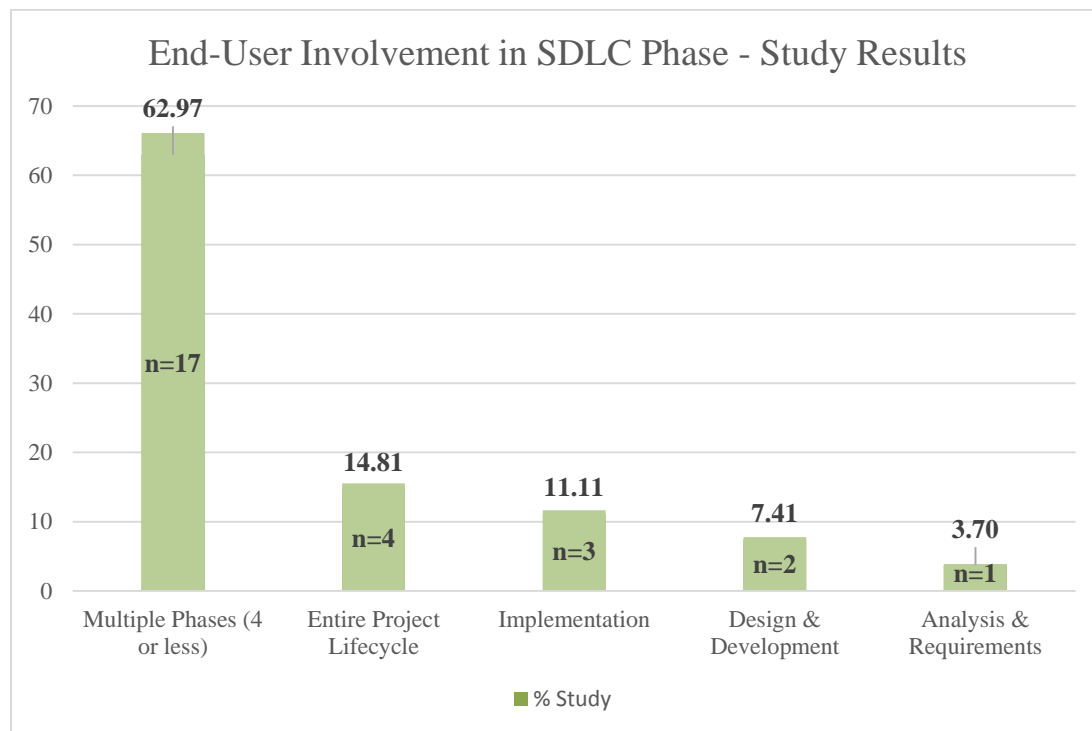
<b>ID</b>	<b>User involvement findings</b>	<b>Where and how should users be involved (results)?</b>
28	Staff and front-line managers had low power of influence and mostly assumed role of recipients of ICT system. Purpose and decisions on why change was initiated was unclear. Lack of management of project and who was responsible for what.	Analysis and Requirements Implementation
29	Success of method attributed to leveraging a range of respectful collaboration and contribution approaches	Analysis and Requirements
30	Technology developers had no direct contact with end users (patients) during project and relied heavily on the clinical expert partners to convey user needs. Clinicians were essential in defining user needs, but clinical background and lack of end user needs engineering methodologies represented a challenge.	Analysis and Requirements Design and Development
31	Factors that impeded implementation included insufficient involvement of nurses and physicians and a lack of time	Analysis and Requirements Implementation
32	Success factors: leveraging enthusiasts during implementation phase and early involvement of stakeholders. Barriers: resistance to change and insufficient buy-in.	Analysis and Requirements Design and Development Implementation
33	High level of user conflict during system development/implementation likely leads to user system avoidance. To increase HMS usage, user participation in system development/implementation process is important. Users will strive for better communication with developers if they believe they can influence the development and get the system they want.	Design and Development Implementation
36	Cannot create a representative tool without user participation in task (i.e. user-centred design). This makes it easier to learn, simpler to use, and gains good acceptance and perception of utility by users.	Project lifecycle
38	Provided feedback in terms of system's usability and usefulness	Design and Development Implementation
39	Older people able to take action in their health by adding their perspectives on social dimensions of health and well-being into the tool	Design and Development
40	Close collaboration between developer and paediatrician throughout cycle of design and evaluation resulted in a reliable, valid and acceptable prototype which was easily implemented into routine practice	Design and Development Maintenance
42	Active involvement of representatives of all relevant user groups and other stakeholders in all phases of the project was a major challenge. Involvement of end user organizations is	Project lifecycle

ID	User involvement findings	Where and how should users be involved (results)?
	crucial for access to expert knowledge and to ensure they can be actively involved in all phases of the project. Use of participatory approach during requirements phase was successful and helped prioritize services according to actual user needs.	
43	Promote patient participation in three stages of health technology assessment	Not specified
45	User involvement in PACS planning, training, technical support, and rollout of pilot projects was a key success factor. Non-technical factors also need to be recognized and resolved.	Analysis and Requirements Implementation
47	User-centred design effective in informing design of new modules, but inefficient in obtaining iterative feedback for enhancements due to resource intensiveness and difficulty of scheduling with busy clinicians to obtain timely feedback necessary for rapid agile software development cycles. This gap was addressed by using participatory design and user co-design methods. Through participatory design, physician and nursing leads embedded as part of core design and played key role in design decision making. Used in tandem with co-design and critical to success of project where adoption was easily achieved.	Design and Development
48	End user involvement and capacity building should have been carried out at the early stages of system development	Design and Development Implementation
50	End users of the technologies must be involved in every stage of the process - from software development from choice of hardware to enabling technologies to perform all of the required nursing tasks	Analysis and Requirements Design and Development Testing Implementation
51	Use of participatory design increases possibility that development results in a system that the stakeholder group needs, approves of, and will use	Analysis and Requirements Design and Development Testing Implementation

*Table 21: Data Results Charting (End-User Involvement Recommendations)*

Of the 27 articles, 14.81% (n=4) indicated that end-users should be involved throughout the entire project life cycle, or in other words, all phases of the SDLC. One article (3.70%) stated to include end-users in the analysis and requirements phases. Two articles (7.41%) stated to

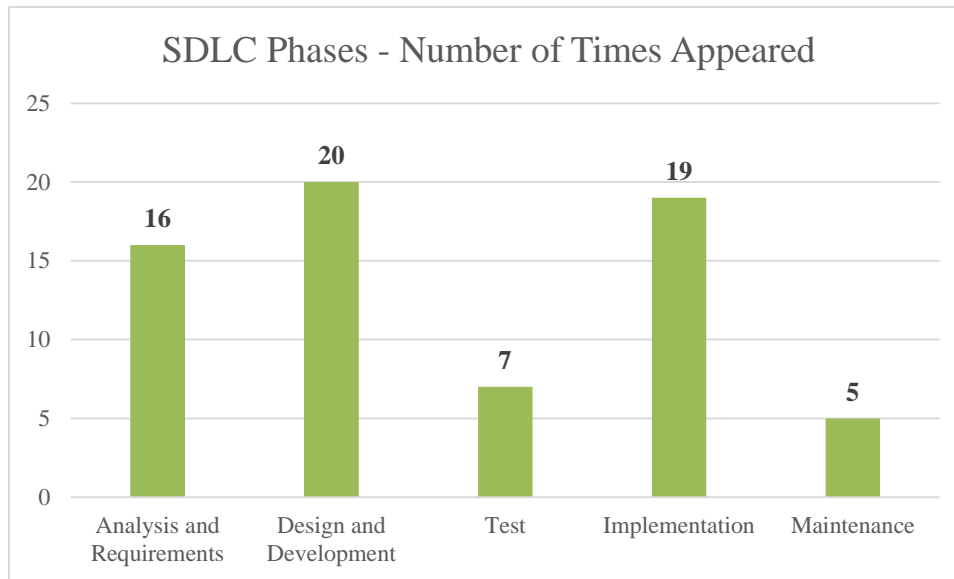
include end-users in the design and development phase. Three articles (11.11%) stated to include end-users in the implementation phase. The remaining 17 articles (62.96%) stated to include the end-users in multiple phases of the project. Figure 21 summarizes these results in a data chart.



*Figure 21: Data Chart – End-User Involvement in SDLC Phase – Study Results*

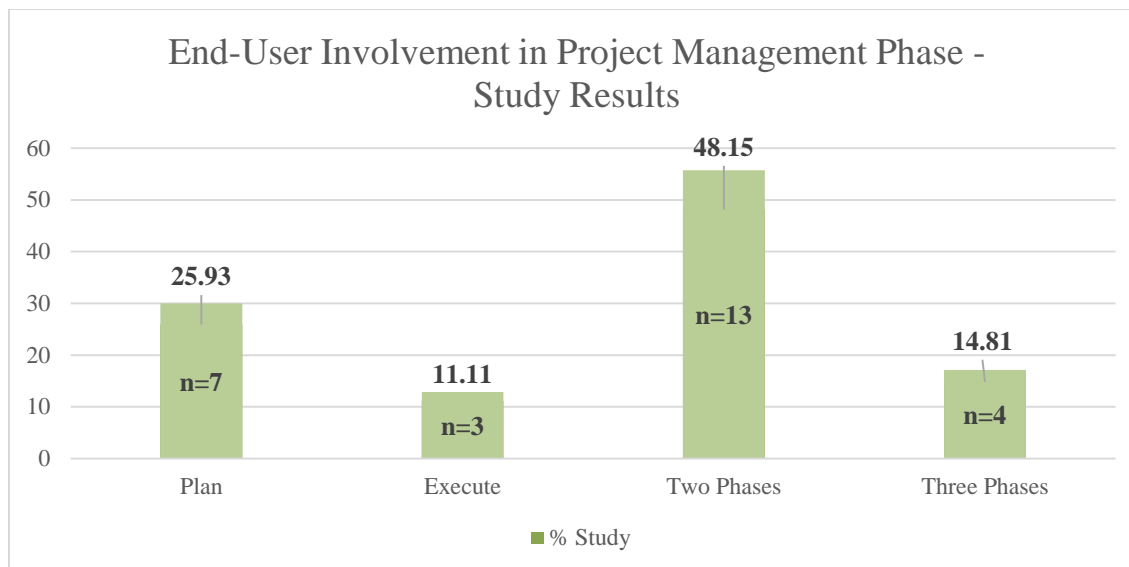
The phases within the 17 articles in which end-users should be involved varied. Twelve articles stated to include end-users in two phases of the SDLC (four were analysis and requirements and design and development; five were design and development and implementation; and three were analysis and requirements and implementation). Three articles stated to include end-users in three phases of the SDLC (two were analysis and requirements, design and development, and implementation; and one was design and development, test, and maintenance). The remaining two articles stated to include end-users in four phases of the SDLC (both were all phases except maintenance).

With regards to the SDLC phases, analysis and requirements appeared 16 times, design and development appeared 20 times, test appeared seven times, implementation appeared 19 times, and maintenance appeared five times (throughout all the articles). The three major phases of the SDLC that end-users should be involved with are (1) analysis and requirements, (2) design and development, and (4) implementation. Figure 22 summarizes these results in a data chart.



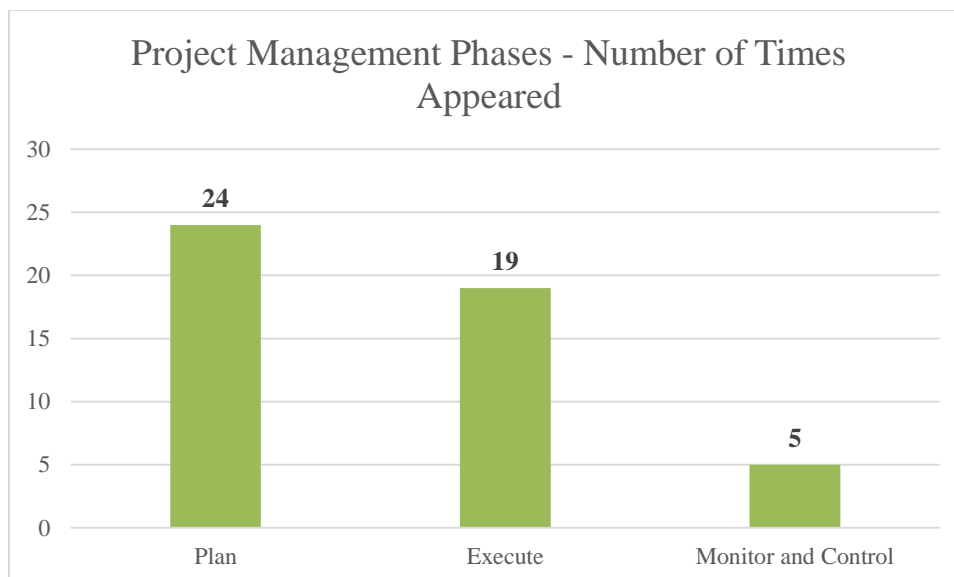
*Figure 22: Data Chart – SDLC Phases: Number of Times Appeared*

Of the 27 articles, seven articles (25.93%) stated to include end-users in the Plan phase, while three articles (11.11%) stated the Execute phase. Thirteen articles (48.15%) stated to include end-users in two phases of the project management process (12 articles were the Plan and Execute phases while one article was the Plan and Monitor and Control phases). The remaining four articles (14.81%) stated to include end-users in three phases of the project management process (all four were the Plan, Execute, and Monitor and Control phases). Figure 23 summarizes these results in a data chart.



*Figure 23: Data Chart – End-User Involvement in Project Management Phases: Study Results*

With regards to the project management phases, Plan appeared 24 times, Execute appeared 19 times, and Monitor and Control appeared five times (throughout all the articles). The two main phases of the project management process that end-users should be involved with are Plan and Execute. Figure 24 summarizes these results in a data chart.



*Figure 24: Data Chart – Project Management Phases: Number of Times Appeared*

### 3.4.3 Relationship between End-User Involvement and Outcomes

As the benefits of end-user involvement and project management outcomes is the key objective of this study, this section analyses the relationship between end-user involvement and the outcomes specified within the studies.

#### *What are the outcomes the studies measured and what measurements were used?*

The outcomes measured throughout the studies varied, even between the qualitative and quantitative studies. The main outcomes measured were to identify end-user involvement factors in either the design or implementation phases. Outcome for design factors was in 22.22% (n=6) of the articles, while outcome for implementation factors was in 18.52% (n=5) of the articles. An additional three articles included both design and implementation factors as their outcome overlapped between the two outcomes categories (these were not included in the previous percentages). Three other outcomes followed closely behind the main outcomes: identifying end-user experiences/perceptions, implementation of a system or mobile application, and end-user engagement process factors. Outcomes for end-user experiences/perceptions and implementation of a system or mobile application both appeared in 14.81% (n=4) of the articles. Outcome for end-user engagement was in 11.11% (n=3) of the articles. The remaining outcome, end-user system use or acceptance, was in 7.41% (n=2) of the articles. Figure 25 summarizes these results in a data chart. Table 22 details these results.

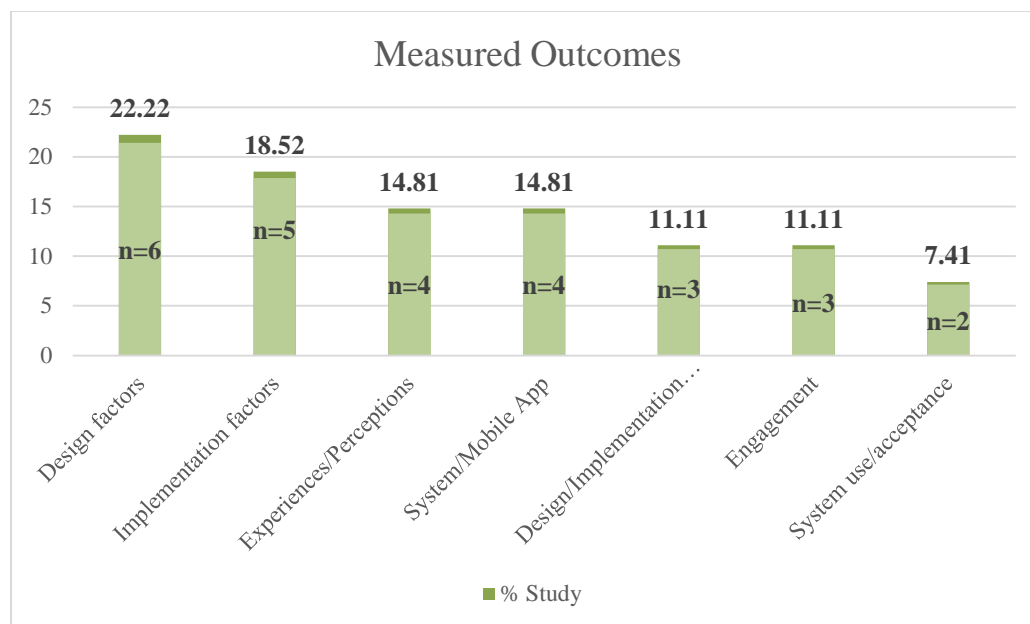


Figure 25: Data Chart – Measured Outcomes

ID	Outcomes	Outcomes (Category)
16	Stakeholder engagement through user-centred design	Engagement
17	Participant experiences on the new electronic integrated care pathway	Experiences/Perceptions
18	Applicability, importance, and priority of pre-defined factors for EHR implementation. Main outcome measures = Consensus and priority - both were defined.	Implementation factors
19	Engagement process for implementation of decision support tool	Engagement
22	When and how Lean should be integrated into design process	Design factors
23	Successes, challenges, and unanticipated consequences from design and implementation of system	Design factors Implementation factors
24	Process of collaborative healthcare system redesign and challenges to collaboration associated with participation of multiple stakeholders	Design factors
25	Identify chasms in implementation of system projects	Implementation factors
26	Identify factors essential to develop successful systems	Design factors
27	Identify benefits of extended patient involvement in entire development process	Design factors
28	Identify experiences of management during technology implementation	Implementation factors
29	Mobile smartphone app for adolescents with Lupus	System/Application
30	Application and perceptions of user-centred design process to develop integrated care technology	Experiences/Perceptions

<b>ID</b>	<b>Outcomes</b>	<b>Outcomes (Category)</b>
31	Management of process of implementation, participants' opinions of program elements and context factors which influence implementation	Implementation factors
32	Identify success factors and barriers during implementation of system	Implementation factors
33	Test importance of factors proposed in literature as important determinants of system usage	System use/acceptance
36	Mobile application for transfusion medicine	System/Application
38	Computer software for palliative and hospice patients	System/Application
39	Identify key aspects from user perspectives to expand existing technology tool	Experiences/Perceptions
40	Text message scheduling system	System/Application
42	Identify objectives, approaches and status of regions where technology piloted	Design factors Implementation factors
43	Identify promotion and assess impact of patient participation	Engagement
45	Identify factors of importance in increasing user acceptance	System use/acceptance
47	Identify user involvement methods in design and development of system	Design factors
48	Identify issues in design and implementation of EHR system	Design factors Implementation factors
50	Identify views, expectations and attitudes of nurses using EHRs	Experiences/Perceptions
51	Identify participatory action research on development of participatory design framework for large system design	Design factors

*Table 22: End-User Involvement and Outcomes (Category)*

Though the measured outcomes were placed into specific categories, the variables or attributes they were observing/measuring differed. The measured outcome category for both Hayward-Rowse and Whittle (2006) and Walker and Clendon (2016) are experiences/perceptions. Hayward-Rowse and Whittle (2006) wanted to determine what the involved end-user experience had been when building the integrated care pathway. Their yes/no questionnaire asked respondents to answer questions on their opportunity to comment prior to implementation and if those comments were taken into account; if the documentation was easy to follow, user friendly, clearly set out, and comprehensive; and if the patient experience was

enhanced due to this project. On the other hand, Walker and Clendon (2016), looked to identify views, expectations, and attitudes of nurses that were using EHRs. Though they did not indicate how the questions were answered, one assumed it was through general discussion, which listed out their opinions on the helpful aspects of using EHRs along with the barriers to their effective use. Both of these studies measured outcomes on the experiences and perceptions of the end-users, though their actual focus and specific variables were vastly different. The measured outcome category for both Ruland (2001) and Tang et al. (2018) is design factors. Ruland (2001) designed and developed a decision support system for nurse managers, through which they focused on describing the nurse managers' tasks and responsibilities, along with identifying barriers and difficulties in managing these tasks, information needs, and expected benefits. All of this information was then used to design and develop a decision support system that would best suit the end-users' needs and requirements. Tang et al. (2018) also designed and developed an electronic system for clinical communication and collaboration, which could integrate with the primary HIS. They focused on agile development with end-users being directly engaged on design decisions and software requirements while also completing testing and providing feedback after each version release. Both of these studies measured outcomes on design factors for the development of their HIS, though their actual focus and specific variables were again vastly different.

Measurements were defined based on the study being categorized as qualitative (definitions) or quantitative (instruments). Table 23 details these results.

<b>ID</b>	<b>Measurements</b> Qual = definitions Quan = instruments
16	Not specified
17	Questionnaire
18	Questionnaire

<b>ID</b>	<b>Measurements</b> Qual = definitions Quan = instruments
19	Not specified
22	Not specified
23	Not specified
24	Yes - user involvement
25	Not specified
26	Not specified
27	Not specified
28	Not specified
29	Not specified
30	Not specified
31	Not specified
32	Not specified
33	Questionnaire - + def
36	Not specified
38	Yes - usability evaluation, overall evaluation (usefulness)
39	Not specified - other
40	Yes – user-centred design and participatory design
42	Not specified
43	Not specified - other
45	Not specified - other
47	Yes - user involvement and three major strategies
48	Not specified
50	Not specified
51	Yes - participatory design

*Table 23: End-User Involvement and Measurements*

Of the 23 qualitative studies, 78.26% (n=18) did not specify any definitions relating to end-user involvement or successful integration. Though two of these articles did not define end-user involvement, they did define strategies and definitions for those strategies on how to engage end-users. Iliffe et al. (2010) defined three routes to obtain user involvement, which included general practice engagement, locality engagement, and professionals within health and social care. Gagnon et al. (2014) noted the strategies that were used within their collaborative approach: presentation of progress reports and results; communication of each phase's results; targeted presentations to discuss research process; data analysis; and interpretation of results among the

various stakeholder groups. The other 21.74% (n=5) of the studies did provide definitions relating to end-user involvement. Two studies defined end-user involvement, two studies defined either participatory or user-centred design, and one study defined usability. Xie et al. (2015) defined end-user involvement by using “collaborative healthcare system redesign as the involvement of different stakeholders in the process of healthcare system redesign” (p.151) while Tang et al. (2018) defined it as “any direct contact with users” (p.90). Waller et al. (2006) defined participatory design as “the inclusion of users as equal members of the design team” (p.306) while Pilemalm and Timpka (2008) focused on a specific participatory method named Participatory Action Research (PAR) where “researchers participated in a system development process as both observers and change agents” (p.329). Kallen, Yang, and Haas (2012) defined usability through evaluation using the System Usability Scale (SUS) that “is designed to assess the usability of a system’s user interface design” with questions focusing “on ease of learning, efficiency of use, memorizability, and subjective satisfaction with the user interface design” (p.171). They further defined the overall evaluation or usefulness through a project-developed instrument that included both provider and patient/caregiver versions, along with fixed-response and open-response items (Kallen, Yang, and Haas, 2012).

Of the four quantitative studies, 75% (n=3) used a questionnaire as the instrument of measure, while 25% (n=1) did not specify the instrument of measure. Two of the quantitative studies also provided end-user involvement related definitions. One defined multiple terms while another defined a single term. Caccia-Bava et al. (2016) defined usage, participation, experience, communication, training, influence, and conflict, and based all results on the end-user responses to these definitions. Definitions were as follows. Usage is the actual amount of time spent on the system per day and the frequency of use (how often they use it); participation is the extent to

which they were primary players (nine specific activities); experience is the rate extent of experience relative to peers (five dimensions); communication is the rate communication process between user and developer (12 statements); training is the extent of training, which in any way affects use of the system; influence is how much influence the end-user had in decisions, the extent that their opinions about the system were considered by others, personal influence on the system; and conflict is how much conflict between themselves and others, along with the extent they were directly involved in disagreements and debates about issues concerning the system and others (Caccia-Bava, Guimaraes, & Guimaraes, 2016, p.634-635). Crivianu-Gaita et al. (2000) defined user acceptability as the “capable and consistent use and positive acceptance of a picture archiving and communication system (PACS) installation” (p.13).

It is also key to relate the measured outcome categories (Figure 25) to the measurements that were just detailed above. Table 24 details this relationship.

<b>Outcome (Category)</b>	<b>Measurements</b>
Design Factors	Not specified = 3 Definition = 3
Implementation Factors	Not specified = 4 Questionnaire = 1
Experiences/Perceptions	Not specified = 3 Questionnaire = 1
Systems/Mobile App	Not specified = 2 Definition = 2
Design/Implementation Factors	Not specified = 3
Engagement	Not specified = 3
System Use/Acceptance	Not specified = 1 Questionnaire = 1

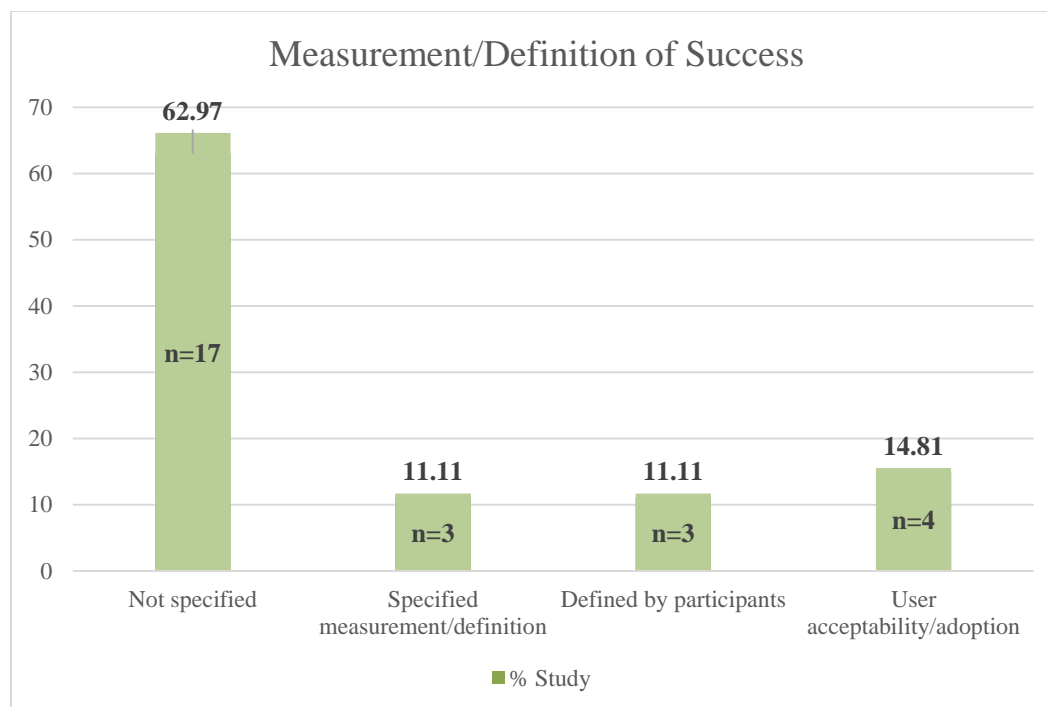
*Table 24: Measured Outcome Categories and their Measurements*

The indications of end-user involvement in both the project management and SDLC phases needs to be compared to the quality of measurements used within the articles. Five qualitative studies provided definitions relating to end-user involvement, while three of the

quantitative studies defined appropriate instruments. Together, only 29.63% (n=8) of the articles defined the appropriate use of measurement for their study in relation to end-user involvement.

***Was project success in relation to end-user involvement defined?***

An important area to note within the reviewed literature is the presence of a definition of success, particularly in relation to end-user involvement in the project or study. In other words, how is success defined, if at all, in the reviewed literature? This section looks specifically at if the study defined project success. Of the 27 articles, 62.97% (n=17) did not specify a definition of success. The remaining 10 articles had some definition of success. Three articles (11.11%) indicated that success was defined by the participants, though there was no definition or measurement to back this statement up. Four articles (14.81%) indicated that success was based on user acceptability and adoption, though this was again only in the form of a statement with no evidence to back it. The remaining three articles (11.11%) did specify a definition of success. Caccia-Bava et al. (2016) based success on the results done within the cross-sectional study and were able to confidently report a direct relationship between each of their hypotheses and system usage. Kallen, Yang, and Haas (2012), defined success as usability, which was considered as an incorporation of system effectiveness, efficiency, and user satisfaction (each of which was further defined in the article). As Waller, Franklin, Pagliari, and Greene (2006) followed user-centred and participatory design within their article, success of the project was user defined as the study indicated that the main user would dictate the success of the new system and ultimately the project itself. Figure 26 summarizes these results in a data chart. Table 25 details these results. The majority of the literature does not define what system success is in relation to their study. If it is defined, the definitions are independent and not shared across the articles.



*Figure 26: Data Chart – Measurement/Definition of Success*

ID	Measurement/Definition of Success
16	Not specified or defined
17	Not specified or defined
18	Not specified or defined. Noted, it relies on perception of participant on what might influence implementation success without actual evidence from implementation.
19	Not specified or defined
22	Not specified or defined
23	Defined by participants
24	Not specified or defined
25	Not specified or defined
26	Not specified or defined
27	Not specified or defined
28	Not specified or defined
29	Not specified or defined
30	Not specified or defined
31	Not specified or defined
32	Defined by participants
33	Yes - based on results
36	Not specified or defined
38	Yes - usability defined success
39	Not specified or defined
40	Yes - user defined success

<b>ID</b>	<b>Measurement/Definition of Success</b>
42	Defined by participants
43	Not specified or defined
45	Based on user acceptability
47	User acceptance and adoption (statement)
48	User acceptance and adoption (statement)
50	User acceptance and adoption (statement)
51	Not specified or defined

Table 25: Measurement/Definition of Success

***What is the broad picture for end-user involvement and project outcomes as a whole?***

Most organizations want to know how end-user involvement impacts their HIS project outcomes. This leads to many questions on the forefront of HIS projects. Should they change how they have been involving end-users in their HIS projects? Is it worth involving end-users at different stages of the project or should they keep this involvement status quo? Is there any evidence to back the general statements that end-user involvement is beneficial and has a positive impact on HIS projects?

Of the 27 articles, 92.59% (n=25) did indicate in their findings that end-user involvement is essential and will have a positive impact on the project, while the other 7.41% (n=2) did not specify any details with regards to this association. Table 26 details these results.

<b>ID</b>	<b>End-User involvement Positive Impact</b>
16	Y
17	Y
18	Y
19	Y
22	Y
23	Y
24	Y
25	Y
26	Y
27	Y
28	Y
29	Y

ID	End-User involvement Positive Impact
30	Y
31	Y
32	Y
33	Y
36	Y
38	Not specified
39	Y
40	Y
42	Y
43	Not specified
45	Y
47	Y
48	Y
50	Y
51	Y

Table 26: End-User Involvement with Positive Impact

Though the findings varied and were specific to their study, three major themes are seen across the 25 articles that noted end-user involvement as being essential. The findings statement of each article specific to end-user involvement was reviewed and then associated to one of these three themes. The themes include end-user ownership of the solution, end-user involvement being fundamental, and end-user involvement early in the project being crucial. Figure 27 summarizes these three themes.

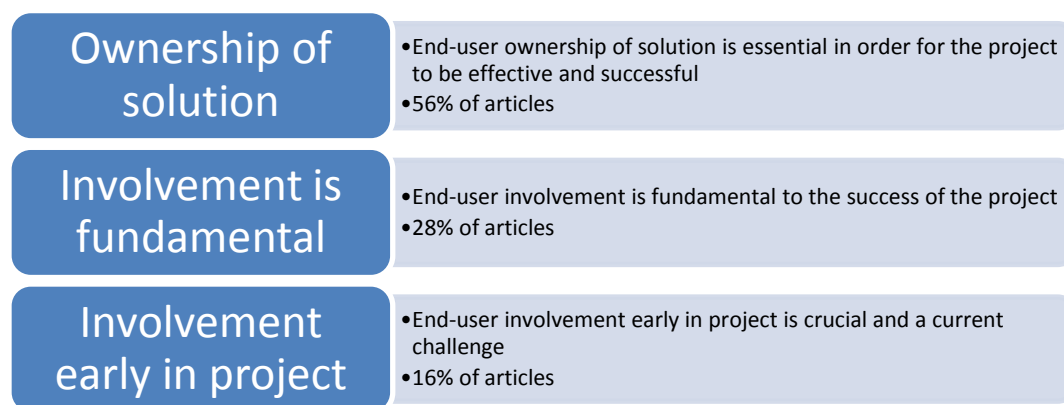


Figure 27: Themes of End-User Involvement Findings

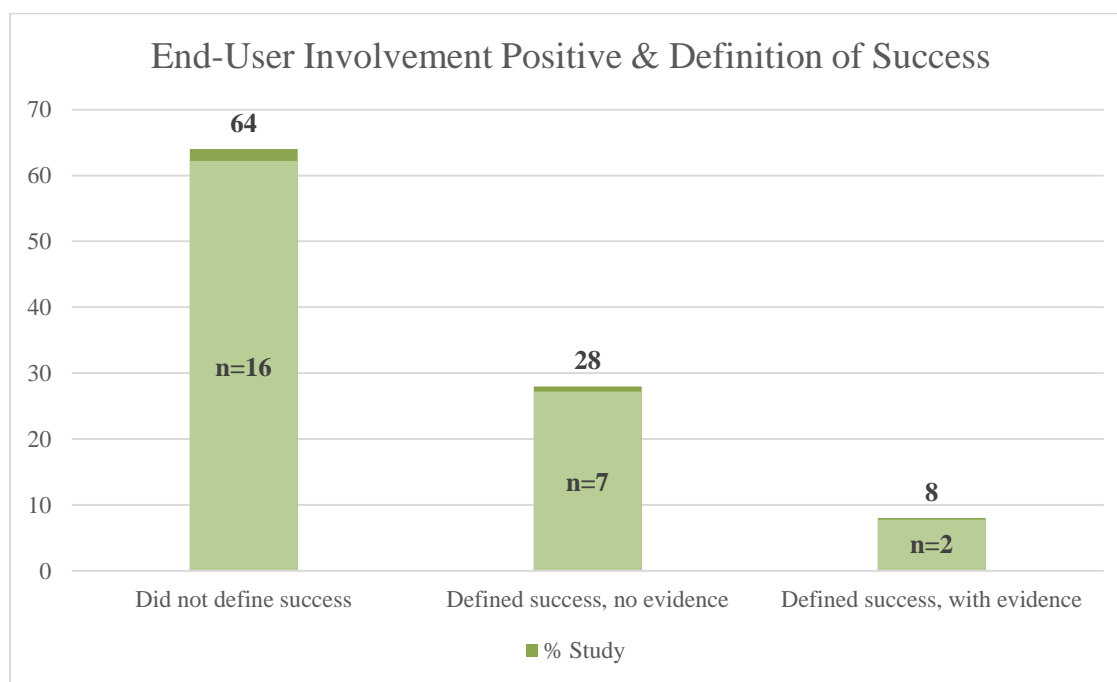
The first theme regarding end-user ownership of the solution being essential in order for it to be effective and overall successful includes the project incorporating end-user comments, feedback, and agreement in order to meet the end-user's needs and requirements. Fourteen (56%) of the articles fit into this theme. Caccia-Bava et al. (2016) state that “[end-]users also will be more likely to strive for better communication with system developers if they believe they can influence the development and get the system they want” (p.640). McNichol et al. (2015) indicate that end-user participation in the product development brings benefits to understanding the issues that are important to them and thereby increasing clinical outcomes, use of clinical resources, and tailoring technical requirements to ensure they fit the lived world as well as the laboratory.

The second theme states that end-user involvement is fundamental with seven (28%) of the articles fitting into this theme. Hayward-Rowse and Whittle (2006) state that “fundamental to the success of any project is the ownership of the participants and research group in order for the task to have longevity and be integrated into clinical practice” (p.571). Crivianu-Gaita et al. (2000) identified the following key success factors from their study: user involvement in PACS planning, training, technical support, and roll out of pilot projects.

The third theme states that end-user involvement early in the project is crucial with four (16%) of the articles fitting into this theme. Kamadjeu, Tapang, and Moluh (2005) noted there is a current challenge to the sustainability of HIS implementations if end-user involvement was not carried out at the early stages of development.

It is important to distinguish that though the article states end-user involvement is beneficial to the project, the majority do not define what project success is. Though it may not have been the intent of the study to define project success, if their results indicated the project

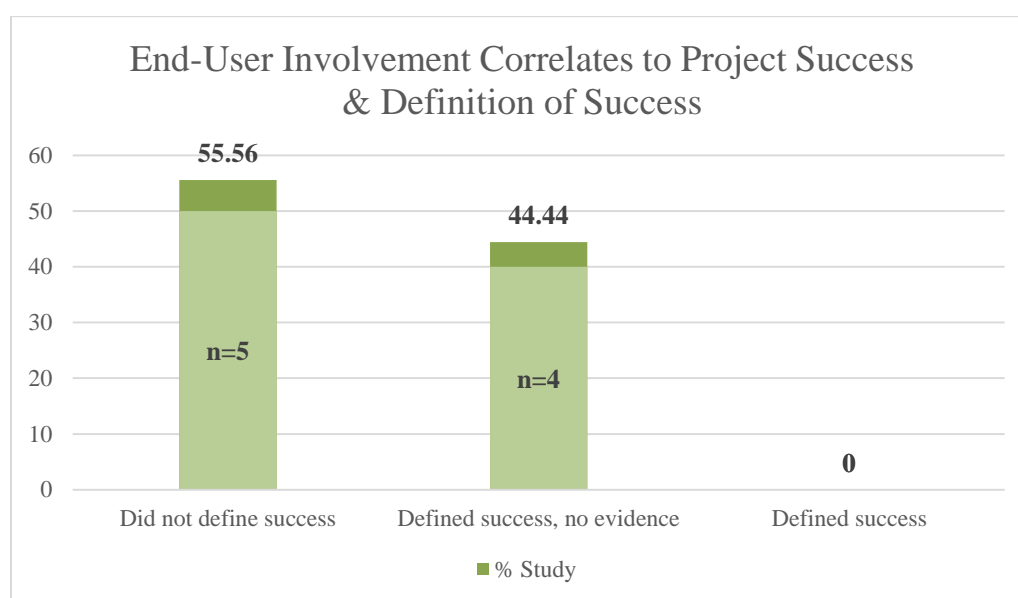
was successful, there needs to be a definition or measurement of what success means. Sixteen articles (64%) did not define success (14 qualitative and two quantitative). Seven articles (28%) did define success, but had no evidence, measurement or definition to back that statement (six qualitative and one quantitative). Two articles (8%) did define success and provided evidence (one qualitative and one quantitative); definitions from both the Caccia-Bava et al. (2016) and Waller, Franklin, Pagliari, and Greene (2006) articles were noted in the previous section. Although 92.59% of the articles indicated end-user involvement is essential and has a positive impact on the project, only 8% of those articles actually defined what success meant within their study. Figure 28 summarizes these results in a data chart.



*Figure 28: Data Chart – End-User Involvement Positive & Definition of Success*

Of the 27 articles, 33.33% (n=9) specifically stated that end-user involvement was related directly to the success of their project, while the other 66.67% (n=18) did not specify any details with regards to this association. Of the nine articles, seven were qualitative and two were quantitative. It is again important to distinguish that although the article states end-user

involvement is directly related to the success of the project, none of the articles provided a definition of what project success is. Five articles (55.56%) did not define success (four qualitative and one quantitative). Four articles (44.44%) did define success, but had no evidence, measurement or definition to back that statement (three qualitative and one quantitative). Although 33.33% of the articles indicated that end-user involvement is directly associated to the success of a project, none of those articles actually defined what success meant within their study. Figure 29 summarizes these results in a data chart. Table 27 details these results.



*Figure 29: Data Chart – End-User Involvement Correlates to Project Success & Definition of Success*

ID	Impact to Project Success
16	Y
17	Y
18	Not specified
19	Not specified
22	Not specified
23	Not specified
24	Not specified
25	Not specified
26	Y
27	Y

<b>ID</b>	<b>Impact to Project Success</b>
28	Not specified
29	Y
30	Not specified
31	Not specified
32	Y
33	Not specified
36	Not specified
38	Not specified
39	Not specified
40	Not specified
42	Y
43	Not specified
45	Y
47	Y
48	Not specified
50	Not specified
51	Not specified

*Table 27: End-User Involvement and Impact to Project Success*

#### **4. Discussion**

The main focus of this study was to determine the level of evidence-based literature regarding the benefits of end-user involvement throughout the entire continuum of the project management process. This included analysing end-user involvement within the studies, end-user involvement recommendations in the study results, and the relationships between end-user involvement and study outcomes. A number of other categories in relation to the overall objective were also analysed. These categories included, but were not limited to, the types of findings (primary/secondary and evidence/opinion); research type, study design, and methods; project methodology used; project management process area; relation to the SDLC; type of HIS studied; and assessment of methodological quality.

##### ***General Points***

Before getting into the discussion on this study's findings, it should be noted that there is a need to better define the key terms that are used for these types of studies. Studies used different definitions for the same terms and often used certain words interchangeably. This makes it harder to analyse each article across the same common space and leaves room for interpretation on the part of the reviewer. For example, the terms involvement and participation are often used interchangeably, though they may not be defined the same within each study. Additionally, the spelling of certain key terms varies and creates the need for additional searches to ensure studies are found regardless of the spelling used. For example, healthcare and health care and user-centred design and user-centered design. Consistency is required to then allow researchers to easily compare results across all articles.

##### ***Research Location & Type of Findings***

Though the majority of articles (66.67%) were published in the United States, research was actually conducted the most in Canada (22.22%) with the United States following close

behind at 18.51%. The majority of articles being published in the United States is not surprising, but what is surprising is that Canada is leading the way for where the research is being conducted.

As 96.30% of the articles were classified as primary sources (evidence-based), this leads one to believe that there is a somewhat higher quality of work being represented in the literature. An interesting point that was noted is that though almost all articles were considered evidence-based, the level of quality for the evidence noted in these articles was not to the same high standards.

### ***Research Type, Study Design, and Methods***

When there is a heavier presence of quantitative studies for a specific topic, the findings can be applied more broadly. In the case of this review, the majority of articles (85.19%) were qualitative studies, which seems to indicate that research regarding the benefits of end-user involvement in HIS projects is still in the early days. Focus has not been placed on the pertinent end-user involvement questions that are being asked.

Though a study design was documented for all articles, it was not easily identified in many of the articles. It took multiple reads, plus reviews by secondary sources in a couple cases, to determine the study design that was used. This indicates that future researchers need to follow an appropriate guideline when creating their studies and ensure that all major categories are easily identifiable to the reader. Not only will this allow for easier reading, categorization, and correlation of their findings, but it will also decrease the assumptions that readers are making. On the other hand, methods were more easily identified throughout the articles, which implies that the tools being used to answer the research question are being adequately documented within the study itself, but the plan behind how the research question will be answered is lacking.

Additionally, there was not one specific study design that seemed to be favored throughout the articles (the majority used the case study design, though this was only used in 34.78% of the articles). This suggests that there is a lack of evidence indicating which study design is most effective and whether or not using a combination of study designs would increase the benefits of end-user involvement in HIS projects. This leaves a gap in the literature that should be explored. Though there does not appear to be one set study design used throughout the primary articles, Tang et al. (2018) indicate that there are three major strategies for involving end-users in HIS projects: user-centred design, user co-design, and participatory design. Interestingly enough, when compared to the 23 qualitative studies, user-centred design is tied for the most used study design, while participatory design follows closely behind. In comparing the included articles to Tang et al.'s (2018) findings, the literature does tend to utilize the study design that provides the user with the most control – participatory design. So although there is a lack of evidence indicating which study design is most effective for increasing the benefits of end-user involvement in HIS projects, the included literature does utilize previously indicated study designs.

### ***Project Methodology***

Every project that is carried out follows a specific project methodology. As such, it is important to understand which ones are being used and how they may have impacted the overall project success. In this study, the majority of articles (88.89%) did not specify which project methodology was used, which makes it difficult to compare across all studies. Having such a low percentage of articles that do state the project methodology that was followed indicates a lack of focus in existing literature on the importance and potential impact that project methodology may have on HIS projects involving end-users. Furthermore, when a project methodology is not

specified, this can cause readers to make an assumption that the traditional waterfall approach was used (as it is the most commonly used methodology), which may not be the case for some articles. The few articles that follow a project methodology besides traditional (i.e. agile or lean) did specifically state this within their study, which may be due to the agile and lean approaches becoming more prominent and discussed methodologies in healthcare organizations today.

The lack of specified project methodology also reveals a lack of attention within the literature in identifying the specific project methodology that is used. Traditional and agile tend to be the most discussed project methodologies, particularly in relation to healthcare projects, though agile is still newer to the scene. Both have their advantages and disadvantages, though many healthcare organizations still follow the traditional approach as they are not as well versed or mature in using the agile project methodology. The need to define what project methodology was followed is essential in future work so those reviewing the results will know which methodology was applied and how the results may have been impacted based on the methodology used.

### ***Project Management Processes & SDLC Phases***

The project management processes used in this study were based on the PMI categories of Initiate, Plan, Execute, Monitor and Control, and Close. With regards to the SDLC, this referenced five phases: (1) analysis and requirements, (2) design and development, (3) test, (4) implementation, and (5) maintenance.

Based on the articles in this study, the top project management processes that end-users were being involved in were Plan and Execute, while the top SDLC phases that end-users are being involved in were (2) design and development, (1) analysis and requirements, and (4) implementation (in that order). Including end-users in SDLC phases 1 and 2 is directly

associated with the project management processes and including end-users in the planning phase. Involving end-users in the implementation phase is also directly associated with the project management processes and including end-users in the execute phase. This tends to match the discussions of including end-users during the planning phase, particularly for requirements and scope definition, and the executing phase, particularly as they are the primary users of the system that is being implemented. It has been previously believed that end-user participation in the early stages of development was sufficient, though it has been observed to be equally important to involve end-users in the design, testing, and implementation of healthcare systems (Zowghi, et al., 2015). Organizations want to maximize the involvement of end-users in their HIS projects, particularly as time and money are often hard to come by in healthcare. In order to better maximize their end-users time and stay on budget, particular attention should be made to the other project management process areas to determine the effectiveness of including end-users there as well. The evidence needs to back up the statements made that end-user involvement should be done through the entire project lifecycle before healthcare organizations should completely change their entire practice.

According to the literature, careful consideration must be given to the timing and extent of end-user participation at the different stages of the SDLC (Zowghi, et al., 2015). The results of this study indicate that end-users are being involved particularly in the design and development of HIS projects. Though according to the literature, “user satisfaction and acceptance has always been considered one of the fundamental measures of system success” (Zowghi, et al., 2015, p.1). If this is truly the case, one would have expected the number one inclusion phase to be the implementation and/or maintenance phases, which were third and fifth within the included articles. More review is required focusing directly on end-user involvement throughout the

SDLC phases and how beneficial it is at each phase, particularly in relation to the project or system success.

### ***Type of HIS***

The type of HIS that was studied throughout the articles varied (66.67%), which speaks to the diversity of systems that are being implemented today. The top HIS' that are being implemented include EHRs and EMRs, which were only noted in 14.82% and 3.70% of the studies, respectively. Although the literature should focus on these top systems, this also denotes just how complicated it is to implement software systems in healthcare and how hard it is to compare these systems across a multitude of studies. As there are hundreds of different types of HIS' out there, the results in this study show that the literature does not focus on a specific HIS, but instead carries across a variety of them. One would expect the majority of the literature to focus on the top HIS' like EHRs and EMRs, but this was not the case as found in this study.

Despite the fact that one of the inclusion criteria for this study was healthcare, it is important to also review literature that spans outside of the healthcare field. This is particularly true for software related projects as these have been done in other fields for many decades and can provide valuable insight to HIS projects. The main difference between the healthcare related and non-healthcare related studies is that the non-healthcare studies tend to reference the specific phases of the SDLC with regards to end-user involvement. The healthcare related articles did not usually specify the specific SDLC phase. As a result, this took additional analysis to determine which phase of the SDLC they were referencing.

### ***Assessment of Methodological Quality***

Assessment for the methodological quality of an article is extremely important in understanding the quality of not only the study itself, but also the findings and/or evidence

presented within the results. If an article is not methodologically sound and/or does not follow the appropriate guidelines as per its research type and study design, the findings it does present will not be of any high value. Regardless of research type (qualitative or quantitative), all articles properly conceptualized the research question, while 88% of the articles also conceptually met the guidelines for their discussion section. This suggests that literature tends to always state the research question and present their findings in an acceptable format that is then linked back to existing literature.

When assessing the quality of the methods section within the included articles, this varied based on the specific categories (i.e. study design, participants and setting, data collection, and data analysis). The data collection was met in 81% of the articles, while study design was met in nearly 78% of the articles. Participants and settings were only documented appropriately in nearly 52% of the articles, while data analysis was certainly lacking at just over 22%. Future studies need to ensure that they are capturing all main method sections, paying particular attention to accurately defining the participants and settings and how they completed their data analysis. There is a key question to keep in mind when developing the methods section for any study – if the reader wanted to replicate this study, could they? If the answer is no, the quality of the method section will not be up to par.

Result analysis was typically well detailed with 75% of the articles meeting the criteria within their guideline. Limitations were stated in 52% of the articles, which indicates there is room for improvement as all studies should indicate its limitations. If the researcher believes there are no limitations, then this should also be stated. Ethics were rarely noted within the articles as only 20% of them contained a reference to ethics. Again, this should be noted within all studies, even if it is to state that the study is exempt from ethics review.

Each article was then rated for completeness. Fourteen of the articles were rated at 62.50% and above. Of these 14 articles, only five of them had a 100% rating for completeness. So, although the methodological assessment of each category may have fared well, the overall completeness for the articles did not. Overall, the included articles rated quite well on the methodological assessment, but lacked on their overall rating of completeness. Though there is room for improvement in certain areas, the major focus should be on improving the data analysis area as this area should always be extremely detailed in every study so nothing is left up to the assumption of the reader.

### ***End-User Involvement within the Studies & their Recommendations***

A promising detail of the literature was that nearly all articles (96.30%) actually involved end-users within their study (the one article that did not still spoke to end-user involvement in their results, but just did not actually include end-users within the study referenced in the article itself). This is important within existing literature as healthcare organizations want to be able to review existing studies to see how they actually involved end-users and what their experiences and project outcomes were for that specific study (i.e. use it as a lesson learned for their own project).

The interesting area to note is the difference between where the study included end-users and what their recommendations (or results) were regarding end-user involvement and how this aligns with previous literature and discussions. To discuss this association, one must first look at how the studies involved end-users. Nearly 35% of the articles involved end-users in multiple phases of the SDLC (i.e. more than two phases), of which, (1) analysis and requirements and (2) design and development made the top appearances. When combined with the results of the individual phases (i.e. one phase), (2) design and development, (1) analysis and requirements, (5)

maintenance, and (4) implementation are most often where end-users are involved (in that order). This again matches with previous discussions that denote end-user involvement should be in the planning (i.e. (1) analysis and requirements and (2) design and development) and executing (i.e. (4) implementation) phases of a project. This illustrates that the articles involved end-users in their studies in the same phases that have been noted in the past.

Now one must look at the recommendations or results that these same studies presented, which closely matched how they involved end-users within their own studies. Nearly 63% of the articles indicated that end-users should be involved in multiple phases of the SDLC (i.e. two to four phases), followed by 14.81% in the entire project lifecycle (all five phases). When combined with the results of the individual phases (i.e. one phase), (2) design and development, (4) implementation, (1) analysis and requirements were recommended for end-user involvement (in that order). This again matches with previous discussions that denote end-user involvement should be in both the planning (i.e. (1) analysis and requirements and (2) design and development) and executing phases (i.e. (4) implementation) phases of a project. Although recommendations are being made that it is beneficial to include end-users in multiple phases of the project, the question still remains if the article backs these recommendations up with any evidence. This is an important question that needs to be addressed and is noted in the next section detailing the relationship between the end-user involvement and study outcomes themselves.

### ***Study Outcomes and Measurements***

The measured outcomes varied among all the articles. There was not a clear outcome value that was consistently measured with regards to end-user involvement in HIS projects. The main outcomes measured were to identify end-user involvement factors in either the design or

implementation phases (nearly 52% of the articles). These outcomes match the previous indications of involving end-users in either the (2) design and requirements phase, (2) analysis and requirements phase, or (4) implementation phase. This is a positive association and provides a sign to healthcare organizations that these are indeed the top phases to include end-users in. Of course, it must be noted that though the measured outcomes of each study were placed into specific categories, the variables or attributes those same studies observed/measured differed. Previous examples detailed how the Hayward-Rowse and Whittle (2006) article wanted to determine what the end-user experiences had been during the project build, while the Walker and Clendon (2016) article wanted to identify views, expectations, and attitudes of EHR end-users. Both of these were placed in the experiences/perceptions category, but the values they looked to measure were different. Though both of these studies measured the experiences and perceptions of the end-users, their actual focus and specific outcomes were vastly different, making it hard to comprehensively compare the results across the studies. In order for healthcare organizations to properly utilize the literature for their own projects, they must find literature that details a specific HIS project that has similar outcomes and variables as their own, which is a tedious task in itself, instead of being able to cross-compare against multiple existing studies.

Though certain outcomes were measured, the measurements used were not of the highest quality and did not provide any direct measures relating to the benefits of end-user involvement. A surprising 78% of the qualitative articles did not specify any definitions relating to end-user involvement or successful project integration. Therefore, although the articles made recommendations on when to involve end-users, they did not actually define or measure end-user involvement and success, which instead leads to speculation on the quality/extent of end-user involvement. There were not enough variables in the qualitative articles to truly describe how

beneficial the end-user involvement was. On the other hand, the majority of the quantitative articles (75%) did use appropriate instruments of measure to support their recommendations. Half of them also provided definitions relating to end-user involvement (i.e. usage, participation, experience, communication, training, influence, conflict, and user acceptability). This allows for a higher sense of trust between the readers and the recommendations presented in the articles.

### ***Definition of Project Success in Relation to End-User Involvement***

If a project is deemed to be successful, healthcare organizations want to know how and why that project was successful. An important aspect of this is for the article to actually define what success is in relation to their study. Is success meeting the budget and/or timeline? Is success meeting end-user satisfaction with the system (if so, how many users does it take to then be considered a success and how do they define system satisfaction)? If end-users are forced to use a system (i.e. they have no choice as that is where all clinical documentation must be done), then how is success measured here? The list of questions can go on and on, but it is a fairly important point to answer.

The presence of a measurement or definition of success was missing from the included articles. Only three of the articles actually specified a definition of success, while seven articles either indicated success was defined by participants or was based on user acceptability and adoption, but had no evidence to back these statements up. Definitions of success are clearly lacking in the literature and of those that do define it, the definitions are independent and not shared across studies. With no defined measurement, how will healthcare organizations know they are achieving the intended result for end-user involvement in HIS projects?

### *The Picture of End-User Involvement*

Almost 93% of the articles indicated that end-user involvement is essential and will have a positive impact on the project. One would assume this would positively indicate that end-user involvement is beneficial to the overall HIS project success. Unfortunately, as noted in the above discussion section, the majority of articles do not actually define what project success is.

Although nearly 93% of the articles indicate end-user involvement as essential and having a positive impact on the project, only 8% of those articles actually define what success meant within their study. This leads one to question what the study means by beneficial end-user involvement and project success if they have not actually defined what success is. Again, with no defined measurement, how do they know if they are achieving the intended results for beneficial end-user involvement in HIS projects?

When further analysing the article findings, only 33% actually specified that end-user involvement related directly to the success of the project. While almost all articles stated that the idea of end-user involvement has a positive impact on the project, their findings did not directly support this. Nonetheless, none of these articles actually defined what project success is.

Although 33% of the articles indicated that end-user involvement directly correlates with project success, none of them actually defined what success meant within their study. This again leads to a lack of evidence in the literature to illustrate this relationship. Future literature needs to provide more volume and quality-based evidence with direct reference to the positive correlation between end-user involvement and HIS project success.

In notable comparison, one article did indicate that there were only marginal differences in terms of project success between those projects where end-user involvement was applied to mitigate risks and those where it was not applied (Amrit, van Hillegersberg, & van Diest, 2012).

Caccia-Bava et al. (2016) summed up the findings of past literature quite well in that it has presented conflicting results of end-user involvement in correlation to system success. The literature has shown positive, negative, and non-significant correlation with system success (Caccia-Bava et al., 2016). When examining the results of the included articles, there is an almost unanimous agreement that end-user involvement is crucial in healthcare projects, particularly HIS projects. The problem that presents itself is that only 33% of the articles specify a positive correlation between end-user involvement and their project/system success. This indicates another gap in the literature that needs to focus on identifying not only the positive, but also the negative correlations of end-user involvement with project/system success. In summary, the literature still does not provide enough volume and quality of evidence-based literature with direct reference to the positive correlation between end-user involvement and HIS project success. The statement made by Caccia-Bava et al. (2016) is still accurate based on the findings of this study.

As end-users ultimately have to use the HIS that is implemented through these projects, it is important to understand how and when to engage them throughout the project process to benefit not only the project, but the end-users themselves. With the end-users ultimately being in charge of how well the HIS is used and if it will be used to its full potential, it is important to understand each of these themes and what may or may not be lacking within the literature in relation to each of them. From the reviewer's personal experience, if end-users are simply told to conform and use the system, this can often lead to hostility and resentment towards the system itself. When they are allowed to participate and be incorporated into the project process, this tends to create the opposite reaction and allows more positive responsiveness, acceptance, and patience throughout the system implementation itself.

### *Themes of End-User Involvement*

The three main **themes** seen throughout the articles relate directly to this statement. These themes include (1) end-user ownership of the solution; (2) end-user involvement being fundamental; and (3) end-user involvement early in the project being crucial.

The main theme indicated that end-user ownership of the final solution is essential in order for the HIS project to not only be effective, but also successful (Andersson Marchesoni, Axelsson, Fältholm, & Lindberg, 2017; Caccia-Bava et al., 2016; Frykholm, Flink, Lindblad, & Ekstedt, 2016; Ijkema, Langelaan, van de Steeg, & Wagner, 2014; Iliffe et al., 2010; Lorenzi, Novak, Weiss, Gadd, & Unertl, 2008; Mazur, Johnson, Pooya, Chadwick, & McCreery, 2017; McNichol et al., 2015; Pilemalm & Timpka, 2008; Ruland, 2001; Starks, Shaw, Hiratsuka, Dillard, & Robinson, 2015; Strisland, Svagård, Austad, & Reitan, 2016; Waller, Franklin, Pagliari, & Greene, 2006; Xie et al., 2015).

The next theme indicated that end-user involvement is fundamental to the success of the project (Albornoz, Márquez, Rubin, & Luna, 2017; Ates et al., 2017; Crivianu-Gaita, Babyn P, Gilday, O'Brien, & Charkot, 2000; Hayward-Rowse & Whittle, 2006; Herschman et al., 2014; McGinn et al., 2012; Walker & Clendon 2016).

The last theme indicated that end-user involvement early in the project is crucial, though it is often noted as a challenge particularly in healthcare organizations (Damani et al., 2018; Kamadjeu, Tapang, & Moluh 2005; Onstad, Westrum, & Fensli, 2016; Tang et al., 2018).

These types of statements tend to match the general discussion that end-users must feel some sense of ownership and involvement through their comments, feedback, and participation in the project instead of just being engaged when the system is being rolled out and there is no opportunity to include their feedback.

## ***Summary***

A lot of reference has been made to the SDLC phases versus the project management processes. It is important to note that the articles did not usually specify what project management process they were referring to; it was often determined by the reviewer based on the provided definitions. An association was done between the SDLC phases and project management processes to determine which of these processes ranked highest in the included articles. As expected, the Plan and Execute phases ranked the highest for end-user involvement. This indicates that end-user involvement within both of these phases will provide benefits to the project itself.

While the literature did present a number of findings, there is still no clear evidence on the benefits of involving end-users in HIS projects. The results are often inconclusive and contradicting and issues of when end-user involvement should be applied and how it should be organized is vaguely covered and mostly separate in different articles (Amrit et al., 2012). Though this observation was made in 2012, it is still accurate of the literature to present day. Research needs to focus on what end-users should be involved, where their involvement should occur throughout the project management process, what this involvement should look like, and how it should be measured. “Effect of user participation on project success is under-researched and there is an incomplete understanding of the kind of user participation and the impact of such user participation on the success” of a HIS project (Amrit et al., 2012, p.4593).

### **4.1 Limitations**

There are limitations to conducting scoping reviews. As indicated by Arskey and O’Malley (2005), these include not appraising the quality of evidence in the primary research reports in any formal sense, generation of data quantity can be considerable which leads to

difficult decisions on the required breadth and depth of the review, and not addressing the issue of synthesis in order to properly weight the evidence. Other limitations may also include using tools that limit the replicability of the search, excluding relevant studies based on a deadline date (if used), and missing relevant studies based on key terms.

In this study, appraisal was done on the quality of evidence and indicated in the Microsoft Excel data chart, thus mitigating this particular limitation from the present study. As previously stated, a deadline of May 4, 2019 was set to collect and summarize the results for this study. Following this date, no new studies were included in the analysis, which may have excluded some articles from the study. Other limitations of this study include gray literature and reports not being included and the use of only one reviewer.

## 5. Conclusion and Recommendations

This study not only analysed the existing literature to determine if there was enough volume and quality of evidence with direct reference to the benefits of end-user involvement within HIS projects, but also studied a number of other categories that directly related to the overall objective. It was identified that all categories that were analysed had some type of gap in the existing evidence and literature. There is a lack of quantitative studies as the majority of articles were qualitative studies. The data collection methods within the articles were well documented, though study design was not as easily identified, which implies that the tools being used to answer the research question are being adequately documented, but the plan behind how the research question will be answered is lacking. There is also a lack of evidence indicating which study design is most effective and whether or not using a combination of study designs would increase the benefits of end-user involvement in these projects. Project methodology is also not commonly identified. With the lack of defined measurements of end-user involvement and project success, there is no true measurement to then back up statements of end-user involvement being beneficial and/or having a positive impact to the project success. This results in no direct measures relating to the benefits of end-user involvement.

Recommendations indicate that end-users should be involved in the Plan and Execute phases of project management, along with the Analysis and Requirements, Design and Development, and Implementation phases of the SDLC. The majority of studies did indicate that end-user involvement is essential and will have a positive impact on the project, though they did not define end-user involvement or project success. A lower number of articles indicated that end-user involvement is directly associated to the success of the project, though they again do not define project success. In relation to the overall effectiveness and success of HIS projects, three main themes were seen throughout the articles and included end-user ownership of the

solution, end-user involvement being fundamental, and end-user involvement early in the project being crucial. These key findings indicate an importance of end-user involvement, though existing literature is lacking in the types of findings being presented. The literature needs to focus on what end-users should be involved, where their involvement should occur throughout the project management process, what this involvement should look like, and how it should be measured. Overall, it was determined that there is still a gap in the literature and future studies must focus on identifying the positive correlation of end-user involvement with project/system success.

### **5.1 Recommendations for Future Research**

There were a number of gaps identified in this study which indicates the need for new studies to be conducted. Research should continue to be conducted in a variety of countries as healthcare varies amongst them. Exploration needs to be done to indicate the most effective study design that should be used when completing studies on end-user involvement in HIS projects. Once the study design is identified, future studies can then narrow down on other areas that have been identified as a gap, particularly the lack of measurement and/or definition of end-user involvement and project success. The use of quantitative studies should be increased in this particular area. If it is not, then the qualitative studies need to ensure they are providing appropriate forms of measurement to back their study outcomes and overall recommendations. More evidence-based studies that focus on identifying both the benefits of end-user involvement in HIS projects and the positive correlation of their involvement with project/system success are essential. Lastly, focus should be made on the indicated themes for end-user involvement in HIS projects: end-user ownership of the solution, end-user involvement being fundamental, and end-user involvement early in the project being crucial. All of which, would close the gap on existing

literature and provide healthcare organizations the information they require to increase their HIT project success rate.

## **5.2 Ethics and Funding**

The University of Victoria Human Research Ethics Board reviewed the proposal for this study on March 24, 2019. It was determined that this study was exempt from human ethics review under the national ethics policy (TCPS2) and the university's human research ethics policy and guidelines (8100, 8105) as the study is a literature review, will exclusively use publicly available databases, and does not involve human participants. Additionally, no funding was used with this study.

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## Tables

**Table 1 - Final Search Strategy**

Search Number	Search Terms	Criteria Match
1	"project management process" AND ("user involvement" OR "user participation") AND (healthcare OR "health care")	Matches all criteria
2	"project management process" AND ("user centered design" OR "user centred design") AND (healthcare OR "health care")	
3	"project management process" AND ("patient involvement" OR "patient participation") AND (healthcare OR "health care")	
4	"project management process" AND ("user involvement" OR "user participation")	Removes "healthcare" match
5	"project management process" AND ("user centered design" OR "user centred design")	
6	"project management process" AND ("patient involvement" OR "patient participation")	
7	"project management" AND ("user involvement" OR "user participation") AND (healthcare OR "health care")	Removes "process" match
8	"project management" AND ("user centered design" OR "user centred design") AND (healthcare OR "health care")	
9	"project management" AND ("patient involvement" OR "patient participation") AND (healthcare OR "health care")	
10	"project management" AND ("user involvement" OR "user participation")	Removes "process" and "healthcare" match
11	"project management" AND ("user centered design" OR "user centred design")	
12	"project management" AND ("patient involvement" OR "patient participation")	
13	"project plan*" AND ("user involvement" OR "user participation")	
14	"project design*" AND ("user involvement" OR "user participation")	

Search Number	Search Terms	Criteria Match
15	"project implement*" AND ("user involvement" OR "user participation")	Looks at specific project management process area without healthcare
16	"project execut*" AND ("user involvement" OR "user participation")	
17	"project clos*" AND ("user involvement" OR "user participation")	
18	"project management process"	Looks simply at project management process (for specific databases)

The above search terms were used during all database searches.

**Table 2 - Inclusion/Exclusion Sample Log**

Database	Search #	Article Title	Include?	If no, why?	ID (For Review)
ACM DL	4	An empirical study to design an effective agile project management framework	Yes		1
ACM DL	8	Activity-based computing for medical work in hospitals	No	No user involvement	n/a
ACM DL	10	Problems and challenges of user involvement in software development: an empirical study	Yes		3
ACM DL	10	An empirical study to design an effective agile project management framework	No	Duplicate	n/a
ACM DL	10	Making a difference: a survey of the usability profession in Sweden	Yes	Not healthcare though	4

Database	Search #	Article Title	Include?	If no, why?	ID (For Review)
CINAHL	4	End-user involvement in a systematic review of quantitative and qualitative research of non-pharmacological interventions for attention deficit hyperactivity disorder delivered in school settings: reflections on the impacts and challenges	No	Duplicate	n/a
CINAHL	4	Critical Success Factors for Integrated Library System Implementation in Academic Libraries: A Qualitative Study	No	Not healthcare, HIS	n/a
CINAHL	4	Five constants of information technology adoption in healthcare	No	Duplicate	n/a
CINAHL	4	Experiences of multidisciplinary development team members during user-centeed design of telecare products and services: a qualitative study	No	No project process, HIS	n/a
CINAHL	8	Design of a Mobile Application for Transfusion Medicine...16 World Congress of Medical and Health Informatics: Precision Healthcare Through Informatics (MedInfo2017) was held in Hangzhou, China from August 21st to 25th, 2017	Yes		36
CINAHL	8	Fostering a chronic care strategy in the basque country through the evaluation of health care providers	No	Duplicate	n/a
CINAHL	8	User-centred design of integrated eHealth to improve patients' activation in transitional care	No	Duplicate	n/a
CINAHL	10	A federated collaborative care cure cloud architecture for addressing the needs of multi-morbidity and managing poly-pharmacy (c3-cloud project)	No	No project process (project not complete, describing	n/a

Database	Search #	Article Title	Include?	If no, why?	ID (For Review)
				what will be done)	
CINAHL	10	A patient-led approach to product innovation in patient education and wound management	No	Duplicate	n/a
CINAHL	10	A technical solution to improving palliative and hospice care	Yes		38
CINAHL	10	An Internet-based collaboration intervention for personal recovery: How did service users and providers address and align expectations about collaboration?	No	No project process	n/a
CINAHL	10	Analysis of how people with intellectual disabilities organize information using computerized guidance	No	No project process	n/a
CINAHL	10	Building consensus on user participation in social work: A conversation analysis	No	No project process	n/a
IEEE	10	A Framework for Requirements Engineering in End-User Computing	No	No project process	n/a
IEEE	10	A Living Lab model for user driven innovation in urban communities	No	No project process	n/a
IEEE	10	Agile development as a change management approach in software projects: Applied case study	No	No HIS	n/a
IEEE	10	Agile Development at Scale: The Next Frontier	No	No project process, user involvement	n/a
Medline	10	23 h Model' for breast surgery: an early experience	No	No project process, HIS	n/a

Database	Search #	Article Title	Include?	If no, why?	ID (For Review)
Medline	10	Involving older people in research: methodological issues	No	Duplicate	n/a
Medline	10	Appointed by young people - a qualitative study on young patients recruiting hospital staff in Denmark	No	No project process, HIS	n/a
Medline	10	End-user involvement in a systematic review of quantitative and qualitative research of non-pharmacological interventions for attention deficit hyperactivity disorder delivered in school settings: reflections on the impacts and challenges	No	Duplicate	n/a

\*A cell under the Article Title column with red fill and dark red text indicates a duplicate article title (Conditional Formatting rule in Microsoft Excel).

\*ID (For Review) column relates to the ID used in other data results charting tables

**Table 3 - Categories for Assessment of Methodological Quality**

	RATS	STROBE (Cross-Sec)	JBI (Quasi)	Delphi
<b>Abstract &amp; Introduction</b>				
Conceptualize research question	1, 2	2, 3	None	1, 2
<b>Methods Evaluation</b>	-	-	-	-
Study Design	3	1a, 4	1	4
Participants and Setting	4, 5, 6, 8	5, 6, 10	2, 3	6
Data Collection	7, 9	7, 8, 11	4	4, 5, 7
Data Analysis	16, 17, 18	12a, 12b, 12c, 12d, 12e	5, 9	8
<b>Results Analysis</b>	-	-	-	-

	<b>RATS</b>	<b>STROBE (Cross-Sec)</b>	<b>JBI (Quasi)</b>	<b>Delphi</b>
Conceptually meets guideline	None	13a, 13b, 13c, 14a, 14b, 15, 16a, 16b, 16c, 17	6, 7, 8	10, 11, 12, 13
<b>Discussion</b>				
Conceptually meets guideline	19	18, 20, 21	None	14, 15, 16
Limitations	20	19	None	None
Ethics	13, 14, 15	None	None	9

**Table 4 - Correlation between Project Management and SDLC Phases**

<b>Project Management Phase</b>	<b>SDLC Phase</b>
Initiate	None
Plan	(1) Analysis and requirements (2) Design and development (3) Test
Execute	(4) Implementation
Monitor and Control	(5) Maintenance
Close	None

**Table 5 - Detail of search parameter and results**

<b>Database Searched</b>	<b>Search #</b>	<b>Date of Search</b>	<b># of Records Retrieved</b>	<b># of Records excluded (duplicate)</b>	<b># of Records excluded after screening?</b>	<b># of Records included</b>
ACM Digital Library	1	17-Apr-19	0	0	0	0
	2	17-Apr-19	0	0	0	0

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
	3	17-Apr-19	0	0	0	0
	4	17-Apr-19	1	0	1	1
	5	17-Apr-19	1	0	0	1
	6	17-Apr-19	0	0	0	0
	7	17-Apr-19	0	0	0	0
	8	17-Apr-19	1	0	1	0
	9	17-Apr-19	0	0	0	0
	10	17-Apr-19	9	2	0	7
	11	17-Apr-19	26	3	22	1
	12	17-Apr-19	0	0	0	0
	13	17-Apr-19	1	1	0	0
	14	17-Apr-19	2	0	1	1
	15	17-Apr-19	0	0	0	0
	16	17-Apr-19	0	0	0	0
	17	17-Apr-19	0	0	0	0
	18	17-Apr-19	18	3	13	2
<b>TOTALS (ACM DL)</b>			<b>59</b>	<b>9</b>	<b>37</b>	<b>13</b>
IEEE xplore Digital Library	1	26-Apr-19	0	0	0	0
	2	26-Apr-19	0	0	0	0

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
	3	26-Apr-19	0	0	0	0
	4	26-Apr-19	0	0	0	0
	5	26-Apr-19	0	0	0	0
	6	26-Apr-19	0	0	0	0
	7	26-Apr-19	0	0	0	0
	8	26-Apr-19	0	0	0	0
	9	26-Apr-19	0	0	0	0
	10	26-Apr-19	39	1	29	9
	11	26-Apr-19	70	21	49	0
	12	26-Apr-19	0	0	0	0
	13	26-Apr-19	6	4	2	0
	14	26-Apr-19	0	0	0	0
	15	26-Apr-19	2	0	2	0
	16	26-Apr-19	1	0	1	0
	17	26-Apr-19	0	0	0	0
	18	27-Apr-19	208	5	203	0
<b>TOTALS (IEEE)</b>			<b>326</b>	<b>31</b>	<b>286</b>	<b>9</b>
CINAHL Complete (EBSCO)	1	20-Apr-19	20	0	14	6
	2	20-Apr-19	3	3	0	0

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
	3	20-Apr-19	74	14	53	7
	4	20-Apr-19	37	20	13	4
	5	20-Apr-19	13	5	6	2
	6	20-Apr-19	140	78	59	3
	7	20-Apr-19	45	20	22	3
	8	20-Apr-19	12	7	4	1
	9	21-Apr-19	228	84	143	1
	10	21-Apr-19	103	61	39	3
	11	21-Apr-19	29	25	4	0
	12	21-Apr-19	440	310	129	1
	13	21-Apr-19	112	34	74	4
	14	21-Apr-19	229	70	153	6
	15	21-Apr-19	136	96	40	0
	16	21-Apr-19	13	10	3	0
	17	21-Apr-19	29	21	8	0
	18	21-Apr-19	Too large (2508)	N/A	N/A	N/A
<b>TOTALS (CINAHL)</b>			<b>1663</b>	<b>858</b>	<b>764</b>	<b>41</b>
Medline	1	4-May-19	0	0	0	0
	2	4-May-19	0	0	0	0

Database Searched	Search #	Date of Search	# of Records Retrieved	# of Records excluded (duplicate)	# of Records excluded after screening?	# of Records included
	3	4-May-19	0	0	0	0
	4	4-May-19	0	0	0	0
	5	4-May-19	0	0	0	0
	6	4-May-19	0	0	0	0
	7	4-May-19	4	1	3	0
	8	4-May-19	0	0	0	0
	9	4-May-19	5	2	3	0
	10	4-May-19	7	4	3	0
	11	4-May-19	3	3	0	0
	12	4-May-19	6	4	2	0
	13	4-May-19	0	0	0	0
	14	4-May-19	0	0	0	0
	15	4-May-19	0	0	0	0
	16	4-May-19	0	0	0	0
	17	4-May-19	0	0	0	0
	18	4-May-19	16	0	16	0
<b>TOTALS (Medline)</b>			<b>41</b>	<b>14</b>	<b>27</b>	<b>0</b>
<b>Full Texts Reviewed</b>						<b>63</b>

Table 6 - RATS Guideline Data (Articles 16-31)

		Article ID	16	19	22	23	24	25	26	27	28	29	30	31
<b>Item</b>	<b>R - Relevance of study question</b>		-	-	-	-	-	-	-	-	-	-	-	-
1		Research question explicitly stated	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2		Research question justified and linked to existing knowledge base	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	<b>A - Appropriateness of qualitative method</b>		-	-	-	-	-	-	-	-	-	-	-	-
3		Study design described and justified	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y
	<b>T - Transparency of procedures</b>		-	-	-	-	-	-	-	-	-	-	-	-
4	Sampling	Criteria for selecting study sample justified and explained	N	Y	N	Y	Y	N/A	Y	N	Y	Y	Y	Y
5	Recruitment	Details of how recruitment was conducted and by whom	N	N	N	Y	Y	N/A	N	N	Y	N	N	Y
6		Details of who chose Not to participate and why	N	N	N	N	N	N/A	N	N	N	N	N	Y
7	Data collection	Method(s) outline and exemplar given	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y
8		Study group and setting clearly described	N	Y	Y	Y	Y	N/A	N	N	Y	Y	N	Y
9		End of data collection justified and described	N	N	N	Y	Y	N	N	N	Y	N	N	Y
10	Role of researchers	Do researchers occupy dual roles?	N	N	N	N	N	N	N	N	N	N	N	N
11		Are the ethics of this discussed?	N	N	N	N	N	N	N	N	N	N	N	N
12		Do the researcher(s) critically examine their own influence on formulation of research question, data collection and interpretation?	N	N	N	N	N	N	N	N	Y	N	N	N

13	Ethics	Informed consent process explicitly and clearly detailed	N	N	N	Y	N	N	N	N	Y	N	N	Y
14		Anonymity and confidentiality discussed	N	N	N	Y	N	N	N	N	N	N	N	Y
15		Ethics approval cited	N	N	N	Y	N	N	N	N	Y	N	N	Y
	<b>S - Soundness of interpretative approach</b>		-	-	-	-	-	-	-	-	-	-	-	-
16	Analysis	Analytic approach described in depth and justified	N	Y	Y	Y	Y	Y	N	N	Y	N	N	Y
17		Indicators of quality	N	N	N	N	N	N	N	N	Y	N	N	Y
18		Method of reliability check described and justified	N	N	N	N	N	N	N	N	N	N	N	N
19	Discussion and presentation	Findings presented with reference to existing theoretical and empirical literature and how they contribute	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
20		Strengths and limitations explicitly described and discussed	N	N	Y	Y	Y	N	N	N	Y	Y	N	Y
21		Evidence of following guidelines	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
22		Written for a health sciences audience	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
23		Red flags	Y	N	N	N	N	N	Y	Y	N	Y	Y	N

Table 7 - RATS Guideline Data (Articles 32-51)

		Article ID	32	36	38	39	40	42	43	47	48	50	51
<b>Item</b>	<b>R - Relevance of study question</b>		-	-	-	-	-	-	-	-	-	-	-
1		Research question explicitly stated	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2		Research question justified and linked to existing knowledge base	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	<b>A - Appropriateness of qualitative method</b>		-	-	-	-	-	-	-	-	-	-	-
3		Study design described and justified	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y



18		Method of reliability check described and justified	N	N	N	Y	N	N	N	N	N	N	N
19	Discussion and presentation	Findings presented with reference to existing theoretical and empirical literature and how they contribute	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
20		Strengths and limitations explicitly described and discussed	N	Y	N	Y	N	Y	N	N	N	Y	Y
21		Evidence of following guidelines	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
22		Written for a health sciences audience	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
23		Red flags	Y	Y	N	N	N	N	Y	N	Y	Y	N

**Table 8 - STROBE Guideline Data (Articles 17 & 33)**

Item		Article ID	17	33
	<b>Title and Abstract</b>		-	-
1a		Indicate study design with commonly used term in title or abstract	N	N
1b		Provide in abstract an informative and balanced summary of what was done and found	Y	Y
	<b>Introduction</b>		-	-
2	Background/Rationale	Explain scientific background and rationale for investigation being reported	Y	Y
3	Objectives	State specific objectives, including any prespecified hypotheses	Y	Y
	<b>Methods</b>		-	-
4	Study design	Present key elements of study design early in paper	Y	Y
5	Setting	Describe setting, location, and relevant dates, including periods of recruitment, exposure, follow-up and data collection	Y	Y

<b>Item</b>		<b>Article ID</b>	<b>17</b>	<b>33</b>
6	Participants	Give the eligibility criteria and sources and methods of selection of participants	Y	Y
7	Variables	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnosis criteria, if applicable.	N	Y
8	Data sources/measurement	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	Y	Y
9	Bias	Describe any efforts to address potential source of bias	Y	N
10	Study size	Explain how study size was arrived at	Y	Y
11	Quantitative variables	Explain how quantitative variables were handled in the analyses. If applicable, describe which grouping were chosen and why.	Y	Y
12a	Statistical methods	Describe all statistical methods, including those used to control for confounding	Y	Y
12b		Describe any methods used to examine subgroups and interactions	Y	Y
12c		Explain how missing data were addressed	N	N
12d		If applicable, describe analytical methods taking account of sampling strategy	N/A	N/A
12e		Describe any sensitivity analyses	N	N
	<b>Results</b>		-	-
13a	Participants	Report numbers of individuals at each stage of study	Y	Y
13b		Give reasons for non-participants at each stage	N	N
13c		Consider use of a flow diagram	N	N
14a	Descriptive data	Give characteristics of study participants	Y	Y
14b		Indicate number of participants with missing data for each variable of interest	Y	Y
15	Outcome data	Report numbers of outcome events or summary measures	Y	Y

<b>Item</b>		<b>Article ID</b>	<b>17</b>	<b>33</b>
16a	Main results	Give unadjusted estimates and if applicable, confounder-adjusted estimates and their precision	Y	Y
16b		Report category boundaries when continuous variables were categorized	N/A	N/A
16c		If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	N/A
17	Other analyses	Report other analyses done	Y	Y
	<b>Discussion</b>		-	-
18	Key results	Summarise key results with reference to study objectives	Y	Y
19	Limitations	Discuss limitations of the study, taking into account sources of potential bias or imprecision	Y	Y
20	Interpretation	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies and other relevant evidence	Y	Y
21	Generalisability	Discuss generalisability (external validity) of the study results	N	Y
	<b>Other Information</b>		-	-
22	Funding	Give source of funding and role of funders for the present study and if applicable the original study on which present article is based	N	N

**Table 9 - JBI Guideline Data (Article 45)**

	<b>Article ID</b>	<b>45</b>
<b>Item</b>		-
1	Is it clear in the study what is the cause and what is the effect?	N
2	Were the participants included in any comparisons similar?	Y
3	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Y
4	Was there a control group?	N

	<b>Article ID</b>	<b>45</b>
5	Were there multiple measurements of the outcome both pre and post intervention/exposure?	Unclear
6	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	Y
7	Were the outcomes of participants included in any comparisons measured in the same way?	Unclear
8	Were outcomes measured in a reliable way?	Unclear
9	Was appropriate statistical analysis used?	Unclear

**Table 10 - Delphi Guideline Data (Article 18)**

		<b>Article ID</b>	<b>18</b>
<b>Item</b>			-
1	<b>Research problem</b>	Clearly defined	Y
2	<b>Research rationale</b>	Topic and method justification	Y
3	<b>Literature review</b>	Topic understudy	Y
	<b>Methodology</b>		-
4	Data Collection	Clear explanation of Delphi method employed	Y
5	Rounds	Number employed, outline of each	Y
6	Sample	Experts selection process and characteristics described in detail	Y
7	Reliability/Validity	Issues identified	Y
8	Statistical Interpretation	Guidelines for the reader	Y
9	Ethical Responsibilities	Towards expert sample and research community	Y
	<b>Data Analysis</b>		-
10	Response rate	For each round	Y
11	Round 1	Presentation of total number of issues generated	Y
12	Round 2	Presentation of results indicating strength of support	Y
13	Further Rounds (if applicable)	Presentation of results	Y

		<b>Article ID</b>	<b>18</b>
	<b>Discussion and Conclusion</b>		-
14		Issue of consensus	Y
15		Interpretations of consensus gained/not gained	Y
16		Direction of further research leading from conclusions	Y
17	<b>Appendices</b>	Copy of each round questionnaire illustrated	N

**Table 11 - Data Results Charting (Article ID, Title, Author(s), Aims/Purpose)**

<b>ID</b>	<b>Title</b>	<b>Author(s)</b>	<b>Aims/Purpose</b>
16	User-centered design of integrated eHealth to improve patients' activation in transitional care	Frykholm, O Flink, M Lindblad, M Ekstedt, M	Describe user-centred design in development of an eHealth service
17	A pilot project to design, implement and evaluate an electronic integrated care pathway	Hayward-Rowse, L Whittle, T	Discuss user involvement in the design, implementation and evaluation of an electronic integrated care pathway
18	Users' perspectives of key factors to implementing electronic health records in Canada: a Delphi	McGinn, CA Gagnon, MP Shaw, N Sicotte, C Mathieu, L Leduc, Y Grenier, S Duplantie, J Abdeljelil, AB Legare, F	Understand EHR user perspectives in Canadian context

<b>ID</b>	<b>Title</b>	<b>Author(s)</b>	<b>Aims/Purpose</b>
19	Engaging stakeholders to develop a depression management decision support tool in a tribal health system	Starks, H Shaw, JL Hiratsuka, V Dillard, DA Robinson, R	Report on stakeholder engagement process across the project cycle, specifically related to the depression management tool
22	Integrating Lean Exploration Loops Into Healthcare Facility Design: Programming Phase	Mazur, LM Johnson, K Pooya, P Chadwick, J McCreery, J	Explore what, when, and how Lean methods and tools can add value during the programming phase of design
23	Insights from the design and implementation of a single-entry model of referral for total joint replacement surgery: Critical success factors and unanticipated consequences	Damani, Z MacKean, G Bohm, E Noseworthy, T Wang, JMH DeMone, B Wright, B Marshall, DA	Describe the system's design/implementation, including successes, challenges, and unanticipated consequences (single entry model for referrals for hip and knee replacement surgery)
24	Multi-stakeholder collaboration in the redesign of family-centered rounds process	Xie, A Carayon, P Cartmill, R Li, Y Cox, ED Plotkin, JA Kelly, MM	Examine collaboration of multiple stakeholders in a specific project aimed to redesign the family-centered rounds (FCR) process. Specifically: process of collaborative healthcare system redesign; challenges to collaboration associated with participation of multiple stakeholders

<b>ID</b>	<b>Title</b>	<b>Author(s)</b>	<b>Aims/Purpose</b>
25	Crossing the implementation chasm: a proposal for bold action	Lorenzi, NM Novak, LL Weiss, JB Gadd, CS Unertl, KM	Identify "chasms" in IT project implementations that represent risky stages in the process. Chasms are classified into four categories: design, management, organization, and assessment (interactions within these categories).
26	Developing a decision support system to meet nurse managers' information needs for effective resource management...CLASSICA	Ruland, CM	Describe system development process steps to successfully develop and implement a decision support system to assist nurse managers in resource management activities
27	A patient-led approach to product innovation in patient education and wound management	McNichol, E McKay, A Milligan, C Bennett, K Hulme, R Joy, H	Explore potential enhanced benefits of extended patient involvement in entire live product development process
28	Going from "paper and pen" to ICT systems: Perspectives on managing the change process	Andersson Marchesoni, A Axelsson, K Faltholm, Y Lindberg, I	Describe and interpret experiences of the management during change processes where ICT was introduced among staff and managers in elderly care
29	Development of a smartphone app for adolescents with lupus: a collaborative meeting-based methodology inclusive of a wide range of stakeholders	Herschman, J Kasenberg, T Levy, D Ruth, N Taberner, C Kaufman, M Regina, A	Describe development of a mobile (smartphone) app for adolescents with lupus as well as the process used to overcome the challenges associated with creating medical apps

<b>ID</b>	<b>Title</b>	<b>Author(s)</b>	<b>Aims/Purpose</b>
30	Meeting end user needs in international research projects aiming to develop medical device technology prototypes for integrated care: A case study	Strisland, F Svagard, IS Austad, HO Reitan, KK	Develop integrated care solutions for chronic liver failure patients, including ICT system
31	What impedes and what facilitates a quality improvement project for older hospitalized patients?	Ijkema, R Langelaan, M van de Steeg, L Wagner, C	Gain insight into which factors impede and which facilitate the implementation of a complex multi-component improvement initiative in hospitalized older patients
32	New and useful, but is it utilized? Experiences with implementation of Lifecare eRoom in Norwegian municipalities	Onstad, SM Westrum, I Fensli, R	Determine success factors and barriers experienced during Lifecare eRoom implementation
33	Empirically testing some factors affecting HMS usage	Caccia-Bava, MC Guimaraes, VCK Guimaraes, T	Test importance of factors proposed in literature as important determinants of HMS usage measured by number of hours used and frequency of use. Main determinants: user training, participation in system implementation, and others.
36	Design of a Mobile Application for Transfusion Medicine...16 World Congress of Medical and Health Informatics: Precision Healthcare Through Informatics (MedInfo2017) was held in Hangzhou, China from August 21st to 25th, 2017	Albornoz, MA Marquez, S Rubin, L Luna, D	Describe iterative design and development of a Mobile Application for safe administration of blood components when blood transfusion performed
38	A technical solution to improving palliative and hospice care	Kallen, MA Yang, D Haas, N	Develop a EMR compatible prototype to store clinical data and patient reported outcomes

<b>ID</b>	<b>Title</b>	<b>Author(s)</b>	<b>Aims/Purpose</b>
39	User involvement in the development of a health promotion technology for older people: findings from the SWISH project	Iliffe, S Kharicha, K Harari, D Swift, C Goodman, C Manthorpe, J	Identify key aspects of social situations that affect health and well-being from perspectives of older people and professionals to expand existing health risk appraisal tool
40	Participatory design of a text message scheduling system to support young people with diabetes	Waller, A Franklin, V Pagliari, C Greene, S	Describe a participatory design methodology to develop a text message scheduling system for supporting young people with diabetes
42	Assistive Solutions in Practice: Experiences from AAL Pilot Regions in Austria..."Health Informatics meets eHealth conference," Vienna, Austria, 2017	Ates, N Aumayr, G Drobics, M Forster, KM Frauenberger, C Garschall, M Et Al.	Overview of the objectives, approaches, and status of all Austrian Active and Assisted Living (AAL) pilot regions
43	Involving patient in the early stages of health technology assessment (HTA): a study protocol	Gagnon, MP Candas, B Desmartis, M Gagnon, J La Roche, D Rhains, M Coulombe, M Dipankui, M Legare, F	Project objectives are: 1) setting up interventions to promote patient participation in three stages of the HTA process (identify topics, prioritize, develop assessment plan); 2) assessing the impact of patient participation on relevance of suggested topics, prioritization process, and assessment plan.

<b>ID</b>	<b>Title</b>	<b>Author(s)</b>	<b>Aims/Purpose</b>
45	User acceptability -- a critical success factor for picture archiving and communication system implementation...Proceedings of the 17th Symposium for Computer Applications in Radiology. 'The Electronic Practice: Radiology and the Enterprise.' Philadelphia PA, June 3-6, 2000	Crivianu-Gaita, D Babyn, P Gilday, D O'Brien, B Charkot, E	Describe experience of implementing PACS from point of view of user acceptability
47	Clinician user involvement in the real world: Designing an electronic tool to improve interprofessional communication and collaboration in a hospital setting	Tang, T Lim, ME Mansfield, E McLachlan, A Quan, SD	Share real-world experience of applying a variety of user involvement methods in the design and implementation of a clinical communication and collaboration platform
48	Designing and implementing an electronic health record system in primary care practice in sub-Saharan Africa: a case study from Cameroon	Kamadjeu, RM Tapang, EM Moluh, RN	Review key issues related to the design and implementation of an EHR system in urban primary health care practice in Cameroon
50	The case for end-user involvement in design of health technologies	Walker, L Clendon, J	Explore practice, views, expectations, and attitudes of nurses concerning EHRs, use of mobile devices and access to data storage platforms
51	Third generation participatory design in health informatics--making user participation applicable to large-scale information system projects	Pilemalm, S Timpka, T	Examine how participatory design methods can be modified to be applicable to comprehensive HIS projects

**Table 12 - Data Results Charting (Year of Publication)**

<b>ID</b>	<b>Year of Publication</b>
16	2016

<b>ID</b>	<b>Year of Publication</b>
17	2006
18	2012
19	2015
22	2016
23	2018
24	2015
25	2008
26	2001
27	2015
28	2017
29	2014
30	2016
31	2014
32	2016
33	2016
36	2017
38	2012
39	2010
40	2006
42	2017
43	2014
45	2000
47	2018
48	2005

<b>ID</b>	<b>Year of Publication</b>
50	2016
51	2008

Note, the ID numbers are not a direct sequence as 12 articles were excluded during the full review.

Note, the following acronyms were used in the above chart.

EHR = Electronic Health Record; ICT = Information and Communication Technologies; HMS = Healthcare Management Systems; IT = Information Technology; EMR = Electronic Medical Record; PACS = Picture Archiving and Communication System

**Table 13 - Data Results Charting (Country Published In & Where Researched Conducted)**

<b>ID</b>	<b>Country Published In</b>	<b>Country Where Researched Conducted</b>
16	USA	Not Stated
17	USA	UK
18	USA	Canada
19	USA	USA
22	USA	Not Stated – Assume USA
23	USA	Canada
24	USA	USA
25	USA	USA
26	USA	Not Stated
27	USA	UK
28	USA	Sweden
29	USA	Canada
30	UK	European Union
31	USA	Netherlands
32	UK	Norway
33	USA	USA
36	China	Argentina
38	USA	USA
39	UK	UK
40	UK	Scotland

<b>ID</b>	<b>Country Published In</b>	<b>Country Where Researched Conducted</b>
42	Austria	Austria
43	UK	Canada
45	USA	Canada
47	USA	Canada
48	Cameroon	Cameroon
50	USA	New Zealand
51	Sweden	Sweden

**Table 14 - Data Results Charting (Type of Findings)**

<b>ID</b>	<b>Primary or Secondary</b>	<b>Type of Findings</b>
16	Primary	Evidence
17	Primary	Evidence
18	Primary	Evidence
19	Primary	Evidence
22	Primary	Evidence
23	Primary	Evidence
24	Primary	Evidence
25	Secondary	Opinion
26	Primary	Evidence
27	Primary	Evidence
28	Primary	Evidence
29	Primary	Evidence
30	Primary	Evidence
31	Primary	Evidence
32	Primary	Evidence
33	Primary	Evidence
36	Primary	Evidence
38	Primary	Evidence
39	Primary	Evidence

<b>ID</b>	<b>Primary or Secondary</b>	<b>Type of Findings</b>
40	Primary	Evidence
42	Primary	Evidence
43	Primary	Evidence
45	Primary	Evidence
47	Primary	Evidence
48	Primary	Evidence
50	Primary	Evidence
51	Primary	Evidence

**Table 15 - Data Results Charting (Research Type, Study Design, Method)**

<b>ID</b>	<b>Research Type</b>	<b>Study Design</b>	<b>Method</b>
16	Qualitative	User-centred	Interview Workshop Observation
17	Mixed Method	Cross-sectional	Workshop Questionnaire
18	Quantitative	Delphi Study	Questionnaire
19	Qualitative	Case Study	Interview Workshop
22	Qualitative	Case Study	Workshop
23	Qualitative	Case Study	Interview
24	Qualitative	Phenomenology	Interview
25	Qualitative	Phenomenology	Focus Group Observation Workshop

<b>ID</b>	<b>Research Type</b>	<b>Study Design</b>	<b>Method</b>
26	Qualitative	Participatory	Focus Group
27	Qualitative	Participatory	Workshop
28	Qualitative	Case Study	Interview
29	Qualitative	User-centred	Workshop
30	Qualitative	User-centred	Semi-structured interview
31	Qualitative	Case Study	Semi-structured interview
32	Qualitative	Case Study	Interview
33	Quantitative	Cross-sectional	Questionnaire
36	Qualitative	User-centred	Interview
38	Qualitative	User-centred	Interview
39	Qualitative	Participatory	Questionnaire Interview Focus Group
40	Qualitative	Participatory User-centred	Workshop
42	Qualitative	User-centred	Interview
43	Qualitative	Participatory	Semi-structured interview Observation
45	Quantitative	Quasi-experimental	Survey *assumed*
47	Qualitative	Participatory User-centred	Observation Workshop
48	Qualitative	Case Study	Observation Interview

<b>ID</b>	<b>Research Type</b>	<b>Study Design</b>	<b>Method</b>
50	Qualitative	Case Study	Focus Group
51	Qualitative	Participatory	Observation

**Table 16 - Data Results Charting (Project Methodology)**

<b>ID</b>	<b>Project Methodology</b>
16	Not specified
17	Not specified
18	Not specified
19	Not specified
22	Lean
23	Not specified
24	Not specified
25	Not specified
26	Not specified
27	Not specified
28	Not specified
29	Not specified
30	Not specified
31	Not specified
32	Not specified
33	Not specified
36	Agile
38	Not specified
39	Not specified
40	Not specified
42	Not specified

<b>ID</b>	<b>Project Methodology</b>
43	Not specified
45	Not specified
47	Agile
48	Not specified
50	Not specified
51	Not specified

**Table 17 - Data Results Charting (Project Management Process)**

<b>ID</b>	<b>Project Management Process</b>
16	Plan Execute
17	Plan Execute
18	Execute
19	All
22	Plan
23	Not specified
24	Not specified
25	Plan Execute
26	Plan Execute Monitor/Control
27	Plan
28	Execute
29	Plan
30	Plan
31	Not specified
32	Not specified

<b>ID</b>	<b>Project Management Process</b>
33	All
36	Plan Execute
38	Plan
39	Plan
40	Plan
42	All
43	Initiate Plan
45	All
47	Plan Execute Monitor/Control
48	Monitor/Control
50	Plan Execute Monitor/Control
51	Plan

**Table 18 - Data Results Charting (SDLC)**

<b>ID</b>	<b>SDLC</b>
16	Design & Development Implementation
17	Design & Development Test Implementation
18	Implementation
19	Analysis & Requirements Design & Development

ID	SDLC
	Test Implementation
22	Analysis & Requirements Design & Development
23	Not specified
24	Implementation
25	Analysis & Requirements Design & Development Implementation
26	Analysis & Requirements Design & Development Implementation Maintenance
27	Analysis & Requirements Design & Development
28	Analysis & Requirements Implementation
29	Analysis & Requirements
30	Analysis & Requirements Design & Development
31	Maintenance
32	Maintenance
33	Maintenance

ID	SDLC
36	Analysis & Requirements Design & Development
38	Design & Development
39	Design & Development
40	Design & Development
42	Analysis & Requirements Design & Development Test Implementation
43	Analysis & Requirements
45	Analysis & Requirements Design & Development Test Implementation
47	Analysis & Requirements Design & Development Test Implementation
48	Implementation
50	Analysis & Requirements Design & Development Test Implementation
51	Analysis & Requirements Design & Development

ID	SDLC
	Test Implementation

**Table 19 - Data Results Charting (Type of HIS)**

ID	Type of HIS
16	Patient self-management
17	Integrated care pathway
18	EHR
19	Depression Management Decision Support Tool (DM-DST)
22	Electronic notification system (part of design for new surgical tower)
23	Referral for total knee replacement surgery
24	Family Centered Rounds (FCR) Checklist
25	HIS
26	Resource management system (Nurse Managers)
27	Wound management
28	Medication administration
29	Mobile app (Lupus)
30	Liver patient management ICT system
31	EHR
32	Treatment plan system (Lifecare eRoom)
33	Healthcare management systems (HMS)
36	Mobile app (Blood transfusion)
38	EMR
39	Health Risk Appraisal for Older People (HRAO)
40	Text message scheduling system
42	Smart home technologies and systems (for Active and Assisted Living)
43	All health technology
45	PACS
47	Interprofessional clinical communication and collaboration platform (Care Connector)

ID	Type of HIS
48	EHR
50	EHR
51	HIS

**Table 20 - Data Results Charting (End-User Involvement within the Studies)**

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
16	eHealth solutions require successful implementation with the healthcare processes - personnel need to feel ownership of the solution to perceive it as effective.	Yes	Not specified	Not specified
17	User involvement is fundamental to success of any project, including integrated care pathway. Should be constructed with whole research group, including users.	Yes	Not specified	Positive
18	One of the ten decision making factors specific to EHR implementation in Canada is the participation of end-users in implementation strategy	Yes	Implementation	Positive
19	Use of iterative, cross-stakeholder interaction with research team acting as coordinator for cumulative information between stakeholder groups resulted in final product that met needs of stakeholder groups and produced a decision support tool that is both clinically accurate and culturally appropriate	Yes	Design and Development Testing Implementation Maintenance	Not specified
22	Lean tools and methods valuable to help establish buy-in and consensus among stakeholders	Yes	Analysis and Requirements Design and Development	Not specified
23	Initial participation among stakeholders was a challenge. Confusion around stakeholder expectations was an unanticipated consequence. Three most common areas of difficulty were change readiness,	Yes	Implementation	Negative

ID	User involvement findings	User involvement in study?	Where and how is user involved (if yes)	User Perception (if yes)
	communication, and participation. Deliberate efforts must be made before and during implementation process to maximize stakeholder readiness, participation, and uptake while mitigating unanticipated consequences.			
24	Stakeholder representatives performed critical functions in collaboration process. Involvement of parent representative was essential	Yes	Implementation	Not specified
25	Lack of integration among groups involved in design and implementation results in a loss of trust by end users. Lack of user involvement is one of the reasons for implementation failures.	No	N/A	N/A
26	Users were heavily involved in design process which allowed project to be successful. Allowed designers to tailor system to users' responsibilities, work process, and needs for information and decision support.	Yes	Design and Development	Not specified
27	Patient and caregiver participation in product development process brings benefits to understanding issues important to them, which results in a more successful product	Yes	Analysis and Requirements Design and Development	Positive
28	Staff and front line managers had low power of influence and mostly assumed role of recipients of ICT system. Purpose and decisions on why change was initiated was unclear. Lack of management of project and who was responsible for what.	Yes	Analysis and Requirements Implementation	Negative
29	Success of method attributed to leveraging a range of respectful collaboration and contribution approaches	Yes	Analysis and Requirements	Not specified
30	Technology developers had no direct contact with end users (patients) during project and relied heavily on the clinical expert partners to convey user needs. Clinicians were essential in	Yes	Design and Development	Not specified

<b>ID</b>	<b>User involvement findings</b>	<b>User involvement in study?</b>	<b>Where and how is user involved (if yes)</b>	<b>User Perception (if yes)</b>
	defining user needs, but clinical background and lack of end user needs engineering methodologies represented a challenge.			
31	Factors that impeded implementation included insufficient involvement of nurses and physicians and a lack of time	Yes	Maintenance	Not specified
32	Success factors: leveraging enthusiasts during implementation phase and early involvement of stakeholders. Barriers: resistance to change and insufficient buy-in.	Yes	Maintenance	Not specified
33	High level of user conflict during system development/implementation likely leads to user system avoidance. To increase HMS usage, user participation in system development/implementation process is important. Users will strive for better communication with developers if they believe they can influence the development and get the system they want.	Yes	Maintenance	Not specified
36	Cannot create a representative tool without user participation in task (i.e. user-centred design). This makes it easier to learn, simpler to use, and gains good acceptance and perception of utility by users.	Yes	Analysis and Requirements Design and Development	Not specified
38	Provided feedback in terms of system's usability and usefulness	Yes	Maintenance	Not specified
39	Older people able to take action in their health by adding their perspectives on social dimensions of health and well-being into the tool	Yes	Maintenance	Not specified
40	Close collaboration between developer and paediatrician throughout cycle of design and evaluation resulted in a reliable, valid and acceptable prototype which was easily implemented into routine practice	Yes	Design and Development Testing Maintenance	Not specified
42	Active involvement of representatives of all relevant user groups and other stakeholders in all phases of the project was a major challenge. Involvement of end user organizations is crucial for access to expert knowledge and to ensure they can be actively	Yes	Analysis and Requirements Design and Development	Not specified

<b>ID</b>	<b>User involvement findings</b>	<b>User involvement in study?</b>	<b>Where and how is user involved (if yes)</b>	<b>User Perception (if yes)</b>
	involved in all phases of the project. Use of participatory approach during requirements phase was successful and helped prioritize services according to actual user needs.		Testing Implementation	
43	Promote patient participation in three stages of health technology assessment	Yes	Analysis and Requirements Design and Development	Not specified
45	User involvement in PACS planning, training, technical support, and rollout of pilot projects was a key success factor. Non-technical factors also need to be recognized and resolved.	Yes	Analysis and Requirements Implementation	Positive
47	User-centred design effective in informing design of new modules, but inefficient in obtaining iterative feedback for enhancements due to resource intensiveness and difficulty of scheduling with busy clinicians to obtain timely feedback necessary for rapid agile software development cycles. This gap was addressed by using participatory design and user co-design methods. Through participatory design, physician and nursing leads embedded as part of core design and played key role in design decision making. Used in tandem with co-design and critical to success of project where adoption was easily achieved.	Yes	Design and Development	Positive
48	End user involvement and capacity building should have been carried out at the early stages of system development	Yes	Implementation	Not specified
50	End users of the technologies must be involved in every stage of the process - from software development to choice of hardware to enabling technologies to perform all of the required nursing tasks	Yes	Maintenance	Not specified
51	Use of participatory design increases possibility that development results in a system that the stakeholder group needs, approves of, and will use	Yes	Maintenance	Not specified

Note, the following acronyms were used in the above chart.

EHR = Electronic Health Record; ICT = Information and Communication Technologies; HMS = Healthcare Management Systems; PACS = Picture Archiving and Communication System

**Table 21 - Data Results Charting (End-User Involvement Recommendations)**

<b>ID</b>	<b>User involvement findings</b>	<b>Where and how should users be involved (results)?</b>
16	eHealth solutions require successful implementation with the healthcare processes - personnel need to feel ownership of the solution to perceive it as effective.	Design and Development Implementation
17	User involvement is fundamental to success of any project, including integrated care pathway. Should be constructed with whole research group, including users.	Implementation
18	One of the ten decision making factors specific to EHR implementation in Canada is the participation of end-users in implementation strategy	Implementation
19	Use of iterative, cross-stakeholder interaction with research team acting as coordinator for cumulative information between stakeholder groups resulted in final product that met needs of stakeholder groups and produced a decision support tool that is both clinically accurate and culturally appropriate	Project lifecycle
22	Lean tools and methods valuable to help establish buy-in and consensus among stakeholders	Analysis and Requirements Design and Development
23	Initial participation among stakeholders was a challenge. Confusion around stakeholder expectations was an unanticipated consequence. Three most common areas of difficulty were change readiness, communication, and participation. Deliberate efforts must be made before and during implementation process to maximize stakeholder readiness, participation, and uptake while mitigating unanticipated consequences.	Implementation
24	Stakeholder representatives performed critical functions in collaboration process. Involvement of parent representative was essential	Design and Development Implementation
25	Lack of integration among groups involved in design and implementation results in a loss of trust by end users. Lack of user involvement is one of the reasons for implementation failures.	Analysis and Requirements Design and Development Implementation

ID	User involvement findings	Where and how should users be involved (results)?
26	Users were heavily involved in design process which allowed project to be successful. Allowed designers to tailor system to users' responsibilities, work process, and needs for information and decision support.	Project lifecycle
27	Patient and caregiver participation in product development process brings benefits to understanding issues important to them, which results in a more successful product	Analysis and Requirements Design and Development
28	Staff and front line managers had low power of influence and mostly assumed role of recipients of ICT system. Purpose and decisions on why change was initiated was unclear. Lack of management of project and who was responsible for what.	Analysis and Requirements Implementation
29	Success of method attributed to leveraging a range of respectful collaboration and contribution approaches	Analysis and Requirements
30	Technology developers had no direct contact with end users (patients) during project and relied heavily on the clinical expert partners to convey user needs. Clinicians were essential in defining user needs, but clinical background and lack of end user needs engineering methodologies represented a challenge.	Analysis and Requirements Design and Development
31	Factors that impeded implementation included insufficient involvement of nurses and physicians and a lack of time	Analysis and Requirements Implementation
32	Success factors: leveraging enthusiasts during implementation phase and early involvement of stakeholders. Barriers: resistance to change and insufficient buy-in.	Analysis and Requirements Design and Development Implementation
33	High level of user conflict during system development/implementation likely leads to user system avoidance. To increase HMS usage, user participation in system development/implementation process is important. Users will strive for better communication with developers if they believe they can influence the development and get the system they want.	Design and Development Implementation
36	Cannot create a representative tool without user participation in task (i.e. user-centred design). This makes it easier to learn, simpler to use, and gains good acceptance and perception of utility by users.	Project lifecycle
38	Provided feedback in terms of system's usability and usefulness	Design and Development Implementation
39	Older people able to take action in their health by adding their perspectives on social dimensions of health and well-being into the tool	Design and Development

ID	User involvement findings	Where and how should users be involved (results)?
40	Close collaboration between developer and paediatrician throughout cycle of design and evaluation resulted in a reliable, valid and acceptable prototype which was easily implemented into routine practice	Design and Development Maintenance
42	Active involvement of representatives of all relevant user groups and other stakeholders in all phases of the project was a major challenge. Involvement of end user organizations is crucial for access to expert knowledge and to ensure they can be actively involved in all phases of the project. Use of participatory approach during requirements phase was successful and helped prioritize services according to actual user needs.	Project lifecycle
43	Promote patient participation in three stages of health technology assessment	Not specified
45	User involvement in PACS planning, training, technical support, and rollout of pilot projects was a key success factor. Non-technical factors also need to be recognized and resolved.	Analysis and Requirements Implementation
47	User-centred design effective in informing design of new modules, but inefficient in obtaining iterative feedback for enhancements due to resource intensiveness and difficulty of scheduling with busy clinicians to obtain timely feedback necessary for rapid agile software development cycles. This gap was addressed by using participatory design and user co-design methods. Through participatory design, physician and nursing leads embedded as part of core design and played key role in design decision making. Used in tandem with co-design and critical to success of project where adoption was easily achieved.	Design and Development
48	End user involvement and capacity building should have been carried out at the early stages of system development	Design and Development Implementation
50	End users of the technologies must be involved in every stage of the process - from software development to choice of hardware to enabling technologies to perform all of the required nursing tasks	Analysis and Requirements Design and Development Testing Implementation
51	Use of participatory design increases possibility that development results in a system that the stakeholder group needs, approves of, and will use	Analysis and Requirements Design and Development Testing Implementation

Note, the following acronyms were used in the above chart.

EHR = Electronic Health Record; ICT = Information and Communication Technologies; HMS = Healthcare Management Systems; PACS = Picture Archiving and Communication System

**Table 22 - End-User Involvement and Outcomes (Category)**

<b>ID</b>	<b>Outcomes</b>	<b>Outcomes (Category)</b>
16	Stakeholder engagement through user-centred design	Engagement
17	Participant experiences on the new electronic integrated care pathway	Experiences/Perceptions
18	Applicability, importance, and priority of pre-defined factors for EHR implementation. Main outcome measures = Consensus and priority - both were defined.	Implementation factors
19	Engagement process for implementation of decision support tool	Engagement
22	When and how Lean should be integrated into design process	Design factors
23	Successes, challenges, and unanticipated consequences from design and implementation of system	Design factors Implementation factors
24	Process of collaborative healthcare system redesign and challenges to collaboration associated with participation of multiple stakeholders	Design factors
25	Identify chasms in implementation of system projects	Implementation factors
26	Identify factors essential to develop successful systems	Design factors
27	Identify benefits of extended patient involvement in entire development process	Design factors
28	Identify experiences of management during technology implementation	Implementation factors
29	Mobile smartphone app for adolescents with Lupus	System/Application
30	Application and perceptions of user-centred design process to develop integrated care technology	Experiences/Perceptions
31	Management of process of implementation, participants' opinions of program elements and context factors which influence implementation	Implementation factors
32	Identify success factors and barriers during implementation of system	Implementation factors
33	Test importance of factors proposed in literature as important determinants of system usage	System use/acceptance
36	Mobile application for transfusion medicine	System/Application
38	Computer software for palliative and hospice patients	System/Application
39	Identify key aspects from user perspectives to expand existing technology tool	Experiences/Perceptions
40	Text message scheduling system	System/Application

<b>ID</b>	<b>Outcomes</b>	<b>Outcomes (Category)</b>
42	Identify objectives, approaches and status of regions where technology piloted	Design factors Implementation factors
43	Identify promotion and assess impact of patient participation	Engagement
45	Identify factors of importance in increasing user acceptance	System use/acceptance
47	Identify user involvement methods in design and development of system	Design factors
48	Identify issues in design and implementation of EHR system	Design factors Implementation factors
50	Identify views, expectations and attitudes of nurses using EHRs	Experiences/Perceptions
51	Identify participatory action research on development of participatory design framework for large system design	Design factors

**Table 23 - End-User Involvement and Measurements**

<b>ID</b>	<b>Measurements</b> Qual = definitions Quan = instruments
16	Not specified
17	Questionnaire
18	Questionnaire
19	Not specified
22	Not specified
23	Not specified
24	Yes - user involvement
25	Not specified
26	Not specified
27	Not specified
28	Not specified
29	Not specified
30	Not specified
31	Not specified
32	Not specified

<b>ID</b>	<b>Measurements</b> Qual = definitions Quan = instruments
33	Questionnaire - + def
36	Not specified
38	Yes - usability evaluation, overall evaluation (usefulness)
39	Not specified - other
40	Yes – user-centred design and participatory design
42	Not specified
43	Not specified - other
45	Not specified - other
47	Yes - user involvement and three major strategies
48	Not specified
50	Not specified
51	Yes - participatory design

**Table 24 - Measured Outcome Categories and their Measurements**

<b>Outcome (Category)</b>	<b>Measurements</b>
Design Factors	Not specified = 3 Definition = 3
Implementation Factors	Not specified = 4 Questionnaire = 1
Experiences/Perceptions	Not specified = 3 Questionnaire = 1
Systems/Mobile App	Not specified = 2 Definition = 2
Design/Implementation Factors	Not specified = 3
Engagement	Not specified = 3
System Use/Acceptance	Not specified = 1 Questionnaire = 1

**Table 25 - Measurement/Definition of Success**

<b>ID</b>	<b>Measurement/Definition of Success</b>
16	Not specified or defined
17	Not specified or defined
18	Not specified or defined. Noted, it relies on perception of participant on what might influence implementation success without actual evidence from implementation.
19	Not specified or defined
22	Not specified or defined
23	Defined by participants
24	Not specified or defined
25	Not specified or defined
26	Not specified or defined
27	Not specified or defined
28	Not specified or defined
29	Not specified or defined
30	Not specified or defined
31	Not specified or defined
32	Defined by participants
33	Yes - based on results
36	Not specified or defined
38	Yes - usability defined success
39	Not specified or defined
40	Yes - user defined success
42	Defined by participants
43	Not specified or defined
45	Based on user acceptability
47	User acceptance and adoption (statement)
48	User acceptance and adoption (statement)
50	User acceptance and adoption (statement)
51	Not specified or defined

**Table 26 - End-User Involvement with Positive Impact**

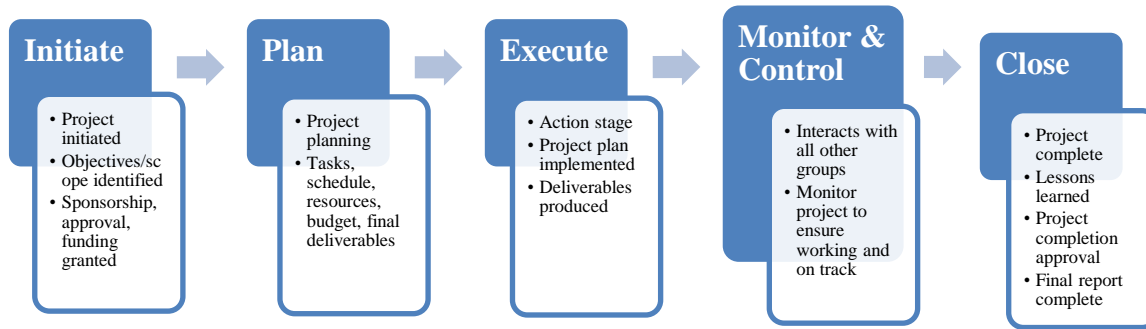
<b>ID</b>	<b>End-User involvement Positive Impact</b>
16	Y
17	Y
18	Y
19	Y
22	Y
23	Y
24	Y
25	Y
26	Y
27	Y
28	Y
29	Y
30	Y
31	Y
32	Y
33	Y
36	Y
38	Not specified
39	Y
40	Y
42	Y
43	Not specified
45	Y
47	Y
48	Y
50	Y
51	Y

**Table 27 - End-User Involvement and Impact to Project Success**

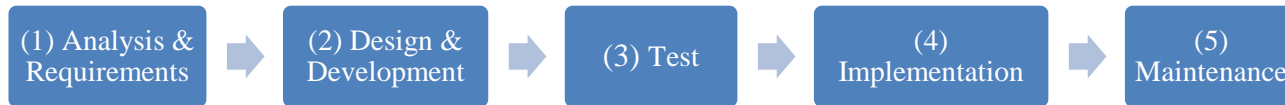
<b>ID</b>	<b>Impact to Project Success</b>
16	Y
17	Y
18	Not specified
19	Not specified
22	Not specified
23	Not specified
24	Not specified
25	Not specified
26	Y
27	Y
28	Not specified
29	Y
30	Not specified
31	Not specified
32	Y
33	Not specified
36	Not specified
38	Not specified
39	Not specified
40	Not specified
42	Y
43	Not specified
45	Y
47	Y
48	Not specified
50	Not specified
51	Not specified

**Figures**

**Figure 1 - Project Management Process Groups and Tasks**



**Figure 2 - Software Development Lifecycle (SDLC) Phases**



**Figure 3 - PRISMA-ScR Checklist for Scoping Reviews**

Table. PRISMA-ScR Checklist		
Section	Item	PRISMA-ScR Checklist Item
<b>Title</b>	1	Identify the report as a scoping review.
<b>Abstract</b>		
Structured summary	2	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.
<b>Introduction</b>		
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.
<b>Methods</b>		
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).
Summary measures	13	Not applicable for scoping reviews.
Synthesis of results	14	Describe the methods of handling and summarizing the data that were charted.
Risk of bias across studies	15	Not applicable for scoping reviews.
Additional analyses	16	Not applicable for scoping reviews.
<b>Results</b>		
Selection of sources of evidence	17	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.
Characteristics of sources of evidence	18	For each source of evidence, present characteristics for which data were charted and provide the citations.
Critical appraisal within sources of evidence	19	If done, present data on critical appraisal of included sources of evidence (see item 12).
Results of individual sources of evidence	20	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.
Synthesis of results	21	Summarize and/or present the charting results as they relate to the review questions and objectives.
Risk of bias across studies	22	Not applicable for scoping reviews.
Additional analyses	23	Not applicable for scoping reviews.
<b>Discussion</b>		
Summary of evidence	24	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.
Limitations	25	Discuss the limitations of the scoping review process.
Conclusions	26	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.
<b>Funding</b>	27	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.

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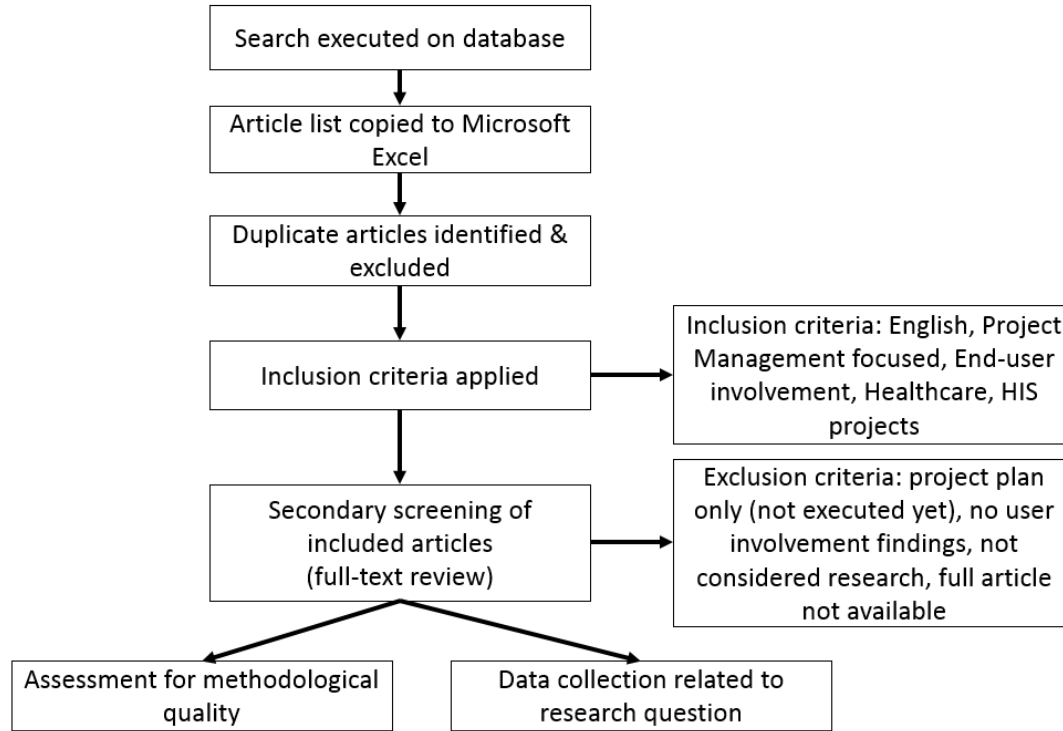
**Figure 4 - Review Screening and Selection Process**

Figure 5 - RATS Guideline for Qualitative Reviews

■ Qualitative research review guidelines – RATS

ASK THIS OF THE MANUSCRIPT	THIS SHOULD BE INCLUDED IN THE MANUSCRIPT	✓
<p><b>R Relevance of study question</b></p> <p>Is the research question interesting?</p> <p>Is the research question relevant to clinical practice, public health, or policy?</p>	<p>Research question explicitly stated</p> <p>Research question justified and linked to the existing knowledge base (empirical research, theory, policy)</p>	
<p><b>A Appropriateness of qualitative method</b></p> <p>Is qualitative methodology the best approach for the study aims?</p> <p><i>Interviews:</i> experience, perceptions, behaviour, practice, process</p> <p><i>Focus groups:</i> group dynamics, convenience, non-sensitive topics</p> <p><i>Ethnography:</i> culture, organizational behaviour, interaction</p> <p><i>Textual analysis:</i> documents, art, representations, conversations</p>	<p>Study design described and justified e.g., why was a particular method (i.e., interviews) chosen?</p>	
<p><b>T Transparency of procedures</b></p> <p><i>Sampling</i></p> <p>Are the participants selected the most appropriate to provide access to type of knowledge sought by the study?</p> <p>Is the sampling strategy appropriate?</p>	<p>Criteria for selecting the study sample justified and explained</p> <p><i>theoretical:</i> based on pre conceived or emergent theory</p> <p><i>purposive:</i> diversity of opinion</p> <p><i>volunteer:</i> feasibility, hard-to-reach groups</p>	
<p><i>Recruitment</i></p> <p>Was recruitment conducted using appropriate methods?</p> <p>Is the sampling strategy appropriate?</p> <p>Could there be selection bias?</p>	<p>Details of how recruitment was conducted and by whom</p> <p>Details of who chose not to participate and why</p>	
<p><i>Data collection</i></p> <p>Was collection of data systematic and comprehensive?</p> <p>Are characteristics of the study group and setting clear?</p> <p>Why and when was data collection stopped, and is this reasonable?</p>	<p>Method (s) outlined and examples given (e.g., interview questions)</p> <p>Study group and setting clearly described</p> <p>End of data collection justified and described</p>	

<p><i>Role of researchers</i></p> <p>Is the researcher (s) appropriate? How might they bias (good and bad) the conduct of the study and results?</p>	<p>Do the researchers occupy dual roles (clinician and researcher)?</p> <p>Are the ethics of this discussed? Do the researcher(s) critically examine their own influence on the formulation of the research question, data collection, and interpretation?</p>	
<p><i>Ethics</i></p> <p>Was informed consent sought and granted?</p> <p>Were participants' anonymity and confidentiality ensured?</p> <p>Was approval from an appropriate ethics committee received?</p>	<p>Informed consent process explicitly and clearly detailed</p> <p>Anonymity and confidentiality discussed</p> <p>Ethics approval cited</p>	
<p><b>S Soundness of interpretive approach</b></p> <p><i>Analysis</i></p> <p>Is the type of analysis appropriate for the type of study?  <i>thematic: exploratory, descriptive, hypothesis generating framework: e.g., policy</i>  <i>constant comparison/grounded theory: theory generating, analytical</i></p> <p>Are the interpretations clearly presented and adequately supported by the evidence?</p> <p>Are quotes used and are these appropriate and effective?</p> <p>Was trustworthiness/reliability of the data and interpretations checked?</p>	<p>Analytic approach described in depth and justified</p> <p><i>Indicators of quality:</i> Description of how themes were derived from the data (inductive or deductive)</p> <p>Evidence of alternative explanations being sought</p> <p>Analysis and presentation of negative or deviant cases</p> <p>Description of the basis on which quotes were chosen</p> <p>Semi-quantification when appropriate</p> <p>Illumination of context and/or meaning, richly detailed</p> <p>Method of reliability check described and justified  e.g., was an audit trail, triangulation, or member checking employed? Did an independent analyst review data and contest themes? How were disagreements resolved?</p>	

<p><i>Discussion and presentation</i></p> <p>Are findings sufficiently grounded in a theoretical or conceptual framework?</p> <p>Is adequate account taken of previous knowledge and how the findings add?</p> <p>Are the limitations thoughtfully considered?</p> <p>Is the manuscript well written and accessible?</p>	<p>Findings presented with reference to existing theoretical and empirical literature, and how they contribute</p> <p>Strengths and limitations explicitly described and discussed</p> <p>Evidence of following guidelines (format, word count) Detail of methods or additional quotes contained in appendix Written for a health sciences audience</p>	
		?
<p>Are <u>red flags</u> present? these are common features of ill conceived or poorly executed qualitative studies, are a cause for concern, and must be viewed critically. They might be fatal flaws, or they may result from lack of detail or clarity.</p>	<p><i>Grounded theory</i>: not a simple content analysis but a complex, sociological, theory generating approach Jargon: descriptions that are trite, pat, or jargon filled should be viewed sceptically <i>Over interpretation</i>: interpretation must be grounded in "accounts" and semi-quantified if possible or appropriate <i>Seems anecdotal, self evident</i>: may be a superficial analysis, not rooted in conceptual framework or linked to previous knowledge, and lacking depth <i>Consent process thinly discussed</i>: may not have met ethics requirements <i>Doctor-researcher</i>: consider the ethical implications for patients and the bias in data collection and interpretation</p>	

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## Figure 6 - STROBE Checklist for Cross-Sectional Studies

**Table 1**  
The STROBE Statement—checklist of items that should be addressed in reports of observational studies.

	Item number	Recommendation
Title and Abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rational	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8 <sup>a</sup>	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses
Results		
Participants	13 <sup>a</sup>	(a) Report the numbers of individuals at each stage of the study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive	14 <sup>a</sup>	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential data confounders (b) Indicate the number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (e.g., average and total amount)
Outcome data	15 <sup>a</sup>	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results.
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based.

<sup>a</sup> Give such information separately for cases and controls in case-control studies, and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies. Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Separate versions of the checklist for cohort, case-control, and cross-sectional studies are available on the STROBE Web site at <http://www.strobe-statement.org/>.

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### Figure 7 – Research Guidelines for the Delphi Survey Technique

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Research problem:	Clearly defined
Research rationale:	Topic and method justification
Literature review:	Topic understudy
Methodology:	Data collection: clear explanation of the Delphi method employed Rounds: number employed, outline of each Sample: experts selection process and characteristics described in detail Reliability and validity issues identified Statistical interpretation: guidelines for the reader Ethical responsibilities: towards 'expert' sample and research community
Data Analysis:	Response rate for each round Round 1: presentation of total number of issues generated Round 2: presentation of results indicating the strength of support Further rounds (if applicable): presentation of results
Discussion : and conclusions	Issue of consensus Interpretations of consensus gained/not gained Direction of further research leading from conclusions
Appendices:	Copy of each round questionnaire illustrated.

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**Figure 8 - JBI Critical Appraisal Checklist for Quasi-Experimental Studies**

**JBI Critical Appraisal Checklist for Quasi-Experimental Studies  
(non-randomized experimental studies)**

Reviewer \_\_\_\_\_ Date \_\_\_\_\_

Author \_\_\_\_\_ Year \_\_\_\_\_ Record Number \_\_\_\_\_

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the participants included in any comparisons similar?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was there a control group?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes of participants included in any comparisons measured in the same way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include  Exclude  Seek further info

Comments (Including reason for exclusion)

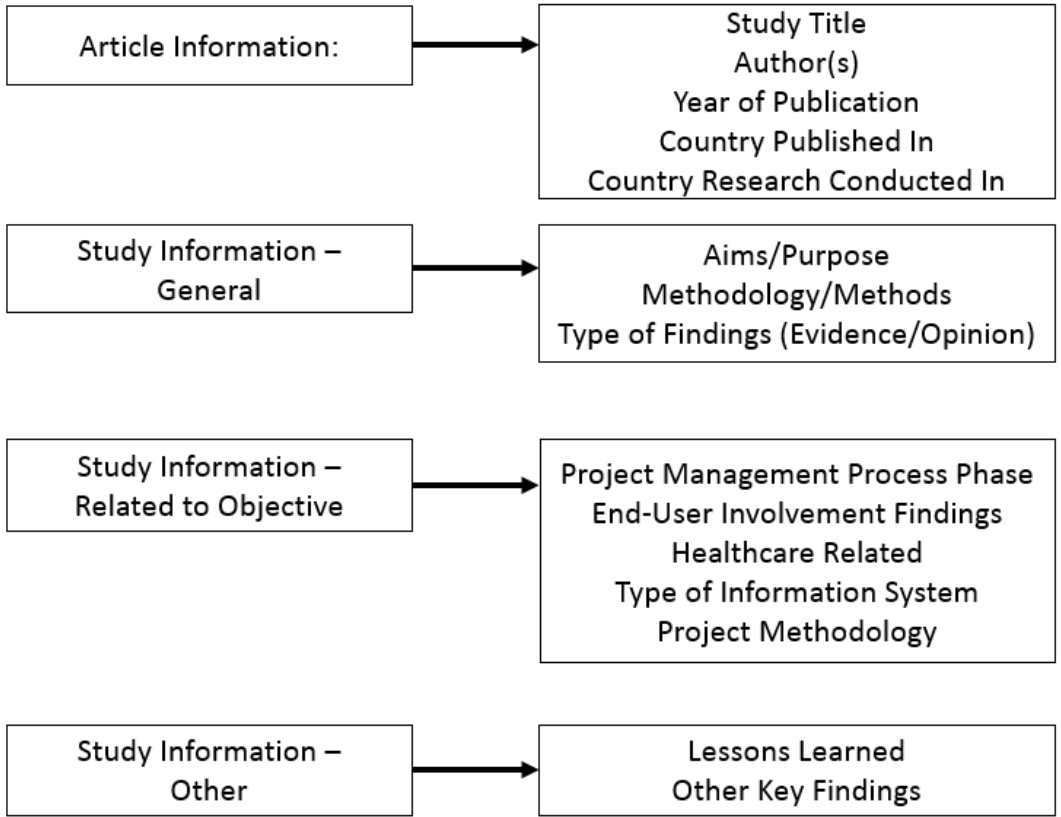
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Reproduced from “Critical Appraisal Tools,” by The Joanna Briggs Institute, 2017, from <https://joannabriggs.org/research/critical-appraisal-tools.html>, p. 3. Copyright 2017 CASP UK. Reprinted with permission.

**Figure 9 - Data Collection Information**



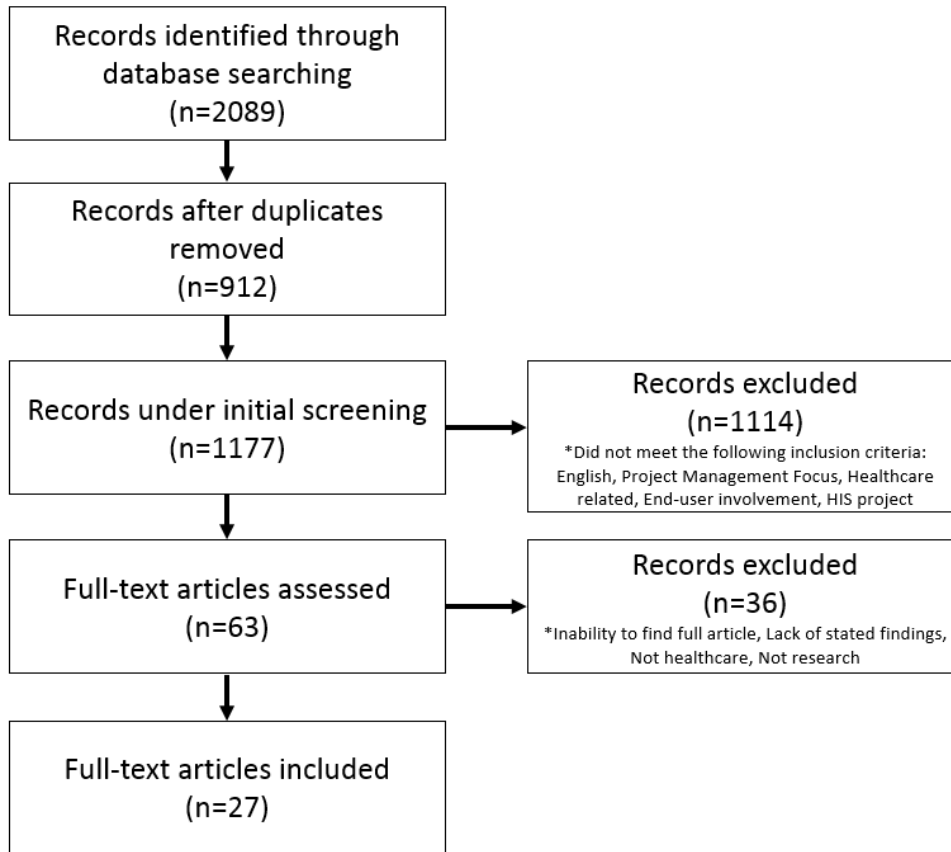
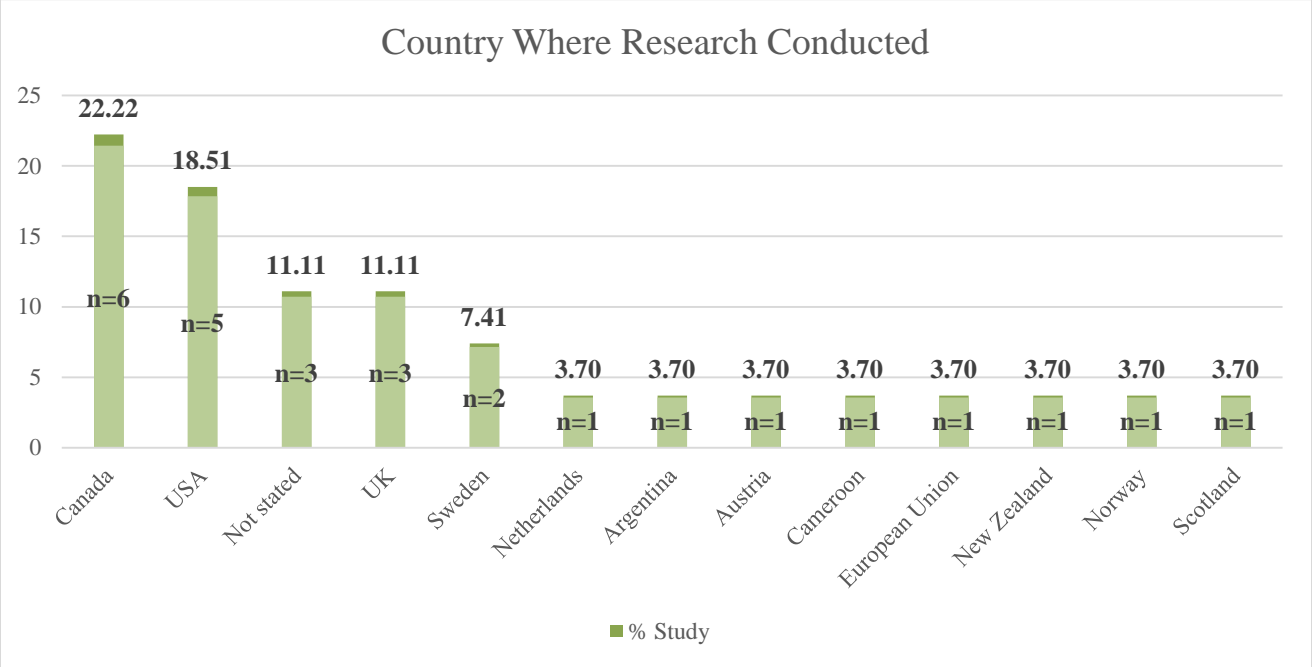
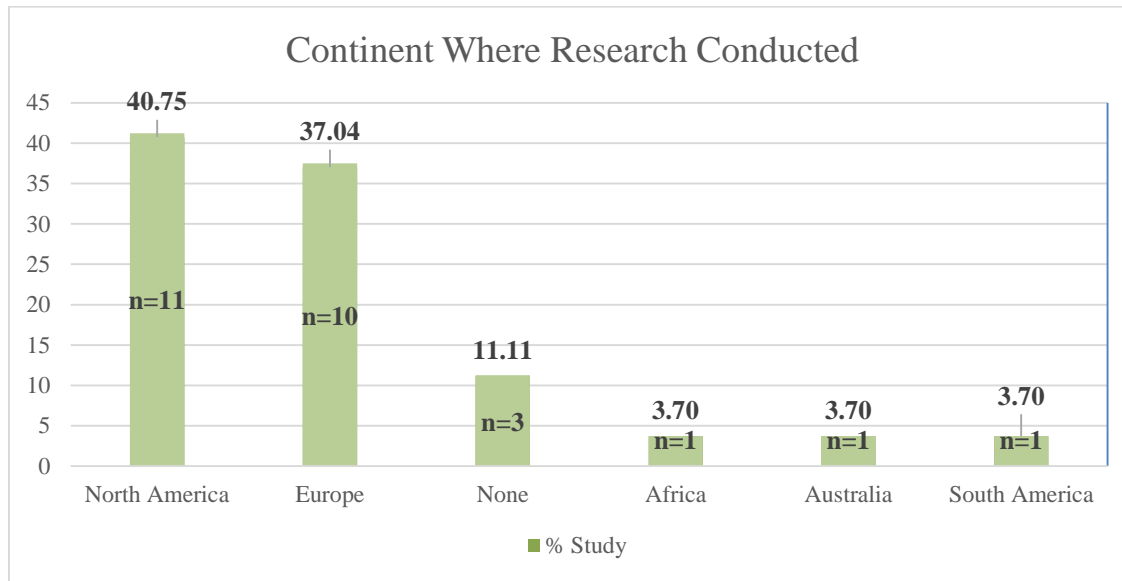
**Figure 10 - Flow Indicating Search and Screening Performed**

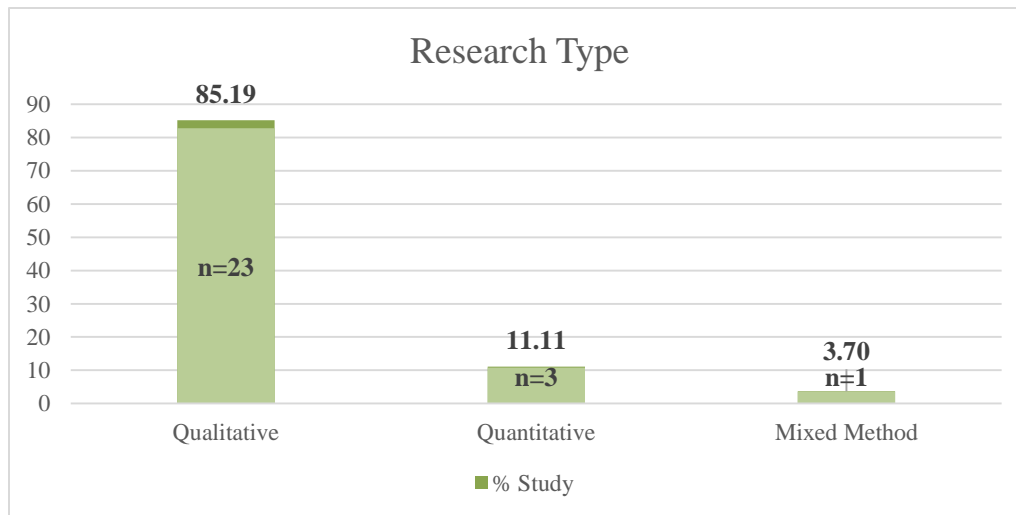
Figure 11 - Data Chart - Country Where Research Conducted



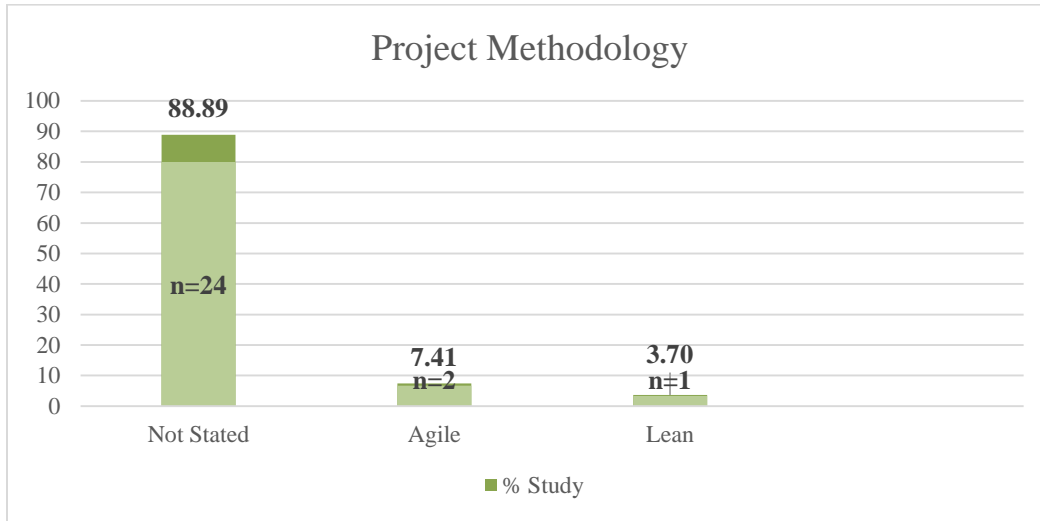
**Figure 12 - Data Chart - Continent Where Research Conducted**



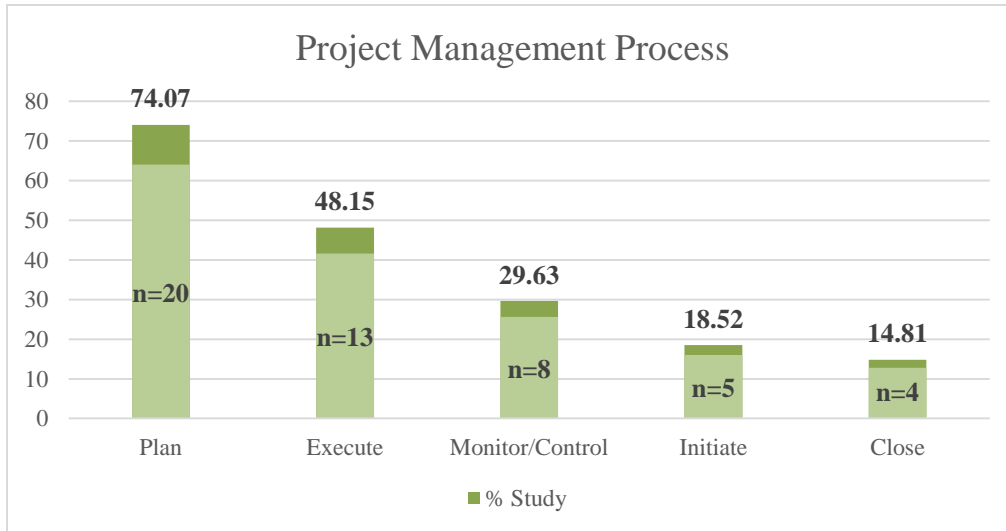
**Figure 13 - Data Chart – Research Type**



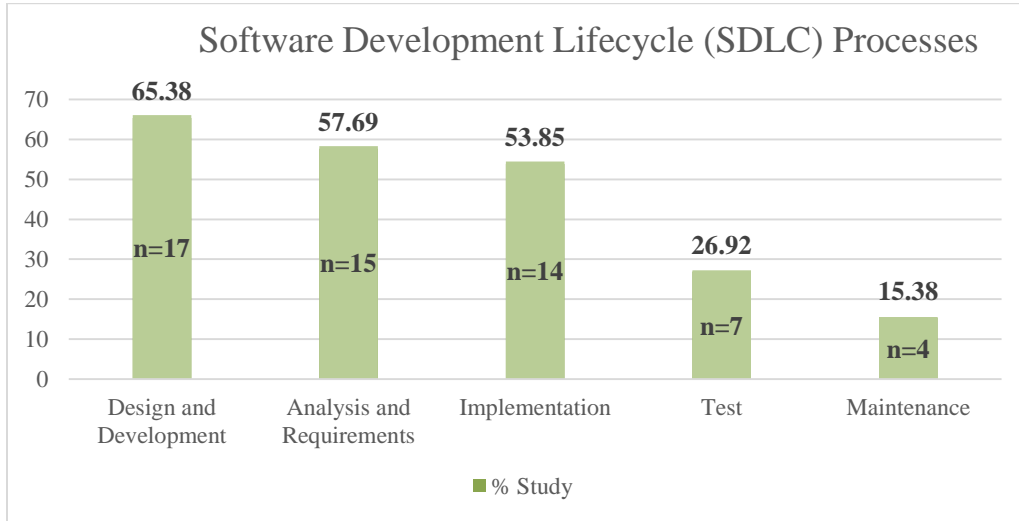
**Figure 14 - Data Chart – Project Methodology**



**Figure 15 - Data Chart – Project Management Process**



**Figure 16 - Data Chart – Software Development Lifecycle (SDLC) Processes**



**Figure 17 - Data Chart – Type of Health Information System (HIS)**

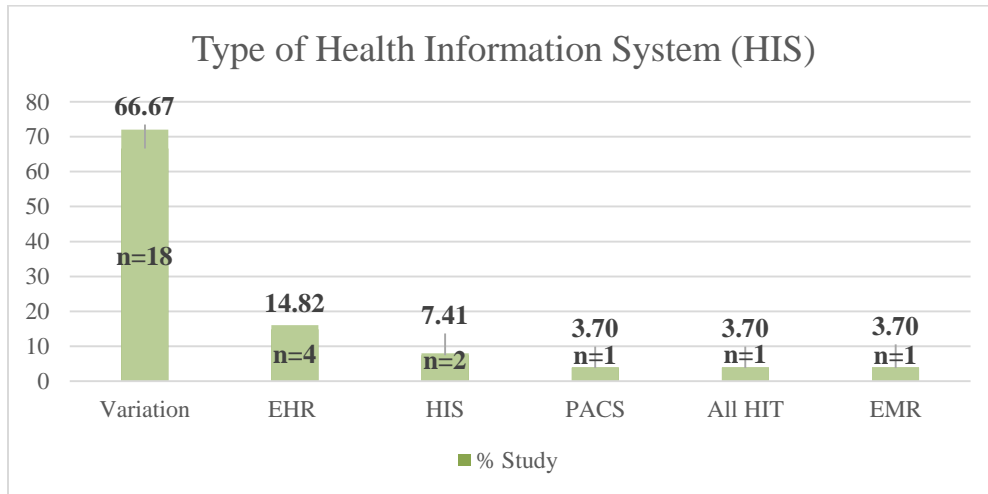
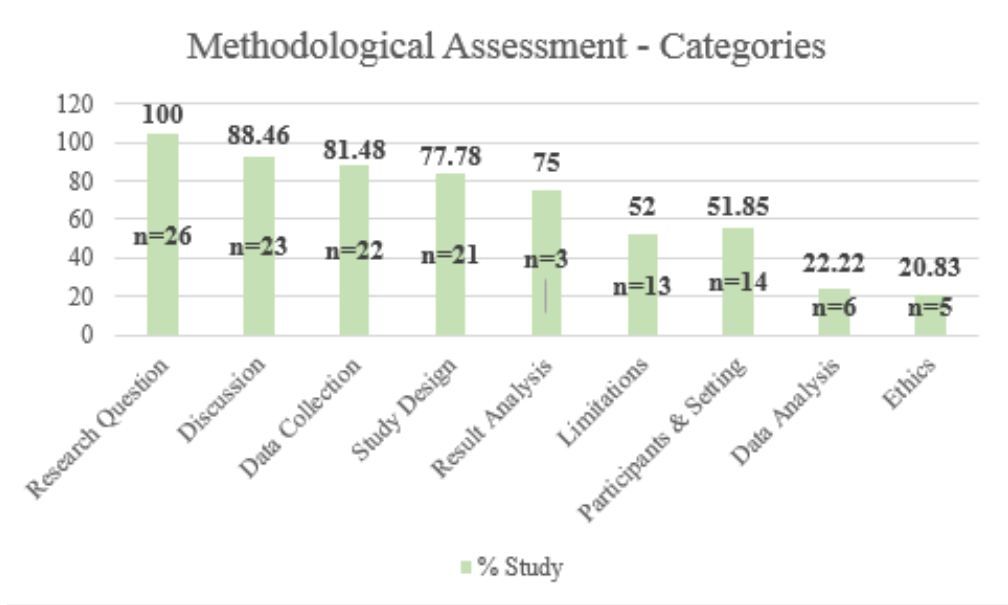
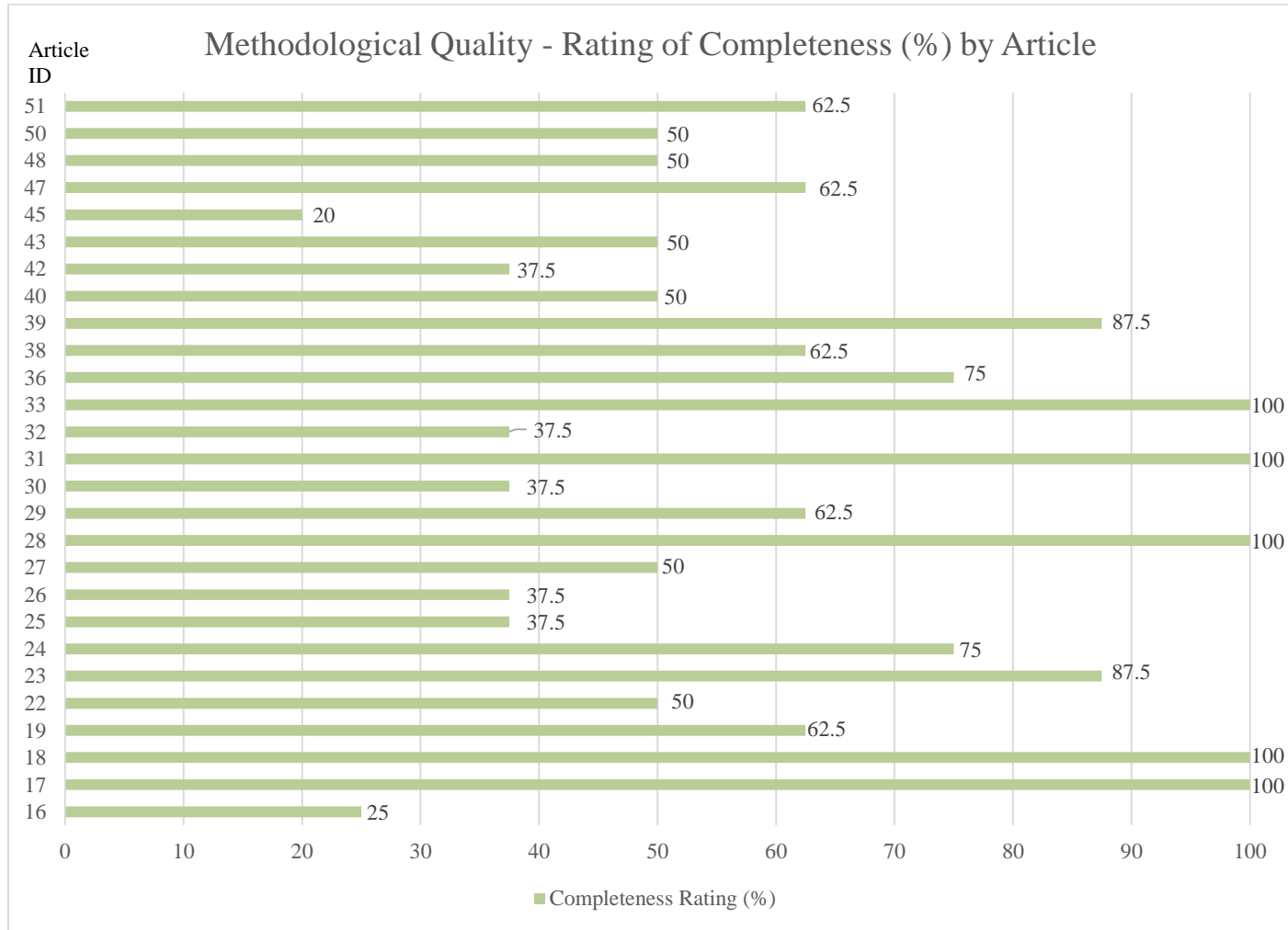


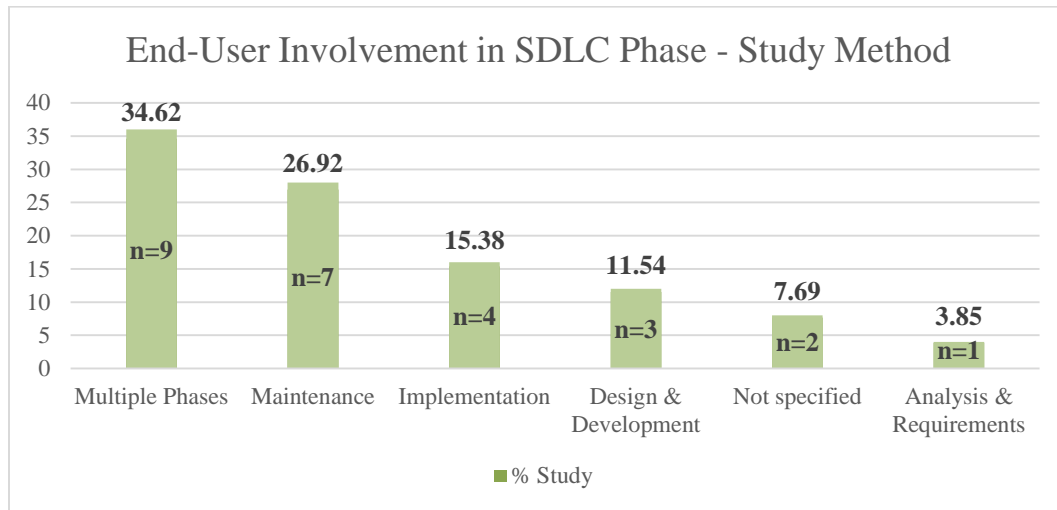
Figure 18 - Data Chart - Methodological Assessment: Categories



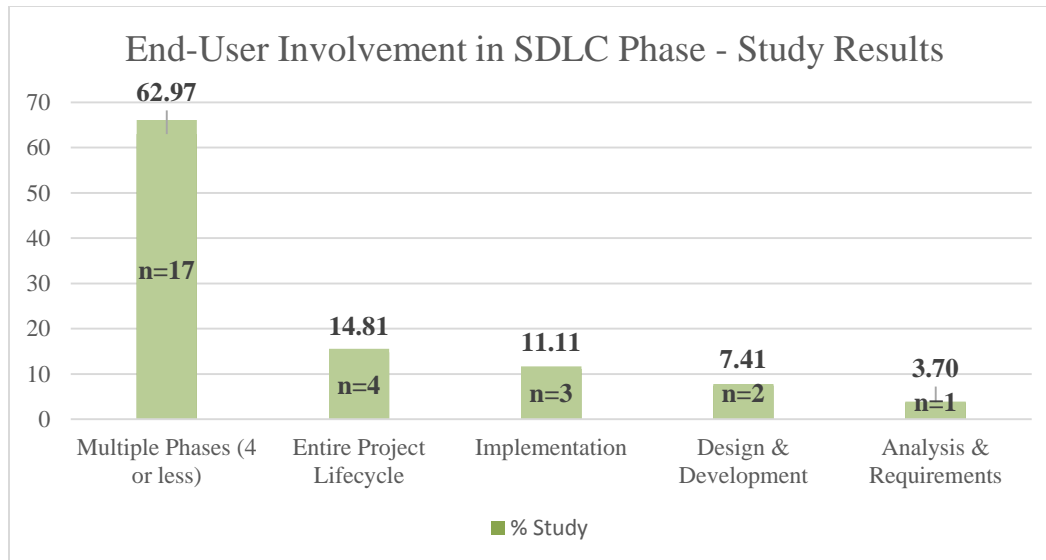
**Figure 19 - Data Chart - Methodological Assessment: Rating of Completeness (%) By Article**



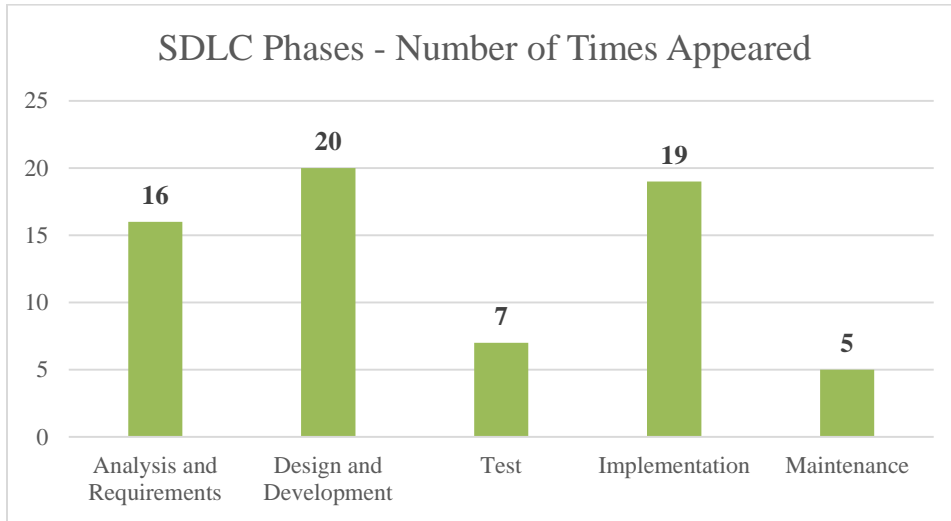
**Figure 20 – Data Chart - End-User Involvement in SDLC Phase – Study Method**



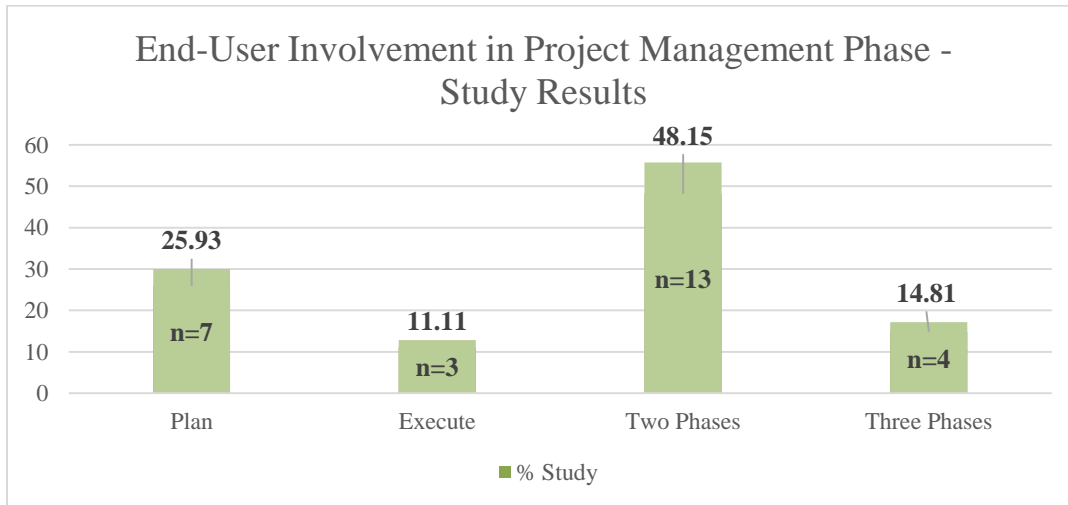
**Figure 21- Data Chart - End-User Involvement in SDLC Phase - Study Results**



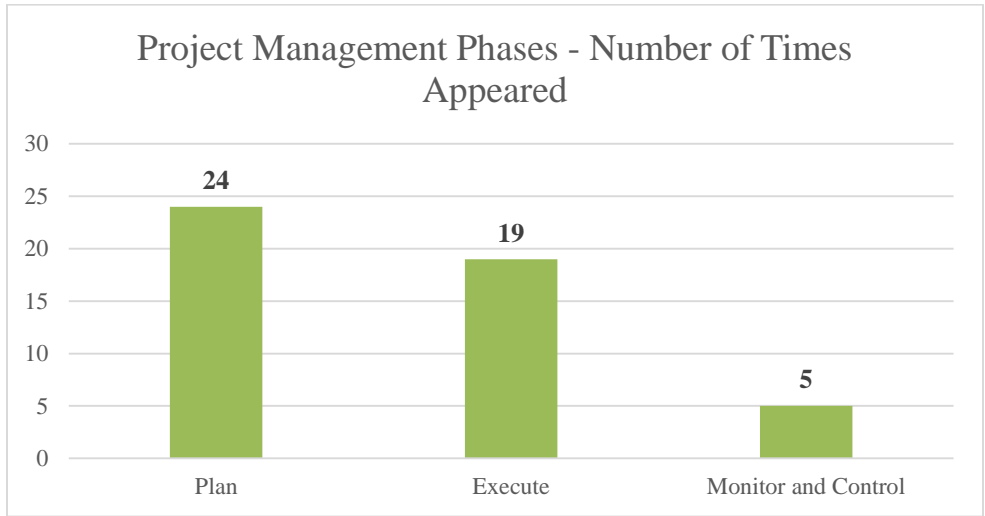
**Figure 22 - Data Chart – SDLC Phases: Number of Times Appeared**



**Figure 23 - Data Chart – End-User Involvement in Project Management Phases: Study Results**



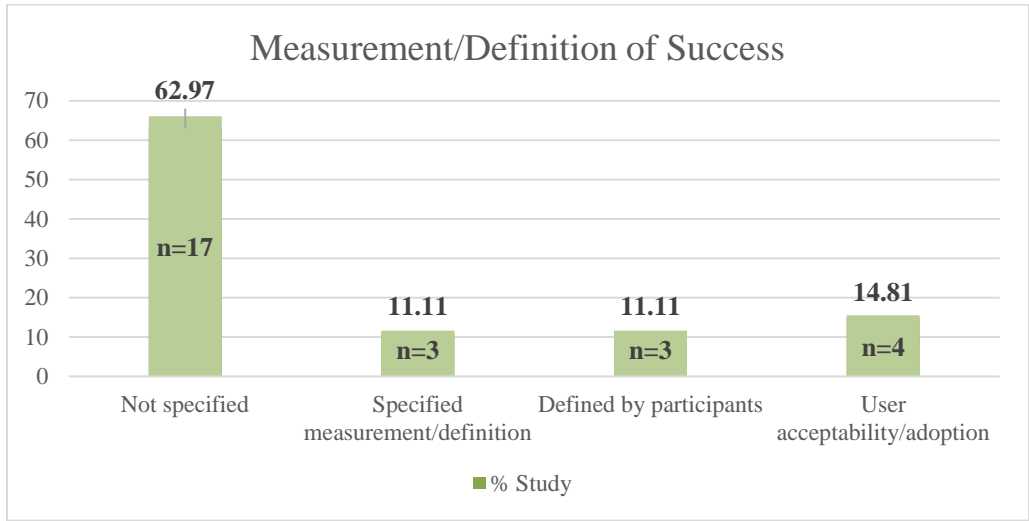
**Figure 24 - Data Chart – Project Management Phases: Number of Times Appeared**



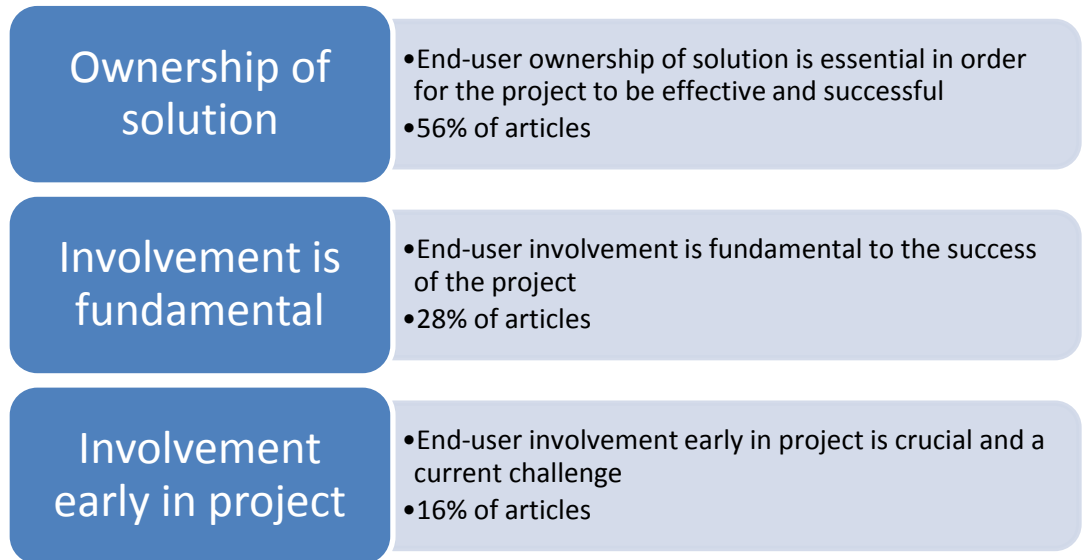
**Figure 25 - Data Chart - Measured Outcomes**



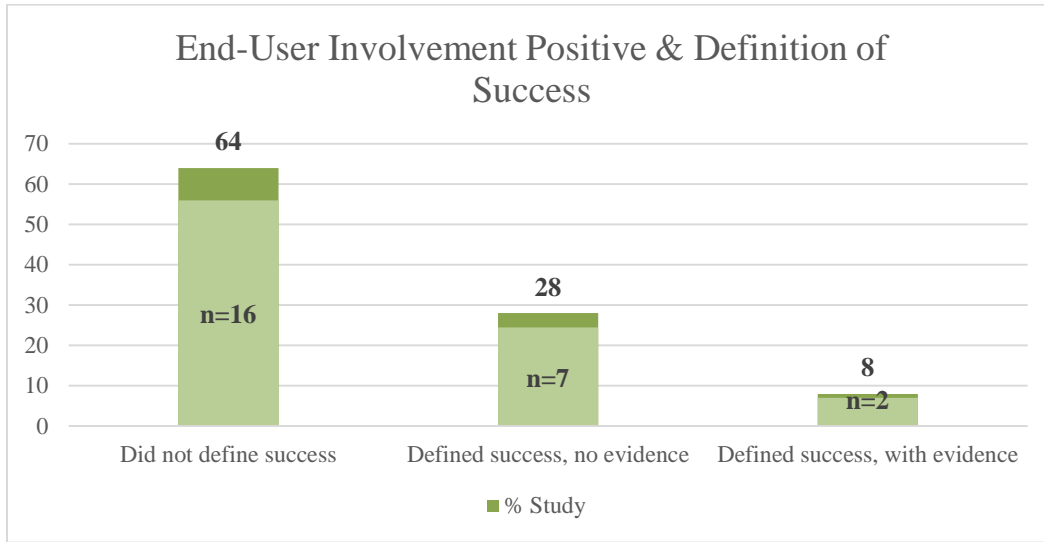
**Figure 26 - Data Chart - Measurement/Definition of Success**



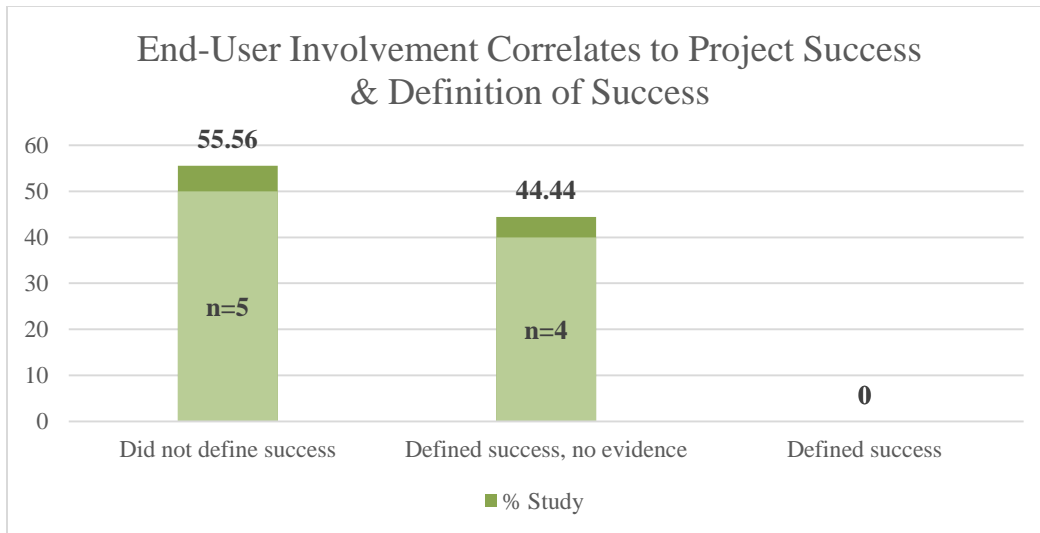
**Figure 27 - Themes of End-User Involvement Findings**



**Figure 28 - Data Chart - End-User Involvement Positive & Definition of Success**



**Figure 29 - Data Chart - End-User Involvement Correlates to Project Success & Definition of Success**



## Appendices

### APPENDIX A Included Reviews

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## APPENDIX C Full Article List



Johnson\_Laura\_MS  
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