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Integrating computerized clinical decision support systems into clinical work: A meta-synthesis of qualitative research

Anne Miller[a,c,*], Brian Moon[b], Shilo Anders[a], Rachel Walden[a], Steven Brown[a,c], Diane Montella[a,c]

[a] Vanderbilt University Medical Center, United States
[b] Perigean Technologies, United States
[c] U.S Department of Veteran's Affairs, United States

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ABSTRACT

Purpose: Computerized clinical decision support systems (CDSS) are an emerging means for improving healthcare safety, quality and efficiency, but meta-analyses findings are mixed. This meta-synthesis aggregates qualitative research findings as possible explanations for variable quantitative research outcomes.
Inclusion criteria: Qualitative studies published between 2000 and 2013 in English, involving physicians, registered and advanced practice nurses' experience of CDSS use in clinical practice were included.
Search strategy: PubMed and CINAHL databases were searched. Study titles and abstracts were screened against inclusion criteria. Retained studies were appraised against quality criteria. Findings were extracted iteratively from studies in the 4th quartile of quality scores. Two reviewers constructed themes inductively. A third reviewer applied the defined themes deductively achieving 92% agreement.
Results: 3798 unique records were returned; 56 met inclusion criteria and were reviewed against quality criteria. 9 studies were of sufficiently high quality for synthetic analysis. Five major themes (clinician-patient-system integration; user interface usability; the need for better 'algorithms'; system maturity; patient safety) were defined.
Conclusions: Despite ongoing development, CDSS remains an emerging technology. Lack of understanding about and lack of consideration for the interaction between human decision makers and CDSS is a major reason for poor system adoption and use. Further high-quality qualitative research is needed to better understand human—system interaction issues. These issues may continue to confound quantitative study results if not addressed.

1. Introduction

The United States' Health Information Technology and Clinical Health (HITECH) Act of 2009 was designed to increase the adoption of electronic health records (EHR). EHRs better integrate patients' healthcare information, and provide a means for building regional and national databases that inform policy and evidence-based practices that improve patient safety, care delivery quality and efficiency [1–4]. Integrated into EHRs, computerized clinical decision support systems (CDSS) are intended to influence clinical decisions and improve the quality of care processes such as ensuring that the criteria for ordering medications (dose, route, absence of contra-indications, allergies or drug interactions) are met. For this reason CDSSs were included as part of the Office of the National Coordinator's (ONCs) EHR certification requirements under the Meaningful Use 2 phase of HITECH implementation.

However, evidence for CDSS role in improving safety, quality and efficiency has been mixed. For example, Garg et al. [5] found that although a majority of systematically reviewed controlled trials showed improved practitioner performance with CDSS, only 13% improved patient outcomes. More recently, Nuckols et al. [6] systematically reviewed 16 pre-post and quasi-experimental studies of computerized physician order entry systems (CPOE, with and without CDSS), and found no differences in the incidence of preventable adverse medication events. Similarly, in an updated version of an earlier meta-analysis of computerized laboratory monitoring alerts [8], Bayoumi et al. [7] found no reductions in adverse drug events or lengths of hospital stay despite behavioral changed in accordance with the alerts. Similar mixed results are evident in systematic reviews and/or meta-analyses addressing

* Corresponding author at: Vanderbilt University Medical Center, United States. Fax: +1 615 936 7373.
E-mail address: Anne.miller@vanderbilt.edu (A. Miller).

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drug dosing, [9] diabetes management, [10] and comprehensive general reviews of CDSS effects [11]. Reviewers' highlight methodological flaws in research protocols as a means for improving research outcomes, [5,12] but few alternative explanations or research directions are provided.

Mixed-methods research combines qualitative and quantitative methods [13]. In the early stages of new initiative development, qualitative methods build contextual knowledge that can suggest interventions, inform research directions and elucidate potentially confounding variables. Used during and following a research intervention, qualitative methods can provide possible explanations for intended and unintended effects that may not have been predictable prior to the intervention [13,14]. The purpose of this meta-synthesis was to conduct an interpretive synthesis of high-quality qualitative research to provide alternative explanations for the variation evident in quantitative CDSS research findings.

2. Meta-syntheses

Meta-synthesis is an emerging approach for interpreting the aggregate findings of qualitative research studies [15,16]. Major and Savin-Baden [15] propose that "synthesists seek to answer a specific research question through combining qualitative studies. .. that are located in broadly the same tradition, in order to make sense of themes and issues.. ." (p.10). In contrast to a comprehensive literature review, whose purpose is to critically locate a research study within a body of knowledge, a meta-synthesis interprets related findings within the synthesist's research question using a structured and highly systematic approach [16,17].

Our guiding research question was: 'What are the possible reasons and causes from healthcare clinicians' perspectives, for difficulties in integrating CDSS into clinical work?' We also sought to better understand the contexts into which CDSS technology has been introduced, including the nature of affected decisions and the types of CDSS being implemented. We found no evidence in the Joanna Briggs Institute Library of Systematic Reviews, The Cochrane Library including the DARE database, MEDLINE or the PROSPERO databases that a meta-synthesis associated with CDSS integration in clinical work had been undertaken.

3. Method

The sections included in this method are those recommended for high quality meta-syntheses by the Joanna Briggs Institute (JBI) [18].

3.1. Inclusion criteria

3.1.1. Participants and context

The participants in the reviewed studies were clinicians who provided direct care to patients in in-patient or out-patient care settings. Thus, CDSS studies were selected for meta-synthesis review if the study participants included licensed physicians, board-registered nurses (RNs) and advanced practice nurses (NPs). CDSS studies involving only patients or allied health workers, such as pharmacists, were not included.

3.1.2. Phenomenon of interest

The phenomena of interest to this meta-synthesis were findings of participants' experiences using CDSS in clinical practice. That is, we were most interested in the direct inspection of clinicians' use of CDSS in clinical work.

Berner and Lande [19] define CDSS as computer modules, functions, features or systems designed to affect clinicians' decision making about individual patients at the time these decisions are to be made. Osheroff et al. [20] propose that CDSS systems present knowledge and patient-related facts, relationships, best practices or new knowledge that has been filtered and presented at an appropriate time to enhance patient care. Table 1 lists the types of applications recognized as CDSS in this meta-synthesis. The CDSS types are based on definitions published by Osheroff et al. [20] and typically coexist with EHRs and CPOEs systems.

3.1.3. Types of studies

Phenomenological, grounded theory, ethnography, action research and studies that described the experience or effects of CDSS on participants' practice in actual clinical settings were included in this meta-synthesis. Surveys without open-ended questions or a 'free-text' component and simulations including usability studies were excluded.

3.2. Search strategy

An experienced librarian (RW), in collaboration with the primary reviewer (AM) conducted a three-phase literature search. In Phase 1, keywords were generated from our research question constructs, (e.g., CDSS in health care; clinicians' experience of CDSS adoption). The keywords were then extended using peer reviewed journal articles' titles; abstracts; keywords and textbook subject indices. In Phase 2; PubMed and CINAHL databases were searched to eliminate the return of CDSS studies from non-healthcare industries. Our specific search strategy is given in Appendix A. Only studies published in English language journals were included. The literature searched was limited to the years 2000–2013 to cover the most contemporary CDSS implementations. In Phase 3; we reviewed the bibliographic reference lists of all studies included in the qualitative synthesis to determine whether additional relevant studies had been overlooked.

3.3. Method of review

Studies returned from the database search were reviewed in two iterations. Three reviewers (AM, BM, SA) conducted the first iteration independently. This iteration was limited to a title and abstract review to determine whether the study met inclusion criteria. Each reviewer provided a short reason for excluding a study. These reasons were collated inductively as a post-hoc analysis of excluded CDSS records. Studies meeting inclusion criteria were evaluated for methodological quality using the appraisal tool presented in Appendix B. This tool expands the JBI's Qualitative Assessment and Review Instrument (QARI) [20] using more explicitly defined qualitative research dimensions (credibility, transferability, dependability and confirmability) and quality criteria [15,21]. Using these criteria, each study was given a score out of a total of 40. Studies with scores in the top 25% of study scores (i.e., the 4th quartile) were included for detailed analysis and results synthesis. We believed that this cut-of criterion achieved a sufficient number of studies for meaningful results while maintaining acceptable levels of quality.

3.3.1. Summarizing study methods and extracting findings

Two reviewers (BM, AM) independently read and systematically summarized each of the retained studies using the following JBI defined dimensions [20]:

1. Method—the way or ways the data was collected and how it was used;
2. Phenomena of interest—the primary focus of the study;
3. Setting—the specific location or context in which the study was conducted including its geographical and/or cultural context;