



Review article

A review of randomized controlled trials of medical record powered clinical decision support system to improve quality of diabetes care



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ABSTRACT

Background: A gap between current diabetes care practice and recommended diabetes care standards has consistently been reported in the literature. Many IT-based interventions have been developed to improve adherence to the quality of care standards for chronic illness like diabetes.

Objective: The widespread implementation of electronic medical/health records has catalyzed clinical decision support systems (CDSS) which may improve the quality of diabetes care. Therefore, the objective of the review is to evaluate the effectiveness of CDSS in improving quality of type II diabetes care. Moreover, the review aims to highlight the key indicators of quality improvement to assist policy makers in development of future diabetes care policies through the integration of information technology and system.

Selection of study: Setting inclusion criteria, a systematic literature search was conducted using Medline, Web of Science and Science Direct. Critical Appraisal Skills Programme (CASP) tools were used to evaluate the quality of studies. Eight randomized controlled trials (RCTs) were selected for the review. In the selected studies, seventeen clinical markers of diabetes care were discussed. Three quality of care indicators were given more importance in monitoring the progress of diabetes care, which is consistent with National Institute for Health and Care Excellence (NICE) guidelines. The presence of these indicators in the studies helped to determine which studies were selected for review. Clinical- and process-related improvements are compared between intervention group using CDSS and control group with usual care. Glycated hemoglobin (HbA1c), low density lipid cholesterol (LDL-C) and blood pressure (BP) were the quality of care indicators studied at the levels of process of care and clinical outcome.

Findings: The review has found both inconsistent and variable results for quality of diabetes care measures. A significant improvement has been found in the process of care for all three measures of quality of diabetes care. However, weak to modest positive results are observed for the clinical measures of the diabetes care indicators. In addition to this, technology adoption of CDSS is found to be consistently low. **Conclusion:** The review suggests the need to conduct further empirical research using the critical diabetes care indicators (HbA1c, LDL-C and BP) to ascertain if CDSS improves the quality of diabetes care. Research designs should be improved, especially with regard to baseline characteristics, sample size and study period. With respect to implementation of CDSS, rather than a sudden change of clinical work practice, there should instead be an incremental, gradual adoption of technology that minimizes the disruption in clinical workflow.

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1. Introduction

The worldwide economic burden of diabetes care is growing as Type 2 diabetes is reaching epidemic proportions as a consequence of urbanization, aging, obesity, physical inactivity and changes in diet throughout much of the world's population. Wild et al. have estimated the global prevalence of diabetes at 2.8% in 2000, but which is projected to be 4.4% in 2030 [27]. The total number of people with diabetes is projected to increase from 171 million in 2000 to 366 million in 2030 [27], with at least 90% of whom have Type 2 diabetes. Diabetes is a major risk factor for cardiovascular disease, and is the primary cause of renal failure, blindness and limb amputation [4].

A major challenge faced by clinicians is the clinical management of diabetes. In many instances, there is a persistent gap between recommended care guidelines and current practice. For instance, in the United States only 50% of diabetic patients receive recommended diabetic care during their disease management period Meigs and Stafford [28]. Patient non-compliance is a common barrier to effective treatment; as many as half of the patients do not take their medications as prescribed Aspden et al. [29].

CDSS is a key tool used to improve the quality of healthcare by enhancing quality of services and controlling the cost of health care delivery [1]. The CDSS running within electronic medical/health records can activate alerts when deviation from recommended care is detected (for instance, through an electronic reminder system). Such alerts are intended to trigger both clinician and patient actions to ensure compliance to diabetes care standards.

A systematic literature review of randomized controlled trials was carried out with the goals of (1) measuring the success of CDSS in improving quality of diabetes care, (2) assessing the potential of CDSS to bridge the gap between current diabetes care practices and recommended diabetes care, and (3) identifying process and clinical outcome related outcomes which are monitored and improved with the use of CDSS. The review paper will also discuss the potential reasons regarding the extent of effectiveness in improving diabetes care with the use of CDSS.

2. Methods

2.1. Research question

The research question is, "Do clinical decision support systems that use electronic medical/health records assist clinical decisions that result in improved quality of diabetes care?" The review will

Table 1
Study inclusion criteria.

1	Study published between January 2000 and April 2014
2	Randomized control trials
3	Study evaluating quality of care measures
4	Type II diabetes or adult diabetic patients
5	All care settings, i.e., primary, secondary and tertiary health care settings
6	Studies satisfying CASP's checklists

further highlight the key indicators of quality improvement to assist policy makers in development of future diabetes care policies with an integration of information technology and system.

2.2. Study selection

The systematic review of literature was conducted of randomized controlled trials (RCTs) on the effects of quality of diabetes care with the use of EMR- or EHR-based clinical decision support systems. Because relatively new healthcare interventions and major developments occurred in the past decade, the RCTs published between January 2000 and June 2014 were included in the review. Medline, Web of Science, and Science Direct were searched. The literature search was performed in June 2014 using keywords and their combinations using Boolean operators. The keywords used for the search were *electronic medical record; electronic health record; computerized clinical decision support system; quality of diabetes care; clinical performance in diabetes care and diabetes patient outcomes*. The inclusion criteria and flow chart of search results are presented below in Table 1 and Fig. 1; respectively.

2.3. Selection results

After applying inclusion criteria (see Table 1) on search results, full texts of 38 studies were identified and retrieved (Fig. 1). Eight studies were selected for review after conducting critical appraisal of the evidence by using CASP tools to evaluate the quality of evidence (CASP n.d. [2]) for RCT. Those studies that are not included in the final set either did not satisfy CASP criteria or were not RCTs.

The eight selected studies reveal seventeen clinical markers for diabetes care improvement. Of these, three measures of clinical outcomes—(i) glucose management, (ii) lipids and hypertension control, and (iii) control of Glycated Hemoglobin (HbA1c)—are given more importance in monitoring the progress of diabetes care [16]. This review will highlight significance of these three indicators

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