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Benefits and limitations of implementing Chronic Care Model (CCM) in primary care programs: A systematic review

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ABSTRACT

Background: Chronic Care Model (CCM) has been developed to improve patients' health care by restructuring health systems in a multidimensional manner. This systematic review aims to summarize and analyse programs specifically designed and conducted for the fulfilment of multiple CCM components. We have focused on programs targeting diabetes mellitus, hypertension and cardiovascular disease.

Method and results: This review was based on a comprehensive literature search of articles in the PubMed database that reported clinical outcomes. We included a total of 25 eligible articles. Evidence of improvement in medical outcomes and the compliance of patients with medical treatment were reported in 18 and 14 studies, respectively. Two studies demonstrated a reduction of the medical burden in terms of health service utilization, and another two studies reported the effectiveness of the programs in reducing the risk of heart failure and other cardiovascular diseases. However, CCMs were still restricted by limited academic robustness and social constraints when they were implemented in primary care. Higher professional recognition, tighter system collaborations and increased financial support may be necessary to overcome the limitations of, and barriers to CCM implementation.

Conclusion: This review has identified the benefits of implementing CCM, and recommended suggestions for the future development of CCM.

1. Introduction

Worldwide, chronic disease remains a significant burden in terms of morbidity and mortality. Diabetes mellitus (DM), hypertension (HT), cardiovascular disease (CVD) and chronic obstructive pulmonary disease (COPD) are four major chronic disease states with a high prevalence in populations around the world. The incidence of these four diseases has increased rapidly in recent decades [1–9]. Historical models of clinical care, largely developed for acute illness management, are proving less able to meet the complicated needs of the increasing burden of chronic care [10,11]. As a result, ineffective therapy and suboptimal disease control could lead to patient dissatisfaction [11]. Escalating healthcare demands have led to a substantial increase in medical burden, including avoidable hospital admissions and unnecessary healthcare expenditure [12,13].

Chronic Care Model (CCM), one of the widely recognized disease models in the world [14], was proposed by Wagner et al. in the 1990s [10]. It served as a patient-centred, evidence-based, proactive framework that aims to redesign ambulatory care systems and achieve health care improvement for patients suffering from chronic disease [10,14–16]. CCM consists of six key components, including health system or a health organization (HSHO), clinical information systems (CIS), decision support (DS), delivery system design (DSD), self-management support (SMS) and community-including organizations and resources for patients (CORP) [10,14,17]. Wagner [10] advised that the interactions between patients and healthcare providers should consist of well-developed processes and incentives that allow changes in the care delivery system. Additionally, these CCMs could give behaviourally complicated self-management support that offers priority to enhancing patients' confidence and skills, so that patients can be the ultimate manager of their own illnesses. Also as Wagner defined [10], the CCMs

Abbreviations: ACIC, Assessment of Chronic Illness Care score; CCM, Chronic care model; CIS, clinical information systems; COPR, community-including organizations and resources for patients; DS, decision support; DSD, delivery system design; HSHO, health system or a health organization; PACIC, Patient Assessment of Chronic Illness Care; SMS, self-management support.

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could "*reorganize team function and practice systems; develop and implement evidence-based guidelines and support those guidelines through provider education, reminders, and increased interaction between generalists and specialists; as well as enhance information systems to facilitate the development of disease registries, tracking system, and reminders and to give feedback on performance.*"

So far, CCM has been adopted and implemented in many areas of medical practice [10,12,18–24]. The results of these studies have suggested that implementation of CCM could greatly improve medical outcomes and reduce unnecessary medical burden. Strategies for preventing avoidable hospitalizations suggested by articles in the literature are strongly connected with CCM components, such as self-management training for both patients and healthcare providers [12, 21,22,25,26], identification of existing community resources [12,27, 28], electronic systems of medical records for monitoring, as well as sharing and linking among ambulatory services, hospitals and communities, and primary care practices [12,13,29]. Moreover, healthcare providers have shown good adherence to the medical practices which were tailored and multifaceted with CCM components [30]. Nevertheless, no single component within CCM may achieve all these expected goals, indicating that adopting multiple components of CCMs is essential to enhancing quality health in primary care [10–12,14–16,19,31–34].

This review aims to summarize and analyse the primary care programs specifically designed and conducted for patient care that comprise various CCM components. The papers reviewed here present a clear view of the current development of CCM implementation in primary care. The medical and social benefits to patients and healthcare providers, as well as present limitations in the system have been systematically analysed and discussed. The objective of this review is to identify the benefits and limitations of CCM so as to inform future optimization of CCM for chronic disease care.

2. Methods

The present systematic review included models of chronic disease care, including diabetes, hypertension, cardiovascular disease and chronic obstructive pulmonary disease. Since both PubMed and EMBase cover the literature of Medline and PubMed alone has the features of easy keyword searching and automatic mapping to MeSH terms without the need of subheading selection, we chose PubMed as convenient and applicable for our use. Thus, the search was performed in the PubMed database from its inception (literature covered back to 1966) to June 2016 by using the following strategies:

1. Model*[Text Word] AND chronic care [Text Word] (1050 articles identified)
2. Limit 1 to "Humans" (824 articles identified)
3. Limit 2 to "English" (789 articles identified)
4. Limit 3 to "full text" (702 articles identified)
5. Limit 4 to each of following sub-theme by combining with the search terms shown in strategy 1

   a. Diabetes[Text Word]
   b. Hypertension[Text Word]
   c. Cardiovascular disease[Text Word]
   d. Chronic obstructive pulmonary disease[Text Word]

The articles included were those that described models providing proactive care for patients with diabetes, cardiovascular disease, hypertension and/or chronic obstructive pulmonary disease. The papers identified focused on clinical perspectives of the models, defined as the direct observation of patients or the viewpoint of health professionals, such as doctors and nurses who worked directly with patients. Articles were excluded if they were duplicate, or did not involve any observation on patients. Meta-analyses, reviews, protocols and commentaries were also excluded. An extensive literature search and careful screening of the potentially eligible studies included in this literature review were performed by two independent reviewers, and any disagreement was resolved by a third reviewer. Supplementary Fig. 1 shows the algorithms by which the articles were included.

3. Results

A total of 702 journal articles were retrieved based on the first three steps of the search strategy. Of these articles, 308 were obtained under the four disease categories. After reviewing the titles and abstracts, 278 were excluded. Five duplicates were removed, resulting in a total of 25 articles being included in the present review (Table 1). All these reviews were related to four chronic medical conditions (i.e., diabetes mellitus, hypertension, cardiovascular disease and chronic obstructive pulmonary disease).

3.1. Diabetes Mellitus

Among all the 25 selected articles, 23 were published in the period 2002–2015 on patients suffering from diabetes as the primary study focus. They demonstrated the impact of CCM on primary care (Table 1). One of these articles by Bodenheimer et al. [17] summarized three CCM-introduced programs in diabetes patients. Hence, there were 25 individual studies included in this review. Based on the information provided in the articles, the majority of the enrolled programs (19/25) were led by professional healthcare providers (i.e., physicians, physician/medical assistants, residents, primary care clinicians, registered nurses, nurse assistants, and health workers) in at least one hospital or primary care centre. The number of participating patients varied from 68 to 553,556 due to the different scales among the included studies. Most programs recruited older patients as subjects and one-third of these studies focused on type 2 diabetes patients. One of the programs included patients with cardiovascular diseases as a comorbidity. Different types of intervention-related studies were used to investigate the impact of CCM implementation. The follow-up period varied between 3 months and 4 years.

A total of 19 enrolled programs (Table 2) reported clinical outcomes that illustrated the impact of CCM implementation on disease optimization. There were several important medical indicators measured in these programs, including HbA1c (Glycated Haemoglobin), blood pressure (in particular systolic blood pressure, SBP), blood lipid levels (e.g. low-density lipoprotein cholesterol), body mass index (or weight), foot examination and periodic eye examination. These data were reported by two different methods: the proportion of patients who reached optimal clinical targets (e.g. HbA1c ≤ 7%, BP ≤ 130/80 mmHg or LDL <100 mg/dl) and the average value of the clinical indicators. Based on a pooled analysis, the proportions of patients reaching the targets in HbA1c, blood pressure and blood lipids in the intervention group were 1.8–28%, 3.8–45% and 3.2–58%, respectively, which were higher than those in the respective control groups. Among them, three programs found significant differences in the improvement of HbA1c, and two programs reported improvement of blood pressure and blood lipids, respectively. Similar significant improvements in these clinical parameters were found when the average values of the intervention and control groups were compared.

In addition, the implementation of CCM was found to bring benefits in patient compliance with therapy, promotion of health behaviour, satisfaction with clinical care, and reductions in the medical burden (Table 3). Data from intervention groups showed an average of 15% improvement in the rate of measuring HbA1c, blood pressure and blood lipids. Also, more obvious improvements were observed in terms of health behaviours (compared with control groups, additional improvement in intervention groups 5.6–85%, average ~30%), including the rate of BMI measurement, smoking status assessment, foot examination, eye examination and self-management plans formulated by healthcare professionals. In six of these programs, both Assessment of Chronic Illness Care (ACIC) score and Patient Assessment of Chronic Illness Care (PACIC) score increased, indicating that patients were more satisfied with CCM implementation compared to usual care. Furthermore, there were two programs that reported the cost-saving aspects of the CCMs. Stock [35] indicated that the Germany Program saved 446.75 USD in the overall cost of illness care per insured patient during 2003 to 2007 and shortened the hospitalization duration per insured patient by 1.44 days. Siminerio [22] reported an 80,000 USD increase in net revenue of "Diabetes Self-Management Training" reimbursement and educators' salary from Jan 2002 to Jun 2004. On the other hand, Vargas [36] measured the 10-year cardiovascular risk for