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## KMAP-O framework for care management research of patients with type 2 diabetes

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### Abstract

#### AIM

To review impacts of interventions involving self-management education, health coaching, and motivational interviewing for type 2 diabetes.

#### METHODS

A thorough review of the scientific literature on diabetes care and management was executed by a research team.

#### RESULTS

This article summarizes important findings in regard to the validity of developing a comprehensive behavioral system as a framework for empirical investigation. The behavioral system framework consists of patients' knowledge (K), motivation (M), attitude (A), and practice (P) as predictor variables for diabetes care outcomes (O). Care management strategies or health education programs serve as the intervention variable that directly influences K, M, A, and P and then indirectly affects the variability in patient care outcomes of patients with type 2 diabetes.

#### CONCLUSION

This review contributes to the understanding of the KMAP-O framework and how it can guide the care management of patients with type 2 diabetes. It will allow the tailoring of interventions to be more effective through knowledge enhancement, increased motivation, attitudinal changes, and improved preventive practice to reduce the progression of type 2 diabetes and comorbidities. Furthermore, the use of health information technology for enhancing changes in KMAP and communications is advocated in health promotion and development.

**Key words:** KMAP-O framework; Type 2 diabetes; Behavioral intervention strategies; Causal mechanisms

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**Core tip:** A complex set of behavioral and cognitive variables related to diabetes care may influence adherence and self-care practice of patients with type 2 diabetes. This systematic review is guided by a behavioral system framework. Care management strategies or health education programs serve as intervention variables that may directly influence a patient's knowledge, motivation and attitude, self-care practice, and outcomes. This review summarizes key findings in regard to the validity of developing a comprehensive behavioral system as a framework for future empirical investigation.

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## INTRODUCTION

More than 29 million people in the United States have diabetes<sup>[1]</sup>. Type 2 diabetes, which accounts for 90% to 95% of all cases, occurs when the body develops insulin resistance and cells no longer transport glucose using insulin. This leads to an overproduction from the pancreas, and eventually the pancreas does not produce enough insulin when blood sugar levels increase<sup>[2]</sup>. In 2012, the total estimated cost of diagnosed diabetes in the United States was \$245 billion, including \$176 billion in direct medical costs and \$69 billion in lost productivity<sup>[3]</sup>. Diabetes is associated with higher risk of blindness, kidney failure, heart disease, stroke, and amputations<sup>[1]</sup>. Diabetes control requires a systematic effort of adherence to medical regimens and preventive practice in diet and exercise. A comprehensive framework for promoting diabetes care is proposed in this review of the empirical literature.

## MATERIALS AND METHODS

This review is centered on type 2 diabetes from a behavioral system perspective and guided by the scientific literature published in social, behavioral, and medical science journals. The research team collectively conducted the review of studies published in the scientific literature. Both conceptual and empirical developments in health education and research are highlighted in the review.

## RESULTS

### **KMAP-O framework for type 2 diabetes**

Behavioral and social scientists have considered a

behavioral systems approach to medical adherence studies. Their research is centered in the identification of how knowledge, attitude, and preventive practice may influence the variability in health and behavioral outcomes. However, this approach fails to articulate causal-specific links among these major contributing factors to outcome variations. Furthermore, the lack of attention to motivational factors in search for the determinants of health care outcomes has compounded the investigative problem that has hindered the full explication of the important role of motivation in the KAP studies.

The KMAP-O framework can be used to guide care management of type 2 diabetes patients. The first construct of the KMAP-O model is knowledge. Knowledge is "the acquisition, retention, and use of information or skills"<sup>[4,5]</sup>. Type 2 diabetes patients should have the knowledge to understand the condition, its progression, and necessary self-care practices<sup>[5]</sup>.

The second construct in the model is motivation. Motivation is an individual's desire or willingness to behave in a certain way. A person can be described as unmotivated if he or she feels no impetus or inspiration to act, while a person who is energized or activated toward an end is characterized as motivated<sup>[6]</sup>.

Following knowledge and motivation, attitude is the next construct in the KMAP-O framework. Attitude is a "psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor"<sup>[7]</sup>. A patient's attitude toward diabetes involves any preconceived ideas about the condition and its management, any feelings and emotions toward aspects of diabetes and diabetes care, and the aptness to behave in particular ways about diabetes and its management<sup>[5]</sup>.

Practice is the fourth construct in the model. Practice is a demonstration of "the acquisition of knowledge (increased understanding of a problem/condition) and any change in attitude caused by the removal of misconceptions about the condition"<sup>[5]</sup>. The following seven key behaviors to practice in diabetes management, as identified by the American Association of Diabetes Educators, are healthy eating, physical activity, blood glucose monitoring, medication taking, problem solving related to diabetes self-care, reducing risks of acute and chronic complication, and healthy coping<sup>[8]</sup>.

The last construct in the framework is outcome. Outcomes that are commonly assessed in type 2 diabetes patients are psychosocial measures such as quality of life (QoL), and physical measures such as blood pressure, body mass index (BMI), body weight, hemoglobin A1c (HbA1c) levels, and lipid levels. The causal specifications among the KMAP-O components are portrayed in Figure 1. This model suggests that health education or behavioral intervention(s) may directly affect knowledge, motivation, attitude and practice. The changes in knowledge, motivation and attitude may also directly influence practice variations

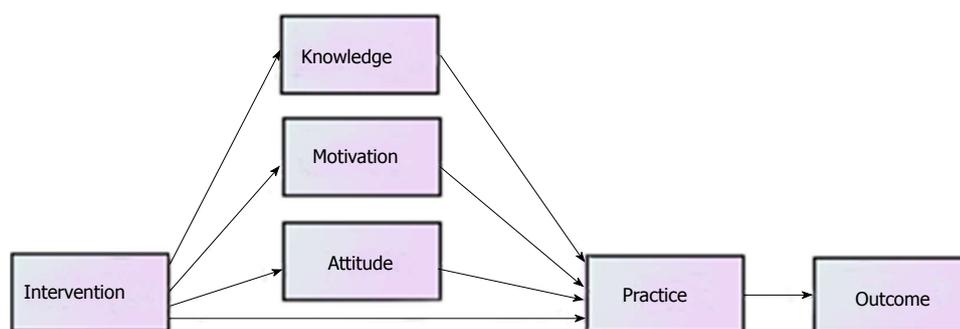


Figure 1 KMAP-O components.

in diabetes control. Consequently, better practice behavior in diabetes care management may result in a positive improvement in clinical and self-reported healthcare outcomes. These causal specifications enable researchers to generate multiple, testable hypotheses in empirical studies on care management effectiveness for type 2 diabetes.

The management of type 2 diabetes requires modification of complex behavior and practices to achieve optimal outcomes. Interventions that encourage these changes include self-management education, health coaching, and motivational interviewing. Self-management education is “a collaborative and ongoing process intended to facilitate the development of knowledge, skills, and abilities that are required for successful self-management of diabetes”<sup>[9,10]</sup>. Health coaching aims to help individuals achieve goals through the assistance of coaches that have received specific training to facilitate the change process, elicit motivation, and build trust, self-efficacy, and growth-promoting relationships. It is appropriate for type 2 diabetes management given that the coaching model is intended to address psychosocial factors and lifestyle behaviors<sup>[11]</sup>. Health coaching interventions “target health behavior changes aligned with self-determined goals leading to improved physical and mental health outcomes”<sup>[12,13]</sup>. Motivational interviewing is a patient-centered communication technique that involves open-ended questions, reflective listening, and support for patient autonomy and self-efficacy with aims to evoke intrinsic motivation of an individual to make behavior changes<sup>[14]</sup>. The objective of this review is to summarize interventions that have significantly improved knowledge, motivation, attitude, practice, and outcomes of type 2 diabetes patients.

### Health education interventions

**Education on knowledge, attitude, and practice:** A study has reported that a health education intervention had a positive impact on the knowledge, attitude, and practice of individuals with type 2 diabetes<sup>[15]</sup>.

A health education intervention consisting of 18 sessions for South Asian diabetes patients in Scotland significantly improved the low baseline scores for knowledge (+ 12.5%), serious attitudes toward diabetes (+ 13.5%), and practice (+ 20.0%)<sup>[15]</sup>.

**Education on knowledge, attitude, practice, and outcomes:** Studies have reported that health education interventions had a positive impact on the knowledge, attitude, practice, and outcomes of individuals with type 2 diabetes<sup>[16-18]</sup>.

A pharmacist-provided patient counseling in India on patients’ perceptions about disease management and QoL improved knowledge, attitude, and practices scores; reduced mean capillary blood glucose levels; and improved mean scores for QoL<sup>[16]</sup>.

A counseling intervention for patients during monthly sessions lasting 20-25 min for three months in South India significantly improved KAP scores, especially knowledge and attitude, and improved the outcome for postprandial blood glucose levels. However, no significant improvements in practice were reported due to high baseline scores<sup>[17]</sup>.

A meta-analysis found that self-management education continually improves the outcome of HbA1c levels and suggested that knowledge and attitude continue to influence practice and outcome after the educational interventions are over<sup>[18]</sup>.

**Education on knowledge and outcomes:** Studies have reported that health education interventions had a positive impact on the knowledge and outcomes of individuals with type 2 diabetes<sup>[19,20]</sup>.

A systematic review of 72 studies evaluating the effectiveness of self-management education lasting for a period of six months or less concluded that such interventions significantly improve knowledge and glycemic control while having variable effects on lipids<sup>[19]</sup>.

A community, pharmacy-based diabetes education intervention based on the American Diabetes Association standards in the United States improved knowledge of diabetes, HbA1c levels, fasting blood glucose levels, lipid levels, and blood pressure measurements<sup>[20]</sup>.

**Education on attitude:** A study has demonstrated that a health education intervention had a positive impact on the attitude of individuals with type 2 diabetes<sup>[21]</sup>.

Diabetes group education for urban, newly diagnosed patients in Ireland continually improved the patients’ attitudes about the seriousness of the condition over time<sup>[21]</sup>.

**Education on practice and outcomes:** A study has reported that a health education intervention had a positive impact on the practice and outcomes of individuals with type 2 diabetes<sup>[22]</sup>.

During a health education intervention that involved access to interactive, self-paced web-based tutorials supplemented with a printout, changes in the practices of healthy eating, physical activity, blood sugar monitoring, blood pressure monitoring, foot care, and avoidance of smoking were associated with significant improvements in the outcome of HbA1c levels<sup>[22]</sup>.

**Education on outcomes:** Studies have reported that health education interventions had a positive impact on the outcomes of individuals with type 2 diabetes<sup>[9]</sup>.

A systematic review of 118 unique interventions, which involved various elements to improve participants' knowledge, skills, and ability to perform self-management activities as well as informed decision-making around goal setting, found data demonstrating that engagement in diabetes self-management education significantly decreases HbA1c levels<sup>[9]</sup>.

#### **Health coaching interventions**

**Coaching on attitude and outcomes:** A study has reported that health coaching interventions had a positive impact on the attitude and outcomes of individuals with type 2 diabetes<sup>[11]</sup>.

An integrative health coaching intervention in the United States consisting of fourteen 30-min sessions conducted over the phone, which focused on individualized visions of health and self-chosen goals, significantly decreased perceived barriers to medication adherence and improved patient activation, perceived social support, benefit finding, and HbA1c levels<sup>[11]</sup>.

**Coaching on practice:** A study has reported that health coaching interventions had a positive impact on the practice of individuals with type 2 diabetes<sup>[23]</sup>.

A three-month peer-led self-management coaching program that involved three monthly home visits and follow-up contacts through phone and email for recently diagnosed patients in the Netherlands improved the self-efficacy in intervention group patients with low baseline self-efficacy<sup>[23]</sup>.

**Coaching on practice and outcomes:** Studies have reported that health coaching interventions had a positive impact on the practice and outcomes of individuals with type 2 diabetes<sup>[24,25]</sup>.

A six-month coaching intervention in Australia consisting of monthly phone-based coaching sessions to establish and assess progress toward individualized goals for self-care activities (*e.g.*, diet, activity) and monitoring (*e.g.*, foot and eye care, vaccinations) in addition to usual care significantly improved the practices of physical activity and adherence to monitoring exams for complications, as well as the outcomes of HbA1c levels, fasting glucose, and diastolic blood pressure<sup>[24]</sup>.

A 16-mo health coaching intervention at outpatient clinics in Turkey which included five or six in-person meetings and three or four telephone coaching sessions significantly improved the practice of oral health and outcome of HbA1c levels, particularly among high-risk patients, compared to formal health education<sup>[25]</sup>.

**Coaching on outcomes:** Studies have reported that health coaching interventions had a positive impact on the outcomes of individuals with type 2 diabetes<sup>[12,26,27]</sup>.

A health coaching intervention in Canada which involved weekly communication with a health coach either in-person, using a mobile device, or using a web-based wellness platform to promote goal setting and monitor progress, as well as access to a free community exercise center, improved the outcomes of HbA1c levels at three months and of body weight and waist circumference at three and six months<sup>[12]</sup>.

A healthcare provider-mediated, remote coaching system *via* a PDA-type glucometer and the Internet in South Korea significantly reduced HbA1c levels (8.0% vs 7.5%) and total cholesterol (10.7 mmol/L vs 10.4 mmol/L) at three-month follow-up<sup>[26]</sup>.

A clinic-based peer health coaching intervention for low-income patients with poorly controlled diabetes in the United States significantly decreased HbA1c levels to under 7.5% for 22.0% of coached mmol/L 14.9% of usual care patients at five months<sup>[27]</sup>.

#### **Motivational interviewing interventions**

**Motivation on knowledge and attitude:** A study has reported that motivation had a positive impact on the knowledge and attitude of individuals with type 2 diabetes<sup>[28]</sup>.

Training for general practitioners in motivational interviewing in Denmark significantly impacted the patients in the intervention group, who became more autonomous and motivated in their inclination to change behavior, more conscious of the importance of controlling their diabetes, and had a significantly better understanding of the ability to prevent complications<sup>[28]</sup>.

**Motivation on practice:** Studies have reported that motivation had a positive impact on the practice of individuals with type 2 diabetes<sup>[29-31]</sup>.

A 12-mo motivational interviewing-based personalized program in the United Kingdom significantly improved healthy eating habits<sup>[29]</sup>.

Motivational interviewing counseling sessions for newly diagnosed patients in the Netherlands significantly improved the practice of healthy eating by reducing saturated fats<sup>[30]</sup>.

A three-month motivational interviewing-based information-motivation-behavioral skills intervention for type 2 diabetes patients in the United States significantly improved the practice of healthy eating<sup>[31]</sup>.

**Motivation on practice and outcomes:** Studies have reported that motivation had a positive impact on

the practice and outcomes of individuals with type 2 diabetes<sup>[32-37]</sup>.

A 16-wk motivational interviewing intervention, in addition to a behavioral weight control program, for obese female patients in the United States significantly improved treatment adherence through higher attendance at group meetings, increased diary entries, better blood glucose monitoring, and the outcome of HbA1c levels<sup>[32]</sup>.

A motivational interviewing intervention, in addition to an 18-mo weight management program, for overweight and uncontrolled female patients in the United States significantly improved treatment adherence through higher attendance at group meetings and increased diary entries, as well as the outcomes of weight loss and HbA1c levels<sup>[33]</sup>.

A three-month motivational interviewing intervention in Taiwan that involved a 45- to 60-min interview, in addition to hospital-based educational sessions and the hospital's support group for diabetes patients, significantly improved patients' self-management, self-efficacy, QoL, and HbA1c levels<sup>[34]</sup>.

A 13-wk motivational interviewing-based eating behavior modification program for obese patients in Thailand significantly improved the practice of healthy eating, HbA1c levels, and BMI<sup>[35]</sup>.

A six-month motivational interviewing intervention with 30-min monthly sessions focusing on behavior change in an outpatient clinic after discharge for hospitalized patients with poor long-term glycemic control in China significantly improved the practice of self-management and the outcome of homeostatic model assessment for insulin resistance scores<sup>[36]</sup>.

A motivational interviewing intervention for African American adults in the United States significantly increased the odds of participants adhering to recommended physical activity level (66.7% vs 38.8%) and significantly decreased glucose levels and BMI<sup>[37]</sup>.

**Motivation on outcomes:** Studies have reported that motivation had a positive impact on the outcomes of individuals with type 2 diabetes<sup>[38,39]</sup>.

A motivational interviewing intervention and a cognitive behavioral group training intervention each consisting of four 90-min sessions in Iran significantly lowered the mean BMI<sup>[38]</sup>.

A two-year motivational interviewing-based behavior change counseling program for high-risk patients in the United States significantly improved blood pressure<sup>[39]</sup>.

## DISCUSSION

The empirical literature illustrates the beneficial impacts of interventions involving self-management education, health coaching, and motivational interviewing for diverse type 2 diabetes patients. This review contributes to the understanding of the KMAP-O framework and how it can guide the care management of patients with type 2 diabetes. It will allow the tailoring of interventions

to be more effective through knowledge enhancement, increased motivation, attitudinal changes, and improved preventive practice to reduce the progression of type 2 diabetes and comorbidities. To ensure the effectiveness of such interventions, outcome tracking can be conducted through longitudinal observations of patients and their knowledge, motivation levels, attitude, practice, and outcomes.

Multiple clinical symptoms such as low plasma adiponectin<sup>[40]</sup>, obesity and sarcopenia<sup>[41]</sup>, and defective fat oxidation capacity<sup>[42]</sup> are linked with type 2 diabetes. Thus, clinical interventions should be designed carefully through causal specifications of the etiology of type 2 diabetes. Obesity is considered a leading cause for type 2 diabetes and cardiovascular disease. It is concluded that diabetes care should not only pay attention to clinical symptoms or etiologies associated with diabetes, but also consider behavioral factors that could either impede or facilitate patient adherence and self-care management of a controllable chronic condition. Furthermore, the efficacy of health promotional strategies, using the KMAP-O framework, can be demonstrated by carefully designed and executed clinical trial studies that are augmented with health information technology<sup>[43]</sup>.

## COMMENTS

### Background

This manuscript summarized the relevance of behavioral components of health education that can improve diabetes care. Type 2 diabetes is considered an ambulatory care sensitive condition. Proper implementation of care management strategies can prevent unnecessary hospital admissions and readmissions.

### Research frontiers

This manuscript introduced a comprehensive model grounded by behavioral and social science theories through a careful review of the scientific literature and document relevant strategies for implementing diabetes education and achieving diabetes control.

### Innovations and breakthroughs

This manuscript articulated the potential causal mechanisms for enhancing preventive practice and improving patient care outcomes of type 2 diabetes.

### Applications

This manuscript suggested plausible causal links between health educational intervention and patient care outcomes mediated by behavioral factors such as knowledge, motivation, attitude, and practice relevant to diabetes care.

### Peer-review

This manuscript is a literature review on impacts of interventions involving self-management education, health coaching, and motivational interviewing for diverse type 2 diabetes patients.

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