

A SYSTEMATIC REVIEW ON THE KAP-O FRAMEWORK FOR DIABETES EDUCATION AND RESEARCH

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ABSTRACT

Background: Diabetes self-management programs have advocated the need to improve knowledge, attitude, and practice of self-care. However, many studies fail to explain how health education works for lack of causal specifications.

Purpose of the Study: This study formulates an appropriate framework, specifies the relationships among knowledge, attitude, practice and outcomes (KAP-O), and examines the factors influencing variations in the glycated hemoglobin (A1C), low-density lipoprotein cholesterol (LDLC), functional capacity (FC), and poor perceived health (PPH).

Review of Conceptual and Theoretical Perspectives: Health behavioral theories were reviewed. Relevant studies on the knowledge, attitude, practice, and health care outcomes were reviewed to support a theoretical framework and to deduce testable hypotheses.

Causal Specifications of the KAP-O Studies: General findings suggest the support of a positive effect of health educational interventions on improved Diabetics' knowledge, attitude, and preventive practice, and health care outcomes. Initially, four causally specified hypotheses were deduced: 1) Health educational intervention directly improves knowledge; 2) health educational intervention directly improves attitude; 3) health educational intervention directly improves preventive practice; and 4) health educational intervention directly lowers A1C and LDLC, improves FC), and decreases PPH. Furthermore, the causal mechanisms of improved outcomes from a behavioral perspective also suggest two additional research hypotheses for further evaluation. They include: 1) health educational intervention may indirectly improve preventive practice via knowledge and attitude improvements; and 2) health educational intervention also indirectly improves outcomes via changing knowledge, attitude, and self-care practice.

Future Research on KAP-O Model: The causal mechanisms in improved diabetes outcomes should be empirically validated in clinical trial studies, using structural equation modeling with multi-centers, multiple providers and a diverse population of Type 2 patients. Baseline knowledge and attitude should be continuously improved during the study period of one to two years. The study should assess outcomes more than four times over the study period. The study will enable discovery of whether knowledge or attitude has a more dominant influence on preventive practice and thus on diabetes care outcomes.

I. Introduction

Patients diagnosed with diabetes, a progressive chronic condition, need to be engaged in behavioral change to avoid complications. According to the American Diabetes Association (2011), the goals of behavioral change as described in standards of medical care in diabetes are: ensure good control of blood sugar through adherence to medications and diet, self-monitor blood sugar, develop healthy eating, perform 150 minutes of physical exercise weekly, and follow up with medical appointments. Promotion of such behavioral changes forms the basis of self-management programs in diabetes care and control.

A majority of such diabetes self-management programs have been shown to improve knowledge, attitude, practice, and health care outcomes. However, in the literature the underlying causal mechanisms for the improvement attributable to health education interventions have not been systematically explored, especially to show how diabetes educational intervention may affect diabetes care outcomes.

The purpose of this scientific review is to identify the underlying causal mechanisms responsible for improved knowledge, attitude, preventive practice and outcomes, so that educational interventions can be tailored efficiently and effectively to patients who are most likely to benefit from self-care management. The review will examine multiple causes of the variation in each of the clinical or health outcomes such as glycated hemoglobin (A1C), low-density lipoprotein cholesterol (LDLC), functional capacity (FC), and poor perceived health (PPH). We include behavioral theories relevant to changing diabetes patients' behaviors: 1) the health belief model, 2) the theory of planned behavior, 3) social cognitive theory, 4) the trans-theoretical model of stages of change, and 5) the patient empowerment model. These

theories seek to identify the determinants or predictors of health behavior.

II. Review of Conceptual and Theoretical Perspectives

1. Health Belief Model

The health belief model (Becker, 1974; Hochbaum, 1958; Janz & Becker, 1984; Kirscht, 1974; Rosenstock, 1960 as cited in Glanz et al., 2002) is one of the oldest theories seeking to explain human health behavior. An individual will perform a preventive behavior if the individual believes that he/she is vulnerable to a disease or problem (susceptibility), that the after-effects of the disease or problem are serious (perceived risk for the severity of illness), that the prescribed action to deal with the problem is helpful (perceived benefits of action), and that the action entails more advantages than costs (perceived costs).

The health belief model (HBM) has several limitations. One is the fact that habitual behavior such as smoking tends not to be influenced by active accounting of costs and benefits. HBM, which attempts to predict human behavior by considering differences in individual beliefs and attitudes, would predict that Type 2 diabetes patients, to avoid complications of diabetes by controlling their blood sugar, would be likely to have a healthy diet and exercise regularly. The HBM model thus identifies as an initial predisposing factor the desire to avoid complications of diabetes; but the model does not consider factors responsible for enabling and maintaining preventive behavior over time (Janz, Champion, & Strecher, 2002). Moreover, the Health Belief Model deals only with personal perceptions such as perceived risk and perceived cost and thus is too subjective for application. This model does not consider the interaction effects of a complex set of behavioral determinants. Although HBM identifies potential predictors of adherence to

medical regimens, its contribution to understanding the causal mechanisms of adherence is limited.

2. Theory of Planned Behavior

The theory of planned behavior (Ajzen, 1991; Ajzen & Driver, 1991; Ajzen & Madden, 1986 as cited in Glanz et al., 2002) states that a person's behavior is determined by his/her intention to perform that behavior. The intention is formed by his/her attitudes toward that behavior, his/her beliefs about what others think he/she should do, his/her motivation to comply with the wishes of others and perceived behavioral control. If the individual evaluates the behavior as beneficial, and significant others approve of the behavior, then the individual has more intention to carry out the behavior and is more likely to do so (Montano & Kasprzyk, 2002). Nevertheless, behavioral intention does not always lead to actual behavior, because environmental and contextual constraints come into play. The theory of planned behavior does not consider such interaction effects. It traces logical sequence, but human behavior is not always logical. In any case, the measures of self-care behaviors are actual actions reported by patients, not just their intentions to act.

3. Social Cognitive Theory

Social cognitive theory (SCT) (Bandura 1986, 1997, 2001 as cited in Glanz et al., 2002, p. 165-184) offers a complex global theory of behavioral change. Determinants of health behavior are described by the key elements of reciprocal determination, observational learning, outcome expectancy, and self-efficacy (Baranowski, Perry, & Parcel, 2002).

Reciprocal determination denotes that behavior and environment interact and influence one another. The theory postulates that change results from the interactions between individuals and their environments as a reciprocal process (Baranowski et al., 2002).

Observational learning is the capacity to learn from observing the behavior of others (Baranowski et al., 2002). Outcome expectancy refers to a person's assessment that a given behavior will result in certain beneficial outcomes (Baranowski et al., 2002). Self-efficacy is the degree of assurance in one's own ability to make a change or perform a behavior (Baranowski et al., 2002).

Social cognitive theory recognizes that environmental influence, social norms, cues, and self-efficacy influence health behavior (Baranowski et al., 2002). The theory implies that health can be promoted by modifying the social environment and fostering skills that empower individuals to make healthy behavioral changes (Baranowski et al., 2002). However, this theory lacks a framework linking the causal components of behavioral change, and it is also resource intensive. For those reasons a conceptual framework was not based on its constructs.

4. Trans-Theoretical Model

The trans-theoretical model (Prochaska & DiClemente, 1983) explains behavioral change as a cyclical process involving five stages of change. Individuals have varying degrees of readiness to change and may vacillate between the stages of pre-contemplation, contemplation, preparation, action and maintenance (Prochaska, Redding, & Evers, 2002). Therefore, the implementation of that research framework entails providing individual psychotherapy. As a model that would require monitoring a large number of study participants as well as the assistance of licensed therapists; therefore, the trans-theoretical model was not a feasible choice as a conceptual framework for a population-based study.

5. Patient Empowerment Theory

Patient empowerment theory (Funnell, Anderson, & Arnold 1991; Funnell & Anderson 2003 as cited in Mensing, 2006, p.46) postulates that decisions about lifestyle

changes cannot be dictated to patients. Patients should be in charge of their self-care. The theory reasons that since self-care first of all benefits patients themselves, they should be the primary decision makers about it (Funnell, Anderson, & Tang, 2006). The patient empowerment model guides educators and health professionals in recognizing a patient's wishes to manage and then tailoring a patient-directed plan for behavioral change (Funnell et al., 2006). This labor-intensive and time-consuming approach is not feasible for a study to be conducted by a single researcher.

In summary, the likely human health behavioral theories or models either do not measure actual health behavior or are very labor- and resource-intensive and time-consuming. Studies that measured knowledge, attitude were reviewed to check if they were useful to propose a theoretical framework and hypotheses. The following section briefly reviews the use of the KAP model in empirical research.

III. History of the Knowledge, Attitude and Practice (KAP) Research

1. KAP Survey

KAP surveys were first developed in the 1950s. After 1960 KAP surveys were extensively used in many countries to research family planning practice. The KAP studies are more cost-effective and conserve resources more than other social research methods, because they are tightly focused and limited in scope (Eckman & Walker, 2008). This research framework has been widely used in the health education field and in the developing world for family planning, and as a guide to understanding the mechanisms of health education for patient behavioral changes and patient health outcomes (Jaccard, Dittus, & Gordon, 1996). KAP surveys are now a widely used methodology for studying

human behavior when affected by a problem or disease.

2. KAP Survey Methodology

“K” stands for knowledge of the problem or disease, “A” for attitude towards the problem or disease, and “P” for practice or preventive behavior to protect against the problem or disease. Researchers assume that knowledge, attitude, and practice are related, and that knowledge and attitude directly influence preventive practice. Surveys are used to measure what individuals know about the disease or health problem. Attitude instruments measure the feelings and beliefs of survey participants about the disease or problem, and information on practice measures and the preventive behaviors that individuals follow to avoid a problem or disease. Researchers choose a sample of participants that is representative of the population. The constructs of knowledge, attitude and practice are further defined below.

Definitions of Constructs:

Knowledge. Knowledge is the acquisition, retention, and use of information or skills (Badran, 1995). Cognition through which knowledge is acquired is a process of understanding and is distinguished from the experience of feeling. Knowledge accrues from both education and experience. Knowledge possessed by diabetics refers to their comprehension of the disease, its progression, and self-care practice necessary for keeping diabetes under control.

Attitude. Eagly and Chaiken (1993) in “The Psychology of Attitude” define attitude as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor”. Attitude has three components: cognition, affect, and behavior, as discussed by Katz & Stotland, 1959; Krech & Crutchfield, 1948; and Rosenberg & Hovland, 1960 as cited in Eagly & Chaiken, 2007. Cognition comprises true

and false beliefs about the attitude object; health education may change such beliefs. Thus there may be overlap between knowledge and attitude. For example, some diabetic patients may have beliefs that they may not live healthy, long lives, because of having heard about older relatives dying at an early age from such complications of diabetes as heart attack, stroke, or kidney failure; they assume that the same fate may befall them. The affective component of attitude is the whole gamut of emotions toward every aspect of the attitude object. Some diabetic patients may have a set of varying attitudes towards self-care management of diabetes. They may love to exercise, as it makes them feel good, but hate self-monitoring their blood sugar because they are averse to pricking their skin. The behavioral components of attitude are the proneness to act in particular ways with reference to the attitude object. Thus some diabetes patients may follow through all recommendations by physicians, while other patients may not. In summary, attitude toward diabetes refers to any preconceived ideas about diabetes and its management, patients' feelings/emotions towards aspects of diabetes and diabetes care, and the aptness to behave in particular ways about diabetes and its management.

Practice. Practice demonstrates the acquisition of knowledge (increased understanding of a problem/disease) and any change in attitude caused by the removal of misconceptions about problems or disease that translates into preventive behaviors. Thus that demonstration may reflect a reciprocal relationship between knowledge and attitude. Practice is behaviors or actions that can avert a disease or delay its progression. In diabetes, practice would involve healthy eating, increased physical activity, adherence to medications, overcoming the barriers to weight loss and sedentary lifestyle, avoidance of overeating or inactivity as responses to stress, follow-up with physicians, and

participation in tests to reassess health outcomes. Those practices are the seven self-care behaviors strongly advocated by the American Association of Diabetes Educators and the American Diabetes Association.

Non-Diabetes Studies Using KAP Survey Methodology:

General studies using KAP survey methodology that assume that knowledge and attitude are related and that knowledge and attitude affect preventive practice are cross-sectional and descriptive; hence they do not enable researchers to generate any causal inferences. These studies lack a strong theoretical framework. Many studies use convenience samples. Most of the studies lack control or comparison groups. Findings for these studies are discussed below.

A community-based descriptive KAP study in 2012 of a convenience sample of 600 women in Iran (Nafissi, Saghafinia, Motamedi, & Akbari, 2012) that examined knowledge of, attitude toward, and practice of breast self-examination showed that 30.8 % knew the necessity of breast self-examination and about 60 % knew how to do breast self-examination, but only 12.9 % carried out the preventive practice of breast self-examination regularly. It was assumed that poor attitude was responsible for the low use of preventive practice.

In 2012, a KAP survey assessed the reporting of adverse effects of drugs to government agencies by Indian physicians (Kharkar & Bowalekar, 2012). Knowledge about and a positive attitude toward reporting adverse effects were found in about 55 % of the group. However, only 18.5 % of the physicians reported adverse drug effects. Reasons for that low rate of reporting were that physicians were wary of government agencies, needed a simple reporting procedure, had no toll-free number available for reporting and disliked or lacked access to electronic submission for reporting.

A KAP comparison study of two environmentally different Vietnam communities was made: an urban community unaffected by the H5N1 flu virus in 2012 and a rural group affected by H5N1 during that outbreak, was conducted in 2012 (Manabe et al., 2012). The study demonstrated that the highly educated, affluent urban group exposed to media had more knowledge and a better attitude, and obtained health care if they had flu symptoms. The rural group affected by the 2010 H5N1 outbreak did not know about or practice precautions in handling sick poultry, as a consequence of their poverty and illiteracy.

In 2005, pregnant women in Rwanda from areas with prevalent malaria both knew about the adverse consequences of malaria for pregnancy and had good attitudes yet only 8.3 % used an insecticide-treated bed net. The unaffordability of the bed nets made the preventive practice impossible for most of the women (Van Geertruyden et al., 2005).

A 2006 cross-sectional study of randomly selected tuberculosis patients discharged from a hospital in Romania investigated their limited adherence to medication regimens. Eighty-one percent of the patients knew that medications had to be continued despite the absence of tuberculosis symptoms and had a good attitude toward doing so, but still some of the patients failed to continue taking their medications because they could not afford them (Berger & Bratu, 2006).

A convenience sample of women from a clinic in Brazil (Vasconcelos, Pinheiro, Casteol, Costa, & Oliveira, 2011) was assessed with KAP for use of the pap test. The preventive practice of pap testing was undertaken by 67 %, even though only 40.4 % of the women had adequate knowledge scores and only 28 % had good attitude scores. The preventive practice was nevertheless frequent because the clinic was accessible to patients and many lived with a partner. Failure to have

pap tests for the rest of the women was due to their negative attitudes toward cervical examination.

A pre- and post- KAP comparison study of the test and control groups in two rural Vietnam communities that had experienced an H5N1 flu outbreak was conducted in 2011 to assess the impact of educational intervention. The difference in the groups' knowledge, attitude, and practice scores between the pre- and post-tests was not significant. The authors acknowledge the difficulty of changing the unhealthy behaviors and customs of people in a poor rural area regarding poultry. Study participants reported touching and eating dead or sick poultry at both KAP_Time 1 and KAP_Time 2. The questionnaires comprised mostly of closed-ended or multiple choice questions (Manabe et al., 2011).

In 2013, Wahed et al. did a cross-sectional KAP assessment of urban slum dwellers of Bangladesh regarding cholera prevention. The sample of 2,830 families was randomized to three arms: one-third of the families were allocated as control, a third received only vaccine, and the remaining families received vaccine as well as intervention messages about hygiene and behavior change. In the majority of the participants, KAP scores for knowledge about cholera were poor and attitude scores were high. Preventive practices were few, however, due to environmental and economic difficulties. Participants with good knowledge of preventive measures against cholera could not practice preventive behavior adequately because of the scarcity of water, gas supply, sanitation and a proper drainage system.

A cross-sectional, telephone KAP survey study conducted in China in 2011 about the knowledge, attitudes and practices relating to the H1N1 pandemic has limitations. The rate of immunization against H1N1 was 10.8 % among the respondents, although 69.9 % believed that vaccine had

few adverse effects and the vaccine was available free from state agencies (Lin et al., 2011).

In summary, the general KAP surveys widely used in non-experimental social research are correlational (ex post facto) and descriptive. They verify correlations, i.e. whether a tendency for a variation in one variable is related to the variation in another variable. The studies attempt to understand the relationships among knowledge of, attitude toward, and preventive behavior against a naturally occurring phenomenon (e.g., an influenza epidemic), using a randomly selected sample and no research intervention. Some researchers studied the association of sample attributes with KAP scores for knowledge, attitude and preventive practice. Such studies are limited to correlational rather than causal analysis. A researcher conducting an ex post facto study lacks any control over the independent variables that have already confounded the association between the independent variable and the dependent variable. As a result, causal relationships cannot be ascertained due to the inability to accurately manipulate the independent variable (s). However, correlations may serve as starting points for generating hypotheses or developing theories. The stronger the association between two variables, the more likely it is to eventually find a potential causal link between them, though not in the associative study. These studies indicate that knowledge and attitude influence preventive practice. However, several studies have shown that lack of money is a serious barrier to preventive practice. Preventive behavior is encouraged by personal support and accessibility to medical care.

IV. Diabetes KAP Studies

A review of KAP studies involving diabetic patients shows that most studies are

cross-sectional, using convenience samples or randomly selected participants. The studies aim to assess scores for knowledge, attitude, and preventive practice as well as clinical outcomes, or to determine associations between socio-demographic factors and knowledge, attitude and practice. A few studies have used single-group convenience samples with a pre- and post- intervention assessment of changes in knowledge, attitude, and practice scores. Other studies have used randomly assigned participants to test and control groups with a pre- and post-intervention assessment of changes in knowledge, attitude, and practice scores.

1. Cross-Sectional KAP Assessments Using Convenience Samples

Using a convenience sample of 75 patients with Type 2 diabetes at an urban center for diabetes care in Malaysia, Ng et al. (2012) assessed KAP scores for knowledge, attitude and practice about diabetes. Although KAP scores were satisfactory, outcomes for glycated hemoglobin (A1C) and fasting blood sugars were not. Eighty-six percent of the participants had significantly poor clinical test outcomes in spite of adequate knowledge and positive attitudes about diabetes. Fewer than 50 % of the participants reported exercising regularly. There was a strong association between knowledge and attitude, and between knowledge and practice. The attitude questionnaire did not differentiate the three components of attitude: cognition, affect and behavior. This study has limited generalizability, since it was a cross-sectional study of a small, urban, convenience sample of 75 patients whose responses were collected on a self-reported questionnaire.

Raj & Angadi (2010) used KAP to assess preventive practice of diabetes in a convenience sample of 730 Type 2 diabetic patients treated at a hospital in Karnataka, India. This was a cross-sectional study. A high number of the respondents had good

knowledge and positive attitudes about diabetes, yet had poor practices; 60 % considered diabetes to be a serious disease; but only 40 % took precautions while travelling, 51 % did not monitor blood glucose regularly, and 60 % did not exercise at all. The cross-sectional, hospital-based study used an 8-item, descriptive KAP instrument that could not examine causality among the KAP components.

A convenience sample of 238 Type 2 diabetes patients from 3 hospital clinics in Saurashtra, Gujrat India were assessed using KAP by Shah V., Kamdar, & Shah N., (2009). About 46 % of the patients knew about the causes and complications of diabetes. Most patients in the study had positive attitudes toward self-care. However, they relied more on dietary modifications than on exercise to manage their diabetes. The study's findings are limited in generalizability.

KAP scores and demographic details for 162 newly diagnosed diabetics from an outpatient clinic in Nepal were assessed by Upadhyay, Mohamed, Alurkar, Mishra, and Palaian (2012) in a cross-sectional study. Eighty-two percent had no family history of diabetes. Their knowledge, attitude and practice scores were very low. The attitude instrument consisted of four questions. The sample population was newly diagnosed and was limited to one hospital from one region, so generalizability of the findings is very limited.

Abubakari et al. (2011) assessed the associations among knowledge, illness perceptions, self-management and clinical outcomes in a convenience sample of 359 Type 2 diabetic patients from London Diabetes Clinics. This study was cross-sectional, using Leventhal's (1980) common-sense, self-regulating model and hypothesis. The findings show that perception of severe consequences of diabetes was associated with poor self-management in patients of both African and European origins. Perceptions of

personal control were associated with better self-management in patients of African origin. After controlling for demographic and disease characteristics, self-management of diabetes did not predict metabolic outcomes in any ethnic group. The study used psychometric instruments. Since data for this study were collected at one-time point, it was not feasible to determine the direction of the relationships between determinants and outcomes or to investigate causal relationships. The limitations of the study were: self-reported data on self-management with concern-for-social-desirability bias, and memory and recall biases. Face-to-face administration of the questionnaires may have introduced interviewer bias. Selection bias due to convenience sampling, however, was minimized by the high participation rate. The authors acknowledged that the sample from the London Diabetes Clinics was not representative, and findings cannot be generalized to other settings.

Venkataraman et al. (2012) studied the relationships among personal, disease and treatment-related factors, and diabetes control in a convenience sample of 507 hospital patients diagnosed with Type 2 diabetes in a cross-sectional survey. Self-efficacy positively influenced mental attitudes. Self-efficacy was the single most important determinant of current diabetes control. The findings of this study need further validation by a longitudinal study design.

A purposive convenience sample of 100 diabetics among Mexican American and Mexican-Native volunteers was recruited from a large Catholic church in north central Texas (Melancon, Oomen-Early, & del Rincon, 2009). KAP surveys were conducted to assess diabetes knowledge, attitudes, disease management, and self-efficacy. Factors promoting or deterring diabetes prevention and management were identified, using Airihenbuwa's PEN-3 Model by Melancon et al. (2009). Eighty-two volunteers

completed quantitative surveys and 18 participated in qualitative focus groups. Knowledge and perceived psychosocial impact scores for the study participants were significantly lower than those from the national samples. Since the sample was not truly representative and data were subject to participants' recall and feelings at one point in time, the results from this study cannot be generalized to all Mexican Americans and Mexican Native adults in the United States with Type 2 diabetes.

2. Cross-Sectional Studies Using Random or Stratified Samples

A cross-sectional study of 125 randomly selected, low-income minority patients in South Carolina with Type 2 diabetes was conducted by Bains and Edgede in 2011, using psychometrically validated instruments. Health literacy was significantly associated only with diabetes knowledge. Diabetes knowledge and perceived health status were significantly associated with glycemic control; health literacy was not associated with glycemic control. Since this was a cross-sectional study, it was not possible to infer any causality. Furthermore, as this study was conducted at a single academic center, the findings are not generalizable. The study did not include either the duration of diabetes or comorbidities as confounding factors. No theoretical framework guided the analysis.

Another cross-sectional study, by Walker et al. (2012), of 378 consecutively scheduled primary care patients with Type 2 diabetes in southeastern US examined the impact of diabetes fatalism on self-care behaviors and medication adherence. Fatalism was defined as a belief that "all events are predetermined and therefore inevitable" and as a psychological state characterized by perceptions of despair, hopelessness and powerlessness. In the linear regression model, fatalism was significantly associated with

extents of medication adherence, diabetes knowledge, diet, exercise, and blood sugar testing. This association was further confirmed once depression was statistically controlled for. Since this was a cross-sectional study, causal directions of the associations could not be assumed. In addition, findings may not be generalizable to other populations or geographical regions.

KAP assessment using a cross-sectional survey of 575 randomly selected diabetic patients of two hospital clinics by Al-Maskari et al. (2013) found that 31% had poor knowledge about diabetes, 72 % had negative attitudes towards diabetes, 57 % had poor glycemic control and 10 % admitted noncompliance with medications. There was a weak but statistically significant correlation between the level of knowledge and practice ($r = 0.320$, $p = 0.001$) and also between attitudes and practice ($r = 0.270$, $p = 0.001$). Similarly, there was a weak but statistically significant association between knowledge and attitude scores ($r = 0.115$, $p = 0.006$). Correlations between glycosylated hemoglobin (A1C) and knowledge, attitude and practice scores did not reach statistical significance. In this study, there was no correlation between the level of knowledge and glycemic control. No theoretical framework guided the research.

Khandekar, Harby, Harthy, and Lawatti (2010), in a cross-sectional study, examined KAP relationships in a randomly selected sample of 750 diabetics from seven regions of Oman regarding eye complications and self-care for diabetes. This study, with 5 questions on knowledge, 3 on attitude and 3 on practice, found diabetes knowledge to be satisfactory; however, attitude and practice were less than satisfactory.

An empirical study, using KAP assessment, of 1982 randomly selected diabetics and non-diabetics from Kenya areas with high prevalence of diabetes was conducted in 2011 (Maina, Ndegwa, Njenga, & Muchemi, 2011). The study examined how

knowledge influenced attitudes and practices about the prevention and control of diabetes, and used KAP assessments to develop prevention programs. About 70 % of all respondents from each of four regions had poor knowledge about diabetes. There was a direct relationship between level of education and knowledge. Forty-nine percent of the respondents had a positive attitude toward diabetes and forty-one percent demonstrated good practices toward diabetes. The KAP assessment in this study indicated the need for diabetes education.

Ardena et al. (2010) assessed KAP and developed an educational program in a stratified sampling of 156 rural persons with Type 2 diabetes in the Philippines. The associations between patient factors and knowledge, attitudes, and practices about diabetes were explored. The overall mean percentage score on knowledge was 43 %. Older patients had lower knowledge scores. Ten percent believed in tight glucose control; only one percent believed that diabetes was a serious disease. College graduates had better attitudes than less educated people did. Only 23 % did regular A1C checks and 34 % examined feet for abnormalities; 25 % continued to smoke despite medical advice.

3. Pre- and Post- Test with a Single Group:

Pre- and post- intervention evaluation of an educational program for a single group of 67 patients with Type 1 diabetes who were receiving free monthly supplies of human insulin at the outpatient clinic of a tertiary care hospital in Pondicherry, India was undertaken by Vimalavathini, Agarwal and Gitanjali (2008), using a KAP survey. The KAP questionnaire consisted of 22 questions, of which four were about attitude. This was a prospective interventional study using a convenience sample. Knowledge and attitudes about diabetes improved after the educational intervention. Only marginal improvement in

practice scores was observed; patients cited financial reasons for non-adherence to the insulin regimen. The practice of storing insulin vials at home did show significant improvement ($p < 0.0001$). It was concluded that knowledge, attitude and some aspects of practice improved after the educational intervention, though some patients were unable to consistently follow an insulin regimen because they could not afford transportation to the clinic.

In a single-group, prospective pre- and post-intervention study using a postal questionnaire for 97 diabetic women in Ireland (Type 1, $n = 89$; Type 2, $n = 8$), Holmes et al. (2012) evaluated use of an educational DVD to evaluate whether or not knowledge and attitudes about preconception care and reproductive health, and behavior changed. The study found a significant positive change in women's perceived benefits of, and their personal attitudes about receiving preconception care and using contraception. There was a significant improvement in self-efficacy, that is, the self-confidence to use contraception and to access preconception care. Viewing the DVD significantly increased the women's knowledge about pregnancy planning and pregnancy-related risks and significantly reduced perceived barriers to preconception care. Knowledge, attitude and self-efficacy all improved as a result of the intervention. This study has limitations, and its findings cannot be generalized. Only 26 % of the women contacted participated in the study. The sample women were relatively upper class, and there was a lower percentage of Type 2 diabetics than that in the general population (9 % vs. 17 %). The study did not measure behavior or practice. More motivated and more highly educated individuals, who acknowledged having earlier received preconception advice, responded and participated in the study. Since there was no comparison control group, the improvement in

knowledge and attitude cannot be accurately attributed to the intervention alone.

A single-group, pre- and post-education, correlational study of a convenience sample of 168 urban, newly diagnosed Type 2 diabetics attending diabetes group education in Ireland was conducted by Clarke (2009). The study found that attitude about diabetes was not related to adoption of diabetes self-care behavior. The study findings were not generalizable since the sample was not representative of the population.

Since data for these cross sectional studies were collected at one-time point, it was not feasible to determine the direction of the relationships between determinants and outcomes or to investigate causal relationships. To delineate causal relationships knowledge, attitude, and practice should be measured pre and post intervention. The classical type of experimental design with two groups, randomly assigned and pre-test and post- test measurements is the gold standard since any differences that appear in post-test are result of the intervention than possible differences between the two groups. Some studies with a test-control, random-assignment and pre-post design are reviewed below.

4. KAP Studies with a Test-Control, Random-Assignment and Pre-Post Design

Malathy et al. (2011) evaluated a custom-designed counseling program, assessing the effects of counseling on knowledge and practice in the test group, in a randomized sample of 207 Type 2 diabetes patients in South India, having an intervention group (n = 137) and a control group (n = 70). KAP scores of the test-group patients improved significantly, in the post-intervention assessment ($p < 0.0001$) especially for knowledge and attitude. The practice scores did not show any improvement ($p < 0.06$); the baseline practice scores had

been relatively high. No significant changes in KAP scores for the control group were observed. The postprandial blood glucose levels decreased significantly in the test group; there were no significant changes in the control group. The study used a questionnaire of 25 questions with only three questions on attitude. The study did not examine glycated hemoglobin (A1C), which is an important biomedical marker of blood sugar control over time. Post-prandial blood glucose was only assessed at a single point in time.

A multi-site, prospective study of randomly selected diabetic Asians living in Scotland, by Baradaran et al. (2006) evaluated an educational intervention tailored for South Asians, using a group comparison of changes in diabetes knowledge between the test group and the ethnic and the white control groups. The final study sample was 101 patients. The test group had low baseline KAP scores. In the intervention group scores improved significantly for knowledge (+12.5 %), serious attitudes (+13.5 %), and practice (+20.0 %). There were no significant differences in KAP improvement between the members of the two control groups (white & other ethnic).

Evaluation of the effectiveness of a diabetes educational intervention with a small group was undertaken by Garrett et al. (2005). Volunteers were randomly assigned to an intervention group (n = 382) or to a control group (n = 382). The intervention group used a book explaining self-care. After accounting for demographic differences between the groups, significant changes were found in diabetes knowledge, feeling of control and self-management behavior between the intervention and the control group. Although the study used a randomly selected sample, the pool of volunteers had higher motivation than in the general population, which may introduce selection bias. Hence the study findings had limited generalizability.

In a randomized, prospective study of Type 2 diabetics in India, Adepu et al. (2007) evaluated the effect of pharmacist- provided counseling on patients' perceptions about disease management and quality of life. A total of 60 Type 2 diabetes patients were randomly allocated to the test group ($n = 32$) or the control group ($n = 28$). In the test group, knowledge, attitude and practice scores markedly improved; mean capillary blood glucose levels fell ($p < 0.05$), and mean quality-of-life scores rose ($p < 0.05$). In the test group, a highly significant correlation was found between the capillary blood glucose levels and the quality-of-life scores ($p < 0.05$). The control group showed a reduction in the quality-of-life scores ($p < 0.05$).

In summary, some of these studies indicate that even though patients had good knowledge and positive attitude they had poor preventive practices and poor clinical outcomes. In one study lack of money was a serious barrier to preventive practice. Since data were collected at one-time point, it was not feasible to determine the direction of the relationships between determinants and outcomes or to investigate causal relationships.

Causal Inquiries of Diabetes KAP Studies

1. Studies Supporting the Concept that Educational Intervention Directly Improves Diabetics' Knowledge

Norris et al.'s (2001) review, cited earlier, of 72 studies focusing on the effectiveness of self-management education for a period of six months or less found that self-management education improves diabetics' knowledge. The Hogue et al. (2003) study, cited earlier, of community, pharmacy-based diabetes education based on the American Diabetes Association Standards with 381 participants found improvements in diabetes knowledge scores, as well as in

glycated hemoglobin (A1C) results, fasting blood glucose levels, lipid levels, and blood pressure measurements.

Evaluation of the effect of an educational KAP program, through a single-group, prospective pre- and post-intervention study of 67 Type 1 diabetic patients receiving free monthly supplies of human insulin at the outpatient clinic of a tertiary care hospital, in Pondicherry, India was undertaken by Vimalavathini et al. (2008). The study used a convenience sample. Diabetes knowledge improved after the intervention.

Holmes et al. (2012), as described earlier, conducted in Ireland a single-group, prospective, pre- and post-intervention study by postal questionnaire of 97 women with diabetes (Type 1, $n = 89$; Type 2, $n = 8$) who were aged 18–40 years. The purpose was to evaluate whether an educational DVD increased their knowledge about diabetes and changed their attitudes towards preconception care and reproductive health behavior. After viewing the DVD, the women's knowledge about pregnancy planning and pregnancy-related risks had increased significantly.

Malathy et al. (2011), in evaluating a custom-designed counseling program as described earlier, assessed the effects of counseling on diabetes knowledge and practice in a test group ($n = 137$) versus a control group ($n = 70$) in a randomized sample of Type 2 diabetes patients in South India. The knowledge scores of the test group patients improved significantly ($p < 0.0001$). There was no statistically significant change in the knowledge scores of the control group.

In other research cited earlier, a multi-site, prospective study of randomly selected South Asian diabetes patients in Scotland, by Baradaran et al. (2006), evaluated a custom tailored, educational intervention by comparing the change in diabetes knowledge among the test, ethnic control and white control groups. The study sample comprised

of 101 Type 2 patients. The test group had low KAP at baseline and significant improvement in the scores for diabetes knowledge after the intervention.

As described earlier, evaluation of the effectiveness of a small group, diabetes educational intervention was undertaken by Garrett et al. (2005), using volunteers randomly assigned to either an intervention group (n = 382) that participated in the small-group learning activity or a control group (n = 382) that received a diabetes self-care book. Adjusting for demographic differences between the groups, there was a significant change in diabetes knowledge in the intervention group as compared to the control group.

In a randomized, prospective study of Type 2 diabetics in India, Adepu et al. (2007), cited earlier, evaluated the effect of pharmacist- provided counseling on patients' perceptions about disease management and quality of life. A total of 60 Type 2 diabetes patients were randomly allocated to the test group (n = 32) or the control group (n = 28). In the test group, knowledge, scores markedly improved.

In the studies discussed above, health educational interventions led to increases in knowledge. This evidence could lead to a hypothesis (H1): Health educational intervention directly improves knowledge.

2. Studies Supporting the Concept that Educational Intervention Directly Improves Attitude

The evaluation by Vimalavathini et al. (2008) of an educational program, cited above, found that diabetic patients' attitudes toward self-care improved after educational intervention.

The study conducted by Holmes et al. (2012) in Ireland using educational DVD improved diabetes knowledge and also the diabetic women's attitudes towards

preconception care, reproductive health attitudes and behavior. At post-intervention, there was a significant positive change in women's perceived benefits of, and their personal attitudes to receiving preconception care and using contraception.

A one- group, pre- and post- education, correlational study in Ireland of a convenience sample of 168 urban, newly diagnosed Type 2 diabetics who were attending diabetes group education was conducted by Clarke (2009) to assess their changing perceptions about diabetes from attending the group education. The patients' attitude about the seriousness of diabetes continued to increase over time.

Malathy et al. (2011), previously cited, evaluated a custom-designed KAP counseling program in South India and found that the scores of the test group improved significantly ($p < 0.0001$), for attitude about diabetes at post-intervention. There were no significant changes in the attitude scores of the control group.

A multi-site, prospective study of 101 South Asian diabetic patients in Scotland by Baradaran et al. (2006) cited previously, compared changes in diabetes knowledge between the test and the ethnic control and the white control groups. The test group had low KAP scores at baseline and significantly improved in scores for attitudes toward the seriousness of diabetes after the intervention.

Adepu et al. (2007), cited earlier, evaluated the effects of pharmacist- provided patient counseling for Type 2 diabetes patients from two community pharmacies in Calicut, Kerala, India. The test group scores for attitude about diabetes markedly improved.

The studies discussed above using health educational interventions found resulting improvements in attitude. This evidence could lead to a hypothesis (H2): Health educational intervention directly improves attitude.

3. Studies Supporting the Concept that Educational Intervention Directly Improves Preventive Practice

In an evaluation of the effectiveness of a small-group intervention, described earlier, by Garrett et al. (2005), there were significant changes in behavior related to self-management of diabetes in the intervention group as compared to the control group, which had simply received a diabetes self-care book. The study adjusted for demographic differences between the two groups.

A multi-site, prospective study of randomly selected diabetic Asians living in Scotland, by Baradaran et al. (2006) evaluated an educational intervention tailored for South Asians, using a group comparison of changes in diabetes knowledge between the test group and the ethnic and the white control groups. The final study sample was 101 patients. The test group had low baseline KAP scores. In the intervention group practice scores improved significantly (+20.0 %).

In a randomized, prospective study of Type 2 diabetics in India, Adepu et al. (2007) evaluated the effect of pharmacist- provided counseling on patients' perceptions about disease management and quality of life. A total of 60 Type 2 diabetes patients were randomly allocated to the test group (n = 32) or the control group (n = 28). In the test group practice scores markedly improved.

These studies suggested that health educational intervention directly increased preventive practice. This evidence could lead to the development of the third hypothesis (H3): Health educational intervention directly improves preventive practice.

4. Studies Supporting the Concept that Health Educational Intervention Improves Health Care Outcomes

In 2001, Norris et al. reviewed 72 studies evaluating the effectiveness of self-management education lasting for a period of six months or less. The authors found that the

interventions improved knowledge and glycemic control; however, they had variable effects on lipids. In 2002, Norris with other researchers found that there was a drop of one percent in glycosylated hemoglobin (A1C) for every additional 23.6 hours of contact time between educator and patient. Tilly et al. (1995) evaluated a diabetes educational program by collecting data on health status, glycemic control (A1C), diabetes-related quality of life, and general health-related quality of life at multiple time points over a period of 15 months. The authors found significant improvement in all four health outcomes.

A study by Hogue et al. (2003) of a community pharmacy-based diabetes educational program with 381 participants, based on the American Diabetes Association Standards, found improvements in Hemoglobin A1C results, fasting blood glucose levels, lipid levels, blood pressure measurements, and diabetes knowledge scores. Similarly, Cranor et al. (2003) studied the outcomes for the five years following the initiation of community-based, pharmaceutical care services for patients with diabetes. The study, with a quasi-experimental, longitudinal, pre-post cohort design, found improvements in all categories of outcomes and a decrease in the mean for total direct medical costs per patient per year. This evidence could lead to the development of the fourth hypothesis (H4): Health educational intervention directly improves diabetes health care outcomes which is further detailed by a specific outcome in each sub-hypothesis. H4₁ states that health educational intervention directly lowers glycosylated hemoglobin (A1C); H4₂ states that health educational intervention directly lowers low density lipoprotein cholesterol (LDLC); H4₃ suggests that health educational intervention directly improves functional capacity (FC); and H4₄ assumes that health educational

intervention directly decreases poor perceived health (PPH).

5. Studies Supporting the Concept that Educational Intervention Indirectly Improves Practice via Knowledge and Attitude

The previously described study by Vimalavathini et al. (2008) evaluated the effects of an educational program on the diabetes knowledge, attitude and practices of 67 Type-1 patients receiving free monthly supplies of human insulin at the outpatient clinic of a tertiary care hospital in India. Patients were of low socioeconomic status, either illiterate or with primary school education, and had longstanding diabetes. Their diabetes knowledge and attitudes improved after the intervention. The improvement in practice scores, though significant, was marginal. The practice of storing insulin vials at home showed significant improvement (< 0.0001), but patients cited financial reasons for not adhering to their insulin regimens.

Baradaran et al. (2006), cited earlier, conducted a multi-site, prospective study of 101 South Asian diabetes patients in Scotland, and compared KAP scores between the test group and the ethnic and white control groups. The test group had low KAP scores at baseline; their scores post-intervention improved significantly for knowledge (+12.5%) and serious attitudes toward diabetes (+13.5%), and for practice (+20.0%), as well.

The studies discussed above suggested that health educational intervention indirectly improves preventive practice via knowledge and attitude. This evidence could lead to the fifth hypothesis (H5): Health educational intervention also indirectly improves preventive practice via knowledge and attitude.

6. Studies Supporting the Concept that Educational Intervention Indirectly

Affects Outcomes, Mediated via Knowledge, Attitude, and Practice

Adepu et al. (2007) previously cited, evaluated the effect of pharmacist-provided patient counseling in India on Type 2 diabetes patients' perceptions about disease management and quality of life. In the test group patients ($n = 32$), knowledge, attitude and practices scores were markedly improved post-intervention, mean capillary blood glucose levels was reduced ($P < 0.05$) and the mean scores for quality of life improved ($P < 0.05$). The correlation between the capillary blood glucose levels and quality of life scores was also found to be highly significant in the test group ($r = 0.955$). In the control group ($n = 28$) quality of life score was reduced ($P < 0.05$).

Malathy et al. (2011) previously cited, assessed the effect of custom-designed counseling on knowledge and practice for test group ($n = 137$) and control group ($n = 70$) of 207 Type 2 diabetes patients in South India. Post-intervention KAP scores of test group patients, especially knowledge and attitude, improved significantly ($p < 0.0001$). Practice scores showed no improvement ($p < 0.06$), since baseline practice scores were high. The control group showed no significant changes in KAP score. The outcome for postprandial blood glucose levels improved significantly in the test group.

Norris et al. (2002) found that self-management education improves the outcome of glycated hemoglobin (A1C) levels at immediate follow-up and that improvement in glycated hemoglobin (A1C) levels increases if the education continues for a longer time. The benefit of improved outcome of glycated hemoglobin (A1C) was sustained for 1-3 months after cessation of the intervention. This suggests that knowledge and attitude continue to influence practice and outcome even after the self-management education ends.

The studies discussed above suggested that influence of health education on clinical outcomes is not direct but is mediated via knowledge, attitude, and practice. This evidence could lead to hypothesize (H6) that the influence of health education on diabetes health care outcomes is not direct, but is mediated via knowledge, attitude, and practice.

7. Knowledge, Attitude, Preventive Practice, and Outcomes (KAP-O) Framework

The literature review suggested that educational interventions improve knowledge

and attitude, and that improved knowledge enhances self-care practice. Improved attitude improves practice, and improved practice leads to improved outcomes. Therefore, the knowledge-attitude-practice -outcome framework (KAP-O model of behavioral change) as proposed by Wan (2014) forms the ideal theoretical basis for a study’s examination of the underlying mechanism by which health educational intervention may improve health care outcomes. The proposed relationships are illustrated in a KAP-O model (Figure 1).

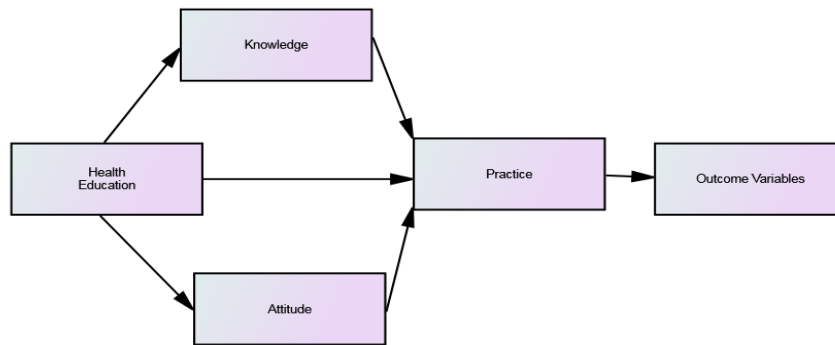


Figure 1. Relationships of KAP-O Components in Health Education Research

V. IMPLICATIONS AND CONCLUSIONS: The Knowledge, Attitude, Practice and Outcome Framework

The KAP behavioral system framework captures both the predisposing factors of attitudes and knowledge about diabetes control, and actual behavior. It is more complete in its causal specifications of determinants of preventive practice and outcomes. Knowledge about and attitudes towards a health disorder are important predictors of adherence to a prescribed regimen. Although the KAP framework cannot address provider behavior, it is still

advantageous when compared to other models in its logical formulation for causal sequences among the determinants of health behavior and outcomes.

Application of KAP-O model in a pre and post- test study in a single medical practice enables discovery of whether the hypothesized pathways specified by the causal model are consistent with the data. Structural equation modeling (SEM) with path analysis can test the causal hypotheses concerning direct and indirect causal effects of health educational intervention on proximal knowledge, attitude, practice and distal outcomes of diabetes control. Those multivariate analytical techniques enable the researcher to remove the potential

confounding effects of variables other than the intervention variable. Further, application of KAP-O in a pre- and post- test study may reveal the relative importance of predictors for the variation in diabetes outcomes. It is important to explore which of the two factors, knowledge or attitude, may have a more dominant influence on preventive practice and thus on diabetes care outcomes. The relative importance of the factors influencing diabetes care outcomes can guide educational programs to target specific knowledge or attitudinal components of the behavioral system. Thus research could improve practice and outcomes.

The KAP-O model should be subjected to empirical validation with a rigorous research design. An experimental study with a randomized control trial design should be conducted using the knowledge, attitude, practice and outcome (KAP-O) framework. The experimental group could receive an innovative diabetes education intervention such as HealthyTutor (www.healthytutor.com). Both control and

experimental groups should receive usual customary care. Knowledge, attitude, practice, functional capacity and perceived health need to be measured before and after intervention using reliable and valid instruments. The analysis of the commonality among four diabetes outcome variables of (A1C), (LDLC), (FC), and (PPH) should be evaluated to determine if these measurements of outcome variables are shared in common with a single latent construct, such as diabetes care outcomes. Furthermore, evaluation research should be executed to consider the dose-response relationship between diabetes education and its outcome variables.

The study should be replicated in multiple communities, using the KAP-O model for guiding the data collection from multi-centers, multiple providers, and a diverse population of Type 2 diabetes patients. Moreover, the study should assess outcomes multiple times over a period of one to two years to elicit the trajectory of change in outcome variables.

REFERENCES

- Abubakari A, Jones M, Lauder W, Kirk A, Anderson J, Devendra D. Associations between knowledge, illness perceptions, self-management and metabolic control of type 2 diabetes among African and European-origin patients. *J Nursing & Healthcare of Chronic Illnesses*. 2011; 3(3):245-56.
- Adepu R, Rasheed A, Nagavi BG. Effect of patient counseling on quality of life in type-2 diabetes mellitus patients in two selected South Indian community pharmacies: A Study. *Indian J Pharmaceutical Sciences*. 2007; 69(4):519-24.
- Al-Maskari F, El-Sadig M, Al-Kaabi JM, Afandi B, Nagelkerke N, Yeatts, K. Knowledge, attitude and practices of diabetic patients in the United Arab Emirates. *PLoS One*, 2013;8: e52857.
- American Diabetes Association. Standards of medical care in diabetes-2012. *Diabetes Care*. 2013 Jan; 33 Suppl: 1: S11-61.
- American Diabetes Association. Standards of medical care in diabetes-2011. *Diabetes Care*. 2011 Jan; 34 Suppl 1: S11-61.
- Anderson B, Funnell M, Tang T. Self-management of health. In: Mensing C, Cypress M, Halstenson C, McLaughlin S, Walker E, editors. *The art and science of diabetes of Self-management education*. 1st ed. Chicago: Amer Assn of Diabetes Educators; 2006. pp. 43-58.
- Ardena GJ, Paz-Pacheco E, Jimeno CA, Lantion-Ang F, Paterno E, Juban N. Knowledge, attitudes and practices of persons with type 2 diabetes in a rural community: Phase I of the community-based diabetes self-management education (DSME) program in San Juan, Batangas, Philippines. *Diabetes Res Clin Pract*. 2010 Nov; 90(2):160-66.
- Bains SS, Egede LE. Associations between health literacy, diabetes knowledge, self-care behaviors, and glycemic control in a low income population with type 2 diabetes. *Diabetes Technol Ther*. 2011 Mar; 13(3):335-41.
- Badran IG. Knowledge, attitude and practice the three pillars of excellence and wisdom: A place in the medical profession. *Eastern Mediterranean Health Journal*. 1995; 1:8-16.
- Baradaran HR, Knill-Jones RP, Wallia S, Rodgers A. A controlled trial of the effectiveness of a diabetes education program in a multi-ethnic community in Glasgow. *BMC Public Health*. 2006 May 18; 6:134-9.
- Baranowski T, Perry CL, Parcel GS. How individuals, environments, and health behavior interact: Social cognitive theory. In: Glanz, K, Rimer BK, Lewis FM. editors. *Health Behavior and health education: Theory, research, and practice*. 3rd ed. San Francisco: Jossey-Bass; 2002. pp.165-84.
- Berger D, Bratu E. Tuberculosis knowledge, attitudes and practices in Romania: A patient-centered assessment. *Cognition, Brain, Behavior*. 2006; 10(1): 93-104
- Clarke A. Effects of routine education on people newly diagnosed with type 2 diabetes. *European Diabetes Nursing*. 2009; 6(3):88-94.
- Cranor C, Bunting B, Christensen D. The Asheville project: Long-term clinical and economic outcomes of a community pharmacy diabetes care program. *J The American Pharmaceutical Association*. Washington D.C. 2003; 43(2):173-84.

- Eagly AH, Chaiken S. The advantages of an inclusive definition of attitude. *Social Cognition*. 2007; 25:582–602.
- Eckman K, Walker R. Knowledge, Attitudes and Practice (KAP) Survey-summary report for the Duluth Lakeside stormwater reduction project (LSRP). Duluth: Water Resources Center, University of Minnesota.2008.
- Garrett N, Hageman C, Sibley S, Davern M, Berger M, Brunzell C, Malecha K, Richards S. The Effectiveness of an interactive small group diabetes intervention in improving knowledge, feeling of control, and behavior. *Health Promotion Practice*. 2005 July; 6(3):320-28.
- Glanz, K, Rimer BK, Lewis FM. editors. *Health behavior and health education: Theory, research, and practice*. 3rd ed. San Francisco: Jossey-Bass; 2002. 583 p.
- Healthy Tutor Modules [Internet]. Orlando (FL). Available: <http://www.healthytutor.com>.
- Hogue VW, Babamoto KS, Jackson TB, Cohen LB, Laitinen DL. Pooled results of community pharmacy-based diabetes education programs in underserved communities. *Diabetes Spectrum*. 2003;16(2):129-33.
- Holmes VA, Spence M, McCance DR, Patterson CC, Harper R, Alderdice FA. Evaluation of a DVD for women with diabetes: Impact on knowledge and attitudes to preconception care. *Diabet Med*.2012 Jul; 29(7): 950-56.
- Jaccard J, Dittus P, Gordon V. Maternal correlates of adolescent sexual and contraceptive behavior. *Family Planning Perspectives*. 1996; 28:159–65.
- Janz NK, Champion VL, Strecher VJ. The health belief model. In: Glanz K, Rimer BK, Lewis FM. editors. *Health behavior and health education: Theory, research, and practice*. 3rd ed. San Francisco: Jossey-Bass; 2002. pp.45-66
- Khandekar R, Al Harby S, Al Harthy H, Al Lawatti J. Knowledge, attitude and practice regarding eye complications and care among Omani persons with diabetes - A cross sectional study. *Oman J Ophthal*. 2010; 3(2): 60-5.
- Kharkar M, Bowalekar S. Knowledge, attitude and perception/practices (KAP) of medical practitioners in India towards adverse drug reaction (ADR) reporting. *Perspect Clin Res*. 2012; 3:90–4.
- Maina WK, Ndegwa ZM, Njenga EW, Muchemi EW. Knowledge, attitude, and practices related to diabetes among community members in four provinces in Kenya: a cross-sectional study. *Afr J Diabet Med*. 2011; 19:15–18.
- Malathy R, Narmadha MP, Ramesh S, Alvin JM, Dinesh BN. Effect of a diabetes counseling program on knowledge, attitude and practice among diabetic patients in Erode district of South India. *J Young Pharm*. 2011 Jan-Mar;3(1):65-72.
- Manabe T, Hanh T, Lam D, Do T, Pham T, Dinh T, Kudo K. Knowledge, attitudes, Practices and emotional reactions among residents of avian influenza (H5N1) hit communities in Vietnam. *PLoS One*, 2012; 7(10): e47560
- Manabe T, Pham T, Vu V, Takasaki J, Dinh T, Nguyen T, Kudo K. Impact of educational intervention concerning awareness and behaviors relating to avian influenza (H5N1) in a high-risk population in Vietnam. *PLoS One*,2011;6(8): e23711

- Melancon J, Oomen-Early J, del Rincon LM. Using the PEN-3 model to assess knowledge, attitudes, and beliefs about diabetes type 2 among Mexican American and Mexican Native men and women in North Texas. *Int Electron J of Health Educ.* 2009; 12:203–221.
- Montano DE, Kasprzyk D. The theory of reasoned action and the theory of planned behavior. In: Glanz, K, Rimer BK, Lewis FM. editors. *Health behavior and health education: Theory, research, and practice.* 3rd ed. San Francisco: Jossey-Bass; 2002. pp. 67-98.
- Nafissi N, Saghafinia M, Motamedi MH, Akbari ME. A survey of breast cancer knowledge and attitude in Iranian women. *J Cancer Research and Therapeutics.* 2012;8(1):46–9.
- Ng SH, Chan KH, Lian ZY, Chuah YH, Waseem AN, Kadirvelu. Reality vs illusion: knowledge, Attitude and Practice among diabetic patients. *Int J Collab Res Intern Med Public Health.* 2012;4(5): 723.
- Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. *Diabetes Care.* 2001 Mar; 24(3):561-87.
- Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. *Diabetes Care.* 2002 Jul; 25(7):1159–71.
- Prochaska JO, Redding CA, Evers KE. The transtheoretical model and stages of change. In: Glanz K, Rimer BK, Lewis FM. editors. *Health behavior and health education: Theory, research, and practice.* 3rd ed. San Francisco: Jossey-Bass; 2002. pp.99-120
- Raj PC, Angadi MM. Hospital-based KAP study on diabetes in Bijapur, Karnataka. *Indian J Med Spec.* 2010;1(2):80–3.
- Shah VN, Kamdar PK, Shah N. Assessing the knowledge, attitudes and practice of type 2 diabetes among patients of Saurashtra region, Gujarat. *Int J Diabetes Dev Ctries* 2009 Jul-Aug;29(3):118–22.
- Tilly KF, Belton AB, McLachlan JC. Continuous monitoring of health status outcomes: Experience with a diabetes education program. *Diabetes Educator.* 1995 Oct;21(5):413-9.
- Upadhyay DK, Mohamed IM, Alurkar VM, Mishra P, Palaian S. Evaluation of knowledge, attitude, and practice of newly diagnosed diabetes patients - a baseline study from Nepal. *Int J Pharm Teach Pract.* 2012; 3(2): 245-252.
- Van Geertruyden, JP, Ntakirutimana D, Erhart A, Rwagacondo C, Kabano A, D'Alessandro U. Malaria infection among pregnant women attending antenatal clinics in six Rwandan districts. *Trop Med Int Health.* 2005 Jul;10(7):681-8.
- Vasconcelos C, Pinheiro A, Casteol A, Costa L, Oliveira R. Knowledge, attitude and practice related to the pap smear test among users of a primary health unit. *Rev. Latino-Am.* 2011 Jan-Feb;19(1): 97-105.
- Venkataraman K, Kannan A, Kalra O, Gambhir J, Sharma A, Sundaram K, Mohan V. Diabetes Self-Efficacy strongly influences actual control of diabetes in patients attending a tertiary hospital in India. *J Community Health.* 2012;37(3): 653-662.
- Vimalavathini R, Agarwal SM, Gitanjali B. Educational program for patients with type-1 diabetes mellitus receiving free monthly supplies of insulin improves knowledge and attitude, but not

- adherence. *Int J Diabetes Dev Ctries.* 2008 Jul-Sep; 28(3): 86-90.
- Wahed T, Kaukab S, Saha NC, Khan I, Khanam F, Chowdhury F, Saha A, Khan A, Siddik A, Qadri F, Uddin J. Knowledge of, attitudes toward, and preventive practices relating to cholera and oral cholera vaccine among urban high-risk groups: findings of a cross-sectional study in Dhaka, Bangladesh. *BMC Public Health.* 2013 Mar 19; 13:242-54
- Walker RJ, Smalls BL, Hernandez-Tejada MA, Campbell JA, Davis KS, Egede LE. Effect of diabetes fatalism on medication adherence and self-care behaviors in adults with diabetes. *Gen Hosp Psychiatry.* 2012 Nov-Dec; 34(6):598-603
- Wan TTH. A transdisciplinary approach to health policy research and evaluation. *Int J Public Pol.* 2014 10(4-5):161-77.