



Swedish Science Pioneers
Developing World Journal Series

Journal of Clinical Research & Governance

www.jcrg.sciencepub.se



Review Article

The Impact of Diabetes Nurse Case Management on Hemoglobin A_{1c} (HgbA_{1c}) and Self-Efficacy of Patients with Type 2 Diabetes: A Systematic Review

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Keywords:

case management
Nursing diabetes case management
Type 2 diabetes
Self-efficacy
Clinical outcomes
HemoglobinA_{1c}
HgbA_{1c}

Received: 2013-07-29

Accepted: 2013-12-20

DOI: [10.13183/jcrg.v3i1.69](https://doi.org/10.13183/jcrg.v3i1.69)

Abstract

Purpose: The aim of this systematic review is to present current knowledge on diabetes nurse case management and assess its effects on Hemoglobin (HgbA_{1c}) and patient self-efficacy.

Methods: An electronic search was conducted for the period of 1998 to 2013 using databases of the scientific literature in Medline, PubMed, Cochrane EPOC, Cumulative Index to Nursing & Allied Health Literature database guide (CINAHL), and PsychInfo using a range of keywords and a variety of combinations of Medical Subject Headings (MeSH) terms. Information gathered was evaluated for relevance.

Results: Eleven studies that met the inclusion criteria were used in this systematic review. In several studies considered in this review, diabetes nurse case management had positive effects on patient's HgbA_{1c}. It reduced HgbA_{1c} and improved HgbA_{1c} values compared to standard care. Moreover, in several studies diabetes case management improved type 2 diabetes patients' self-efficacy.

Conclusion: Diabetes nurse case management is necessary for countries with increasing prevalence of diabetes 2 such as Saudi Arabia and the states of the Co-operation Council for the Arab States of the Gulf as it will help improve the quality of care provided to patients and improve their clients' health outcomes. Overall this study provides evidence that case management has positive effects on type 2 diabetic patients' HgbA_{1c} and self-efficacy.

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Introduction

Type 2 diabetes results from human body resistance or ineffective use of insulin. The disease of type 2 diabetes mellitus is growing dramatically globally [1,2]. There are 347 million people who have diabetes, and type 2 diabetes comprises 90% of people with diabetes worldwide. According to the World Health Organization [1] diabetes will be the 7th leading cause of death in 2030.

Research evidence shows that diabetes is costly and overwhelming to health care systems [3,4,5]. According to the American Diabetes Association (ADA) [3], the total annual economic cost of diabetes in the U.S. in 2012 was \$245 billion, with expenditures for diabetic patients at a rate 2.3 times higher than individuals who do not have the disease. However, health care systems are still inadequately prepared to meet the

challenges of chronic disease care [4]. Diabetes is associated with high morbidity and mortality. Nevertheless, numerous studies have shown the effectiveness of case management in preventing or delaying the progression of co-morbidities associated with diabetes [5,6,7,8].

Although case management has been studied widely in relation to a variety of clinical outcomes including Hemoglobin (HgbA_{1c}) [9,10,11,12], inadequate attention has been paid to the impact case management has on type 2 diabetes patients' self-efficacy. Therefore, there is a gap of knowledge that needs to be addressed further and in particular within international settings. Specifically, there is a striking growth of the disease in the states of the Co-operation Council for the Arab States of the Gulf (GCC). Saudi Arabia has a 16.8% prevalence of type 2 diabetes [13]. The GCC countries

have recorded some of the highest incidences of type 2 diabetes in the world [13,14]. More strikingly is that the projections for the number of people who will have diabetes will increase by 94% in the period between 2010 and 2030 in the Middle East-North Africa [15,16].

Numerous studies have demonstrated the effectiveness of Diabetes nurse case management (DNCM) in improving clinical outcomes, self-monitoring of blood glucose, and self-efficacy [11,12,17,18,19,20]. The aim of this systematic review is to acquire research knowledge on DNCM and compile the best possible research evidence to develop DNCM evidence-based practice in Saudi Arabia and the GCC. This review can assist healthcare providers, health policy makers, and health administrators in their efforts to improve the quality of care provided to patients and health outcomes.

The research questions that this systematic review will answer are:

What impact does DNCM have on Hemoglobin (HgbA_{1c}) of patients with type 2 diabetes?

What impact does DNCM have on self-efficacy on patients with type 2 diabetes?

Methods

Data Sources and Search Strategy

We conducted an electronic search for the period of 1998 to 2013 using databases of the scientific literature in Medline, PubMed, Cochrane EPOC, Cumulative Index to Nursing & Allied Health Literature database guide (CINAHL), and PsychInfo. The search terms included case management, nursing diabetes case management, type 2 diabetes, self-efficacy, clinical outcomes, and HgbA_{1c}. As a result of database structure discrepancies and key words, a variety of combinations of Medical Subject Headings (MeSH) terms were used in this study, including "case management" AND "Diabetes Mellitus, Type 2+"; "case management" AND "Hemoglobin A, Glycosylated" AND "Diabetes Mellitus, Type 2+". In addition, the following MeSH terms were used: "case management" AND "Diabetes Mellitus, Type 2+" AND "self-efficacy or self efficacy". However, when using PubMed the researchers filtered the search by selecting "randomized controlled trial" as the article type, and free full-text, and the publication dates ranged from (01,01,1998-01,01,2013). Furthermore, the CINAHL database was searched using key words such as "case management AND Type 2 diabetes" AND "nurs*" AND "Hemoglobin A" AND "self-efficacy". Further, the researchers selected the source type as academic journal, using major headings "case management"; "hemoglobin A, glycosylated"; and "self-efficacy or self efficacy". Cochrane databases were searched for randomized controlled trials. We added the words "randomised" OR "randomized"; "prospective" and "retrospective" studies. PsychInfo was searched by using keywords and filtering by the age group "adulthood (18 years and older)", "methodology (quantitative study)", peer-reviewed journals, and indicating the date of publications 1998-2013. A systematic literature search was conducted to identify published and unpublished primary studies with data on the impact of case management on the HgbA_{1c}, and self-efficacy. All peer-reviewed journal articles related to the impact of diabetes case management on patient HgbA_{1c} and self-efficacy that were published in English were included in this review.

Inclusion and Exclusion Criteria

Randomized control trials, prospective and retrospective studies evaluating the impact of case management on the clinical outcome HgbA_{1c}, and/or self-efficacy were included in this systematic review. However, case and pilot studies, case-control studies, review articles, letters, and non-English articles were excluded. Also, studies that included HgbA_{1c} as a secondary outcome were excluded. Further, studies were excluded if they did not include self-efficacy, and/or HgbA_{1c} as the clinical outcome of interest to be affected by diabetes nurse

case management. Studies, however, were included if the intervention of diabetes nurse case management involved planning, coordinating, and providing healthcare through facilitating options and services for meeting type 2 diabetes patients' health needs.

Further, the patients in the reviewed studies had to include only adults aged 18 years old and older, with type 2 diabetes. The outcome measures were HgbA_{1c} with a cut point above the threshold 6.5%, and preference was given to studies using the most recent ADA diagnostic criteria, and self-efficacy in diabetes management.

Data Extraction

Studies were grouped based on the diabetes case management intervention approach used. Information on study quality, study characteristics, and the impact the DNCM had on HgbA_{1c} and self-efficacy were extracted from each selected paper. Study design, outcome measures, and the effect of the intervention employed by each study were examined. The sampling frame, recruitment methods, and sample size were examined in each reviewed study.

Results

We identified 13,183 studies using the key word case management. Nevertheless, when specific key words, such as case management and diabetes, were used, 361 studies were retrieved. The use of more precise key words, including case management, diabetes, and HgbA_{1c}, led to 27 studies. When the following key words: case management, type 2 diabetes, HgbA_{1c} and self-efficacy were included; the search resulted in 21 articles. Finally, the search retrieved 12 articles by including the following key words, case management, type 2 diabetes, HgbA_{1c}, self-efficacy, and adults (≥18years old). Of these, only eleven studies met the inclusion criteria (figure 1).

Case Management

In nursing, the term case management was first used in the 1850s [21]. According to Jinnett, Alexander and Esther [22], case management was introduced to help patients in navigating the service system and obtaining needed services. The case Management Society of America defines case management as "a collaborative process of assessment, planning, facilitation and advocacy for options and services to meet an individual's health needs through communication and available resources to promote quality cost-effective outcomes" [23]. In addition, the American Nurses Association defines Nurse case management as a "dynamic and collaborative approach to providing and coordinating healthcare services to a defined population. It is a participative process to identify and facilitate options and services for meeting individuals' health needs, while decreasing fragmentation and duplication of care and enhancing quality, cost-effective clinical outcomes" [24].

Case management has been applied to different chronic diseases such as diabetes, heart failure, psychiatric disorders, and geriatrics [22,25]. Case management effectiveness has been examined in different chronic conditions and was found to be efficient [26]. There are five essential features that case management encompasses: identification of eligible patients, assessment, development of an individual care plan, implementation of the care plan, and monitoring of outcomes. Usually patients are identified in case management due to their poor outcomes, poor coordination of services, and excessive utilization of recourses. Consequently, diabetes patients are in need of services provided by case managers due to their poor glycemic control and/or co-morbidities [26]. Research evidence shows that diabetic patients who receive diabetic case management have better clinical outcomes than patients who do not receive case management intervention [11,12,19].

Case management and Hemoglobin (HgbA_{1c})

Hemoglobin (HgbA_{1c}) is one of the most frequently

evaluated clinical outcomes in relation to case management. HgbA_{1c} is sometimes referred to as glycosylated or glycosylated hemoglobin or glycohemoglobin. According to the ADA [3], the HgbA_{1c} test measures the average blood glucose control for the past two to three months. The HgbA_{1c} test should be performed at least two times a year in patients who are meeting treatment goals, and quarterly in patients whose therapy has changed or who are not meeting glycemic goals. It is determined by measuring the percentage of glycated hemoglobin, or HgbA_{1c}, in the blood. And these recommendations have been adopted by the World Health Organization (WHO) [1].

Recent research evidence shows positive effects of diabetic case management on patient's HgbA_{1c}. For instance, Ishani et al. [6] conducted a randomized control trial in the U.S. and utilized nursing case management with a therapeutic algorithm. This study found that nursing case management significantly (p -value= 0.04) improved the HgbA_{1c} values compared to standard care. In another randomized control trial conducted in the U.S. by Aubert et al. [27], the nurse case manager followed written diabetes management algorithms. In this study, the researchers found that patients in the nurse case management group had mean decreases of 1.7 percentage points in HgbA_{1c} values in comparison to patients in the usual care group who had mean decreases in HgbA_{1c} of only 0.6 percentage points ($P < 0.001$). Wolf et al. [18] conducted a 12-month randomized controlled trial with 147 type 2 diabetes patients. This study revealed an improvement in participants' HgbA_{1c} levels as a result of the case management intervention (p -value = 0.02).

Furthermore, a prospective study conducted in Northern Taiwan Regional Hospital for the purpose of measuring the effectiveness of hospital based diabetes case management; found that the implementation of diabetic case management had significantly improved the HgbA_{1c} levels ($P < 0.0001$) [12]. Moreover, Wilson et al. [19] conducted a retrospective cohort design in the U.S. to compare a treatment group who received case management services to control groups. In this study, the nurse case managers used active outreach, provider referral, and patient self-referral to connect with patients. The nurse case managers encouraged patients to continue to see their primary care providers, attend group classes, individual case manager follow-up, and/or support groups based on a learning needs assessment and in keeping with the patient's learning preferences. Furthermore, the nurse case managers scheduled primary care visits and specialty services referrals and distributed blood glucose self-monitoring equipment and supplies. This study found that case management improved HgbA_{1c} levels significantly compared to the control group by -0.52 units vs. -0.17 units in the control groups ($P < 0.006$).

Mullen and Kelley [10] in their retrospective study using a Diabetes Clinic Management Protocol and Individual Diabetes Disease Case Management Protocol found a reduction of HgbA_{1c} as a result of the positive effect of case management. This study found significant changes ($P < 0.005$) in the HgbA_{1c} mean value of participants admitted to the case management program at different points: admission into the case management program and time of discharge (p -value=0.00), and admission and six months following discharge from the case management program (p -value=0.00). However, in the nursing literature there is a contradiction in some of the findings. Krein et al. [8], for example, found no significant difference between case management intervention and control patients. In this study, two nurse case managers worked with both the patients and their primary care providers. The nurse case managers monitored and coordinated care for the patients through the use of telephone contacts, collaborative goal setting, and treatment algorithms. The study found that there are nonsignificant differences in HgbA_{1c} levels between case management and control groups (p -value = 0.61). Further, the study found no significant difference between baseline HgbA_{1c} levels and the intervention (p -value = 0.86), suggesting that the case management intervention did not result in

improvement of patient outcomes. In addition, Piette et al. [28] found in their study that there was no significant difference in HgbA_{1c} between groups at 12 months, controlling for the baseline insulin use difference (p -value = 0.1). These findings indicate that further studies are needed to evaluate the impact of DNCM on HgbA_{1c}.

Case Management and Self-Efficacy

Self-efficacy is a known predictor for behavior change. Self-efficacy is the individuals' belief that difficulties in any task can be overcome [29]. Researchers agree that patient self-knowledge and self-confidence regarding diabetes and its treatment is a reliable factor in the improvement of conditions and self-management of the disease [30]. The concept of self-efficacy is important for patients with type 2 diabetes because it can influence patients' confidence to adhere to treatment, and improves self-management [31].

Moreover, studies found that diabetes case management has a positive impact on psychosocial variables such as depression, anxiety, and social support, which in turn relate to hyperglycemia, complications, adherence, and quality of life [32, 33]. Studies also have revealed that self-efficacy has been shown to be an important predictive variable in initiating and continuing management behaviors of diabetes [34]. Further, Wolf et al. [18] studied diabetes case management and examined its impact on psychosocial outcomes. This study found that case management improved patients' self-efficacy. Sadur et al. [17] assessed the effect of diabetes case management on psychosocial outcomes and found improvements in patients' self-efficacy. In fact, seven of the eight measures of self-efficacy improved significantly in the intervention group. In addition, diabetes case management delivered using telemedicine resulted in significantly improved diabetes self-efficacy for elderly diabetic patients [20]. In this study, participants received case management through a home telemedicine unit to upload blood glucose readings, videoconference with a nurse case manager and dietitian routinely every 4 – 6 weeks, and access to educational materials. Further, there were supportive interactions that tailored participants' needs. In this study (The randomized Informatics for Diabetes

Education and Telemedicine (IDEATel) trial), the intervention group improved significantly ($p < 0.0001$) in diabetes self-efficacy compared to the control group. This indicates that self-efficacy is important as it relates to better diabetes self-care, lower health risk, and better overall health [20]. Furthermore, in a randomized controlled trial, testing the effectiveness of nurse case management intervention on type 2 diabetes, patient outcomes were enhanced, including patients' self-care for type 2 diabetes [35].

Table 1 summarizes the results of the selected studies in this systematic review.

Conclusion

The researchers conducted this systematic review to present the current knowledge on diabetes nurse case management and assess its effects on HgbA_{1c} and patient self-efficacy. This systematic review provides evidence for the effectiveness of diabetes case management which can significantly contribute to the achievement of the target values of clinical outcomes (HgbA_{1c} levels) recommended by the ADA. Research evidence shows positive effects of diabetic case management on patient's HgbA_{1c}. Moreover, diabetes case management has beneficial effects on diabetes patients' self-efficacy which is a critical component in improving patient health outcomes. In this review, however, we found contradicting evidence in the effectiveness of DNCM on HgbA_{1c} indicating possible variations in the interventions and approaches used to improve patient HgbA_{1c} related outcomes. Further studies are needed to evaluate the content of interventions implemented by DNCM and its impact on HgbA_{1c}.

The current systematic review has several limitations. The

electronic searches of related studies were not exhaustive; thus some studies may not have been found. In addition, by restricting the search to only English language publications, we may have excluded some European or Asian studies, which

might have a significant input to this review. Despite these limitations, this review provides a comprehensive assessment of the literature in regards to the current knowledge on DNCM and its effects on HgbA_{1c} and patient self-efficacy.

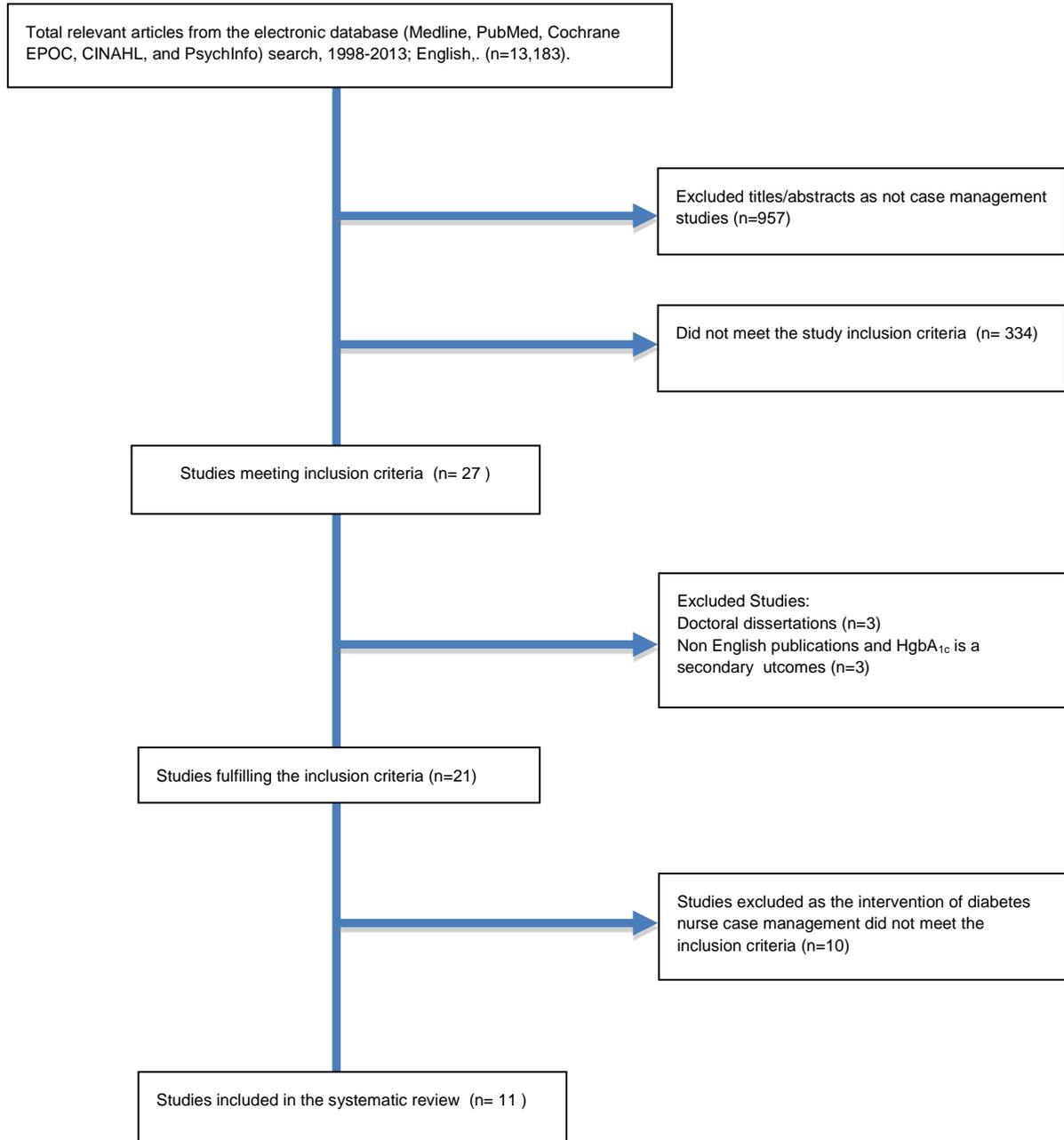


Figure 1: A flow diagram describing the study selection criteria for the present systematic review related to diabetes nurse case management for patients' HgbA_{1c} and self-efficacy.
*n= number of studies.

Diabetes mellitus requires an ongoing adjustment by health care providers, patients, and interactions with the health care system. Diabetes is a multifaceted disorder that has multiple medical, psychosocial, and economic consequences. To improve these consequences, diabetic patients need a healthcare system that enables them to meet multiple self-care needs. In fact, diabetes nurse case management is necessary for countries with increasing prevalence of type 2 diabetes such as Saudi Arabia and the GCC [14, 36] as it will help improve the

quality of care provided to patients and their health outcomes. Future research that examines the benefits of case management should include measurement of psychosocial outcomes. In conclusion, this systematic review sheds light on the importance of nurse case management in the diabetic population as it will help improve many aspects of the disease such as HgbA_{1c} levels, and prevent complications of diabetes. This can be done by identifying eligible patients for diabetes case management, assess each patient's needs, and develop,

implement, and monitor individual care plans. This in turn will reduce healthcare costs, which is imperative in a time of increasing healthcare expenditures dramatically.

Recommendations: The results of this systematic review should encourage healthcare systems such as Saudi Arabia and the GCC to consider establishing diabetes nurse case management interventions to provide better quality of care to their diabetic patients and less utilization of health care services which is cost effective. Furthermore, by having a standard diabetic nurse case management interventions may help these countries to develop diabetic case management programs to serve the needs of the growing number of diabetic patients. This standardized intervention will help health care providers in the selection criterion of eligible patients and identifying their needs and priorities. It also will help in developing training programs for the nurse case managers to improve their skills and experiences when dealing with such patients, which may help in improving type 2 diabetic patients' health outcomes. Further, it will increase access to care for diabetic patients with poor glycemic control and improve glycemic outcomes. Thus, we strongly recommend the implementation of diabetic nurse case management based on the strong evidence provided in this systematic review of its effectiveness in improving patients' HgbA_{1c} and self-efficacy.

Conflict of interests: The authors declare no Conflict of interest.

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Table 1. A Summary of the Studies Selected for This Systematic Review: The Impact of Diabetes Nurse Case Management on Hemoglobin (HgbA_{1c}) and Self-Efficacy of Patients with Type 2 Diabetes.

Author	Year	Design	Sample	Results
1. Ishani, A., Greer, A., Taylor, B., et al.	2011	Randomized control trial.	N= 556 Intervention patients received case management (n=278) compared to usual care (n=278) over a 1 year period.	Significant improvement in HgbA _{1c} in the intervention group, P=0.04.
2. Aubert, R., Herman, W., Waters, J., et al.	1998	Randomized, controlled trial.	N= 138, 17 patients with type 1 diabetes mellitus and 121 patients with type 2 diabetes mellitus. Nurse Case Management Group (n = 71); Usual Care Group (n = 67).	Patients in the nurse case management group had mean decreases of 1.7 percentage points in HgbA _{1c} values; patients in the usual care group had decreases of 0.6 percentage points in HgbA _{1c} values (P< 0.01).
3. Wolf, A.M., Conaway, M.R., Crowther, J.Q., et al.	2004	A randomized controlled trial.	(N=147). Participants were randomized to lifestyle case management or usual care.	Case management resulted in reduced HgbA _{1c} level (P = 0.02) compared with usual care.
4. Chang, H., Chang, Y., Lee,	2007	Prospective design	Sixty subjects diagnosed with type 2	Significantly improved the values of HgbA _{1c} (P < 0.0001).

S., et al.		followed the patients from enrollment to one year.	diabetes. Patients were at least 18 years old.						
5.Wilson, C., Curtis, J., Lipke, S., et al.	2005	Retrospective cohort design.	N=1070 n=793 had a case manager and n=277 did not have a case manager .	The change in HgbA _{1c} in the treatment group is significantly higher than in those in the control group (-0.52 units with vs.-0.17 units without, P< 0.01).					
6.Mullen, B., & Kelley, P.	2006	Retrospective design.	A convenience sample of N= 53 medical records was studied.	Significant reductions in HgbA _{1c} values (p< 0.005) from admission to discharge were achieved, which the patients maintained 6 months following discharge.					
7.Krein SL, Klamerus ML, Vijan S, et al.	2004	A Randomized Trial	(N=246) veterans with type 2 diabetes and baseline of HgbA _{1c} levels at 7.5%.	Mean discharge HgbA _{1c} levels for both case management and control patients were over 9% and the mean change in levels was not significantly different between groups (P=0.61).					
8.Piette J, Weinberger M, McPhee S, et al.	2002	Randomized controlled trial	(n=280) English- or Spanish-speaking adults with type 2 diabetes who were using hypoglycemic medications.	Follow-up HgbA _{1c} levels were 0.3% lower in the intervention group (P=0.1).					
9-Sadur CN, Moline N, Costa M, et al.	1999	A randomized controlled trial	Intervention (n=97) and control groups (n=88).	Intervention (n = 80) Control (n = 62)					
				Before After Before After P value					
				Self-efficacy (10-point scale)					
				-Follow a low-fat diet	6.6	6.7	6.7	6.6	6.7
				-Exercise regularly	7.3	7.0	6.8	7.3	7.0
				-Monitor blood glucose regularly	8.3	8.8	8.0	8.3	8.8
-Balance your diet to keep your blood glucose in control	6.3	7.1	6.0	6.3	7.1				
-Recognize and treat low blood glucose	7.4	8.6	8.0	7.4	8.6				
-Keep your blood glucose in control when you are sick	6.4	7.3	6.4	6.4	7.3				
-Talk to your physician about your concerns	8.2	8.8	7.7	8.2					
-Express your feelings about having diabetes to family and friends	7.9	8.5	7.8	7.9	8.5				
				Intervention group Control group P value					
				(n=82) (n=74)					
				HgbA _{1c} Post intervention					
				8.18 9.33 <0.0001					
				Change in HgbA _{1c}					
				-1.30 -0.22 <0.001					
10.Trief, P., Teresi, J., Izquierdo, R., et al.	2007	Randomized Informatics for Diabetes Education and Telemedicine (IDEATel) trial	(N= 1,355)	Intervention subjects improved significantly (versus control subjects) in diabetes self-efficacy (P < 0.0001).					
11. Stuckey HL, Dellasega C, Graber NJ, et al.	2009	A randomized controlled trial	Type 2 diabetes (N=549) patients with a nursing case management intervention group (n=276) and a control group (n=273).	The treatment group receiving the nursing case management intervention (n=276) reported a mean HgbA _{1c} of 8.29±2.11, and the control group (n=273) reported a mean HgbA _{1c} of 8.50±2.16.					
				Baseline Summary of Diabetes Self Care Activities (SDSCA) data					
				Categories of SDSCA	Categories of SDSCA				
				1. General diet, compliance with					
				2. Specific diet, compliance with					
				3. Exercise					
				4. Self-monitoring of blood glucose					
				5. Foot care					
				6. Cigarette smoking					