



Improvement of Adherence to Treatment in People with Diabetes: An Iranian Perspective

Seyedeh Narjes Mousavizadeh¹, Tahereh Ashktorab^{2*}, Mitra Zandi³

¹PhD of Nursing, Student Research Committee, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

²Professor, Department of Medical-Surgical Nursing, Nursing and Midwifery School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

³Assistant Professor, Department of Medical-Surgical Nursing, Nursing and Midwifery School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

DOI: 10.24896/jrmds.20175613

ABSTRACT

Essential part of diabetes control is adherence to treatment regimen. Improvement of adherence to treatment is a growing priority for health care systems, which has been less considered in Iran. This study evaluates perspectives of Iranian people with diabetes towards improving and facilitating factors of adherence to treatment. This was a qualitative study in which 21 men and women with diabetes were recruited by using purposive sampling. Data was collected by in-depth semi-structured interviews. Data was analyzed by content analysis. The concepts which were reported in experience of the patients as factors facilitating performance and motivating adherence to treatment included individual readiness involving effective awareness, financial strength and psychological capitals, warning supportive resources involving supportive friends, peer observation warning, supportive family and treatment team support. Focus on patient support from health centers and community, family involvement as a major source of support, self-care training and encouragement can be considered as solutions for stimulating behavior change and motivating patients to adhere to treatment and prevent irreversible complications of diabetes in health-care plans.

Key words: Patient Adherence, Diabetes Mellitus, Nursing, Qualitative Study

HOW TO CITE THIS ARTICLE: Seyedeh Narjes Mousavizadeh, Tahereh Ashktorab, Mitra Zandi, Improvement of Adherence to Treatment in People with Diabetes: An Iranian Perspective, J Res Med Dent Sci, 2017, 5 (6):71-78, DOI: 10.24896/jrmds.20175613

Corresponding author: Tahereh Ashktorab

Received: 08/07/2017

Accepted: 20/11/2017

INTRODUCTION

Currently, diabetes is a global crisis and one of the biggest health problems in all countries. There are 366 million people worldwide with diabetes and 280 million people at risk of diagnosed diabetes. It is predicted that 522 million people will suffer from diabetes and 398 million people will be exposed to the risk of diabetes by 2030; meanwhile, the share of developing countries is

higher [1]. In Iran, diabetes is the most common non-communicable disease, accounting for 4.5 to 5 million patients; it is predicted that more than 8

million people will suffer from diabetes by 2030 [2]. In addition to this increase in prevalence, the burden caused by complications of diabetes is substantially increasing [3]. Annually, more than 4 million people worldwide die of diabetes and tens of millions of people suffer from its disabilities and life-threatening complications such as heart attack, stroke, kidney failure, blindness and amputation [1], while its complications are potentially preventable [3]. The significant role of patient education and promotion of self-care has been recognized as a key component in management of chronic diseases and is associated with improved patient outcomes [4]. One component of self-care is adherence to the recommended treatment [5].

The World Health Organization (WHO) introduced the term adherence for use in chronic disorders such as diabetes and defined it as behaviors such as taking the prescribed medications and following the diet, healthy lifestyle and recommendations of health care providers [6]. Adherence to treatment is associated with reduction in complications, mortality and economic burden of disease [7, 8]. Despite strong clinical recommendations to patients with diabetes to adopt a healthy lifestyle, adherence to treatment is quite poor [9]. Poor patient adherence to treatment has been one of the most important contemporary concerns and complex clinical problems in the past two decades and focus of health care workers, researchers and international symposia [10]. Failure to adhere to the recommended treatment is one of the reasons for treatment failure, increased complications, prolonged treatment and increased costs of health care [11].

Little is known about why Iranian patients with diabetes type II particularly do not adhere to their treatment, what the treatment team should do about this, how the patients think and how they feel. Therefore, the increased qualitative research on this can help to understand insights, beliefs and attitudes, interactions of patients. Recognition of experience and understanding of this group of patients about adherence to treatment can lead to identification of factors which influence the improved adherence to treatment and self-care behaviors of these patients. Finally, quality of life of these patients can be improved through proper planning and effective interventions to facilitate and promote adherence to treatment and reduce personal, familial and social complications of the disease.

MATERIALS AND METHODS

This qualitative study was conducted to identify effective factors on adherence to treatment and its improvers in patients with diabetes. The subjects included 21 patients with diabetes type II diagnosed for at least 1 year who were able and willing to share their life experiences regarding diabetes. These patients were selected purposively with maximum diversity in terms of age, gender, length of disease, family history, literacy level, place of residence (urban or rural) and type of treatment. Interviews were conducted in endocrinology of the hospital, Diabetes Association of Iran, doctor's office, clinic or houses of diabetic patients. Data was collected by in-

depth semi-structured interviews for six months from December 2015 to July 2016. The time and place of interviews were determined by considering conditions and willingness of the patients. The interviews were recorded if the participants allowed. The subjects were interviewed once or twice for 40-90 minutes.

Conventional content analysis was used for data analysis [12]. The interviews were transcribed verbatim immediately at last 24 hours after and reviewed several times to understand the content correctly. Semantics were recognized, isolated and labeled to encode the text. By comparison of the codes in terms of similarities and differences, the similar codes were integrated and the codes which implied a single concept were placed in a same class. Classification and development of the classes continued until the themes were identified by careful and deep consideration and comparison of the classes.

To validate the data, quality control was used by the participants to examine fit of the findings. In addition to debate, exchange of views and consensus with consultants and supervisors in various stages of the study, the used methodology, objective of the study and the findings were presented to a fellow researcher familiar with qualitative research to confirm logical procedure. In cases where the findings were not confirmed, the concepts and the findings were reviewed and presented to the fellow researcher. Moreover, the long-term professional experience of the author with the considered phenomenon and the patients with diabetes was helpful.

Authorized by the Research Ethics Committee of the Shahid Beheshti University of Medical Sciences, all ethical considerations such as data confidentiality, right to withdraw, written informed consent, anonymity and time and place of the interviews set by agreement of the participants were taken into account.

RESULTS

The study was based on data obtained from 21 patients with diabetes type II, including 9 men and 12 women aged 36 to 69. Literacy level of the participants ranged from illiteracy to PhD. Length of the disease varied from 2 to 16 years.

The concepts raised as driving and motivating factors of adherence to treatment included individual readiness involving effective awareness, financial strength and psychological

capitals; warning supportive resources involving supportive friends, peer observation warning, supportive family and treatment team support.

Individual Readiness

One of the factors which increase sensitivity and improve collaboration of the patient in adherence to treatment is individual readiness. Knowledge and previous experiences of patients with the disease, financial strength and personal abilities facilitate adherence to treatment and significantly reduce adaptation to treatment.

Effective awareness: the patients who are familiar with diabetes due to previous family history or have high health literacy due to their relevant education or previous knowledge received from training understand the risks and are more sensitive to adherence to treatment. For example, a 46-year old woman with diabetes claimed that experience of death from complications in relatives changed her behavior and adherence to treatment: 'my aunt and my father both had diabetes and died of diabetes. I saw their miserable life. When I found out that I had diabetes, I was afraid ... I'm always taking precaution to not be like them (P₃)'. A 47-year old woman with diabetes said: 'my mother had diabetes; because of her, I had participated in classes before ... when I found out that I had diabetes, I knew what is going to happen ... I constantly exercise and I keep my diet (P₆)'.

Financial strength: the participants claimed that good diabetes management imposes additional financial burden on them and their families and costs more than usual life expenses. Good financial strength or financial support of others facilitate adherence to treatment. A 49-year old man with diabetes said: 'many things can be done with money, you know. For example, I moved to a place near the hospital to visit the doctor faster ... I'm right on time when the diabetes clinic is held once or twice the week. I use all the training courses (P₂₁)'. Regarding the effect of facilities in facilitating adherence to treatment, a 56-year old man with diabetes said: 'I use the insulin pump that my family brings it from the abroad. I do not have to inject ... when people can use these devices they can be more comfortable. When the patient is not bothered for his treatment, he will not quit the treatment (P₃)'.

Psychological capitals: another factor which leads to adherence to treatment is personal

abilities such as determination and perseverance, tenacity, hard work, self-discipline, creativity in self-care, conscious use of available resources. A 52-year old man with diabetes said: 'the patient should be self-disciplined and single-minded; the patients should exercise, eat food and take medications on time ... the patient should follow treatment and learning ... the patient should use facilities provided for diabetics and seek for more facilities (P₈)'. A 48-year old woman with diabetes said: 'I am generally hard-working and strong; I'm used to hard works. That is why self-care and adherence to treatment is easy for me (P₁₇)'.

Warning Supportive Resources

One of the most important facilitators of adherence to treatment is warning supportive resources. Supportive resources are considered as a promising refuge of the patients. Warning resources are objective warnings which encourage self-care and adherence to treatment without experiencing complications of diabetes. These resources are discussed in the form of friends, peers, family and treatment team.

The patients discussed about the effect of their friends who encouraged them to adhere to treatment. For example, a 58-year old man with diabetes said: 'my friends formed an exercise group for me. We exercise several days a week (P₁₁)'.

Moreover, the participants claimed that the complications observed in peers and fear of the similar future was a warning factor for adherence to treatment. A 38-year old man with diabetes said: 'when I saw people who became obsolete due to advanced diabetes and could not handle their personal affairs, I tell myself I should not experience all these problems. I see their problems; then, I should do something to avoid this (P₁₄)'. A 44-year old woman with diabetes said: 'when I see diabetics whose legs are cut-off or their eyesight is not good, I become afraid of my future. I follow my diet; it is not difficult. It is difficult to experience all those problems (P₁₀)'.

Moreover, a majority of participants claimed that family support, particularly spouses, facilitates adherence to treatment. A 49-year old woman with diabetes said: 'my husband follows my treatment; he is even more concerned about my health than myself. He does not let me to neglect the treatment (P₁₆)'. A 67-year old man with diabetes said: 'my wife does not allow me to eat something else than my diet. She always eats unsalted and fat-free food; she avoids desserts and

sweets. Moreover, she hikes with me every afternoon (P₁₅)’.

Cooperation of the family members facilitates adherence to diet as the most difficult aspect of treatment. Cooperation of the family members in following health behaviors leads to adherence to treatment as a routine. For example, a 48-year old man with diabetes said: ‘everyone in our house now follows the diet; we all avoid fats and oils and eat grilled and boiled foods. We eat vegetables. We drink tea without sugar. We do not eat sweets and chocolates at all ... when everyone in the house eats like this, you will not feel that you have diet; you think this is a routine (P₇)’.

Treatment team support: treatment team support involving interaction in care, educational services, incentive practices, follow-up and good relationships with the patient are main factors of self-care and adherence to treatment.

Participants pointed out the essential interactions in care which influence the disease course. A 45-year old woman with diabetes said: ‘it is important to ask opinions of the patients; for example, the nutritionist or the nurse should know the patient completely including income, facilities and interest to prescribe a diet for the patient; the nutritionist or the nurse should not prescribe a diet which cannot be afforded by the patient. The patients are unique; therefore, their treatment should be specific for them (P₃)’.

Moreover, the participants noted positive interactions between the treatment team and the patient based on responsibility and involvement of the treatment team in consulting and helping the patient. A 36-year old woman with diabetes said: ‘some nurses and doctors pay special attention to their patients; they spend time for the patient and ask the patient to involve in their personal affairs. This way, the patients learn to do their things themselves; this makes everyone more comfortable (P₁₂)’.

Moreover, the satisfactory relationship between treatment team and the patient was very important for the patients. The patients believed that the good relationship between treatment team and the patient and support of the treatment team is considerably associated with the increased patient trust to the medical system and next follow-ups and increased adherence to treatment. A 54-year old woman with diabetes said: ‘it is very

important how a doctor communicates with the patients. How can it be helpful when you ask a doctor a question and he does not answer correctly and just prescribes medicine? When he does not even try to see what is the problem? For example, my doctor talked to me to understand the problem in my eye and my leg. He spends time for his patients. I have visited him for several years. I do whatever he says (P₅)’.

Moreover, the patients also noted that services such as follow-up and reminding cares and time of visits by the medical center increase responsibility and loyalty of the patients to the tasks determined by the treatment team. A 56-year old man with diabetes said: ‘services provided by some hospitals are very effective. When you see the personnel constantly follow up, make contact and check the visits, or see if you take medications at home ... you will be ashamed of yourself to not adhere to the treatment (P₁)’.

Reward appeal and external reinforcement are early facilitators of adherence to treatment which increase morale of the patients through positive medical feedbacks and awareness of the improved health and encourage continuation of disease management. A 44-year old man referred to the diabetes clinic said: ‘many things are done here for encouraging the patients; for example, they inform the patients about their good test results to boost their morale. If the control continues, a picture of the patient is published in the journal of the Diabetes Association of Iran as a successful diabetic. This will encourage other diabetics (P₂₀)’.

A 58-year old man with diabetes also said: ‘I constantly come here and control my diabetes, because they reward free insulin pen which is very expensive; they provide it from companies (P₁₁)’.

Special rules of the medical center require the patients to visit regularly. For example, one of the participants said: ‘they will discard my records if I do not visit every month ... thus, I try to visit every month. Perhaps, I would not try so hard if I was left on my own (P₁₉)’.

One of the most effective practices of medical centers in supporting people with diabetes was to provide patients and their families with educational procedures and on-time information (since the diagnosis before the onset of complications). A 47-year old man with diabetes said: ‘I did not take the treatment seriously; I told

myself nothing is wrong with me, why I should do these? Then, I took classes of the Diabetes Association. They talked about consequences of the disease, what would happen. I realized it is not that easy. It is not the way I thought (P₈). Noting the significance of education in preventing complications of the disease, another participant said: 'once, the doctor notices all the diabetics who were member of the clinic and talked about diabetic foot ulcers; he showed slides about exacerbation of a small wound leading to amputation. It was our destiny. If the doctor did not showed those, we would ignore foot ulcers (P₁₇)'.

DISCUSSION

According to findings of this study, compliance with and adherence to treatment is strongly influenced by knowledge and individual abilities of the patient, family and social support, quality of the relationship between the patient and treatment team and information and advice provided to patients. Participatory decision-making and negotiation of the patient and therapist is one of the ways to achieve therapeutic goals. In fact, trust and loyalty of patients to health care workers lead to patient participation in treatment; this participation is associated with continuation of responsibility to maintain and improve health.

Consistent with Karimi Moonaghi *et al* (2014), findings of this study showed that personal factors such as previous experience in relatives or previous knowledge in this field influence adherence to diabetes treatment. These patients are more sensitive to their health and seriously follow preventive and care practices due to their susceptibility to complications and belief in risks [13]. Consistent with Chew *et al* (2014), findings of this study showed that other individual factors such as determination, flexibility and self-efficacy is very important in active coping with disease and new behaviors presented and it is considered as psychological factors related to diabetes control [14]. Economic conditions were also important in this study, like other studies [9, 15, 16]. Economic conditions can influence life with diabetes. Weak financial strength causes many problems in using health care facilities, while good financial strength is a facilitator of adherence to treatment because the patient can easily meet his medical needs.

Consistent with Miller and DiMatteo (2013), findings of this study showed that people with

diabetes need support of others [17]. According to this study, family members, particularly spouses, are the most important and effective sources of support in facilitating adherence to treatment of diabetic people, while Abdoli *et al* (2011) showed that daughters play an important supportive role for people with diabetes [18]. Therefore, identification of the main family caregivers helps the treatment team in encouraging patients to participate in process of adherence to treatment and disease control. Another key finding perceived by the participants in their experiences of adherence to treatment as a factor for integration of treatment in everyday life was coordination of all family members in health behaviors. Without coordination of family members, patients feel alone in adherence to their diet (as the most difficult aspect of treatment); this makes it impossible for the patients to adhere to their diet and their treatment. This finding is a new finding compared to other studies conducted.

In addition to the role of family members, support of health care team, effective communications with patients, education and adequate information provided on diabetes and its complications are facilitators of adherence to treatment, as noted in other studies [19]. This study showed that health care providers in Iran are very effective in facilitating adherence to treatment; along with clinical and therapeutic cares, if they attempt to provide education and counseling and spend enough time to listen to problems of the patients and interact with them and their families, many problems of the patients will be eliminated in the course of the disease and adherence to treatment will be facilitated. Through a qualitative study, Petek *et al* (2010) claimed that empathic connection of the treatment team with the patients develops mutual trust and leads to greater flexibility and strive for self-care. They believed that patients should trust their doctors and perceive their support to increase their capacity for self-management; the patients expect their doctor to help them develop self-management skills and cope with the disease [20]. Moreover, other studies consider training and consulting as one of important facilitator of diabetes management. Parchman *et al* (2010) considered patient centered communication and interaction of the patient and treatment team as a factor enabling self-care, which is associated with adherence to treatment [21]. Through a qualitative study, Booth *et al* (2013) found that patients and the treatment team repeatedly

emphasized allocation of sufficient time for consulting with patients, answering their questions and giving information to patients about a course of performance. This can be a source of good and quality cares and a factor of empowerment for self-care [22]. It seems that the increase in number of nurses, educators and consultants as well as adequate training courses is effective in support of patient adherence to treatment.

Participants also considered the effect of complications observed in peers and fear of similar future as a factor in boosting adherence to treatment. Zare Shahabadi *et al* (2010) showed that training and information received from peers is even more effective in comparison with health care providers, because similar people of a community have a common understanding of problems and needs of each other, which approaches them together; thus, they are more able to provide relevant and effective information [23]. In the present study, the patients shifted to self-care without exchanging ideas and receiving information from peers merely by observing complications and consequences of the lack of disease control in similar patients. Emphasizing on the effect of peers, Morowati *et al* (2012) suggested the use of successful peers in training courses [24].

Moreover, some practices done in health centers, such as follow-up, specific rules or incentives encouraged patients to adhere to treatment and continuous referrals. The patients noted that some of these practices including the rules of the medical centers require them to visit regularly. This is a new finding compared to other studies. Other practices led to satisfaction with medical services and continuous referral to medical centers. Marcolino *et al* (2013) showed that frequent interventions and regular follow-ups by health care centers are essential to promote healthy behaviors and modify incorrect behaviors of the patients, because all the patients are not able to participate in training programs or do not have access to resources [25]. Lyles *et al* (2011) noted the essential use of communicational systems and even new technologies as a part of conventional care services to give patients the opportunity for home care [26]. In this study, positive medical feedbacks as well as rewards and external reinforcement motivated the patients and facilitated adherence to treatment. Petry *et al* (2014) also reported that reward appeal and

external reinforcement are facilitators of adherence to treatment. They showed that external reinforcement (free of charge visits, etc.) can potentially improve diabetes care and control by the patients [27].

CONCLUSION

Findings of this study can be used to design inclusive plans for empowerment of the patients with diabetes in adherence to treatment. Identification of knowledge and individual abilities of the patients, beliefs and attitudes, self-efficiency, supportive resources of the family and other effective factors on adherence to treatment can help nurses and other members of the treatment team to identify resources which improve adherence to treatment and facilitate effective self-care.

Acknowledgement

This study has been carried out with the financial support of Shahid Beheshti University of Medical Sciences as a research project approved with the code of IR.SBMU.PHNM.1395.375. The authors appreciate the Shahid Beheshti University of Medical Sciences and the participants for their cooperation in this study.

REFERENCES

1. Mbanya JC. Global diabetes plan 2011-2021. International Diabetes Federation. 2015. Available at: <https://www.idf.org/GlobalDiabetesPlan>.
2. Whiting DR, Guariguata L, Weil C, Shaw J. International Diabetes Federation Diabetic Atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Research and Clinical Practice*. 2011;94:311-321.
3. Hu FB. Globalization of Diabetes: The role of diet, lifestyle, and genes. *Diabetes Care* 2011;34:1249-57.
4. Dube L, Van den Broucke S, Housiaux M, Dhoore W, Rendall-Mkosi K. Type 2 diabetes self-management education programs in high and low mortality developing countries: A systematic review. *Self-management Education in Developing Countries*. 2014; doi:10.1177/0145721714558305.
5. Ho PM, Bryson CL, Rumsfeld JS. Medication adherence: Its importance in cardiovascular outcomes. *Circulation*. 2009;119:3028-3035.

6. Center for Disease Control and Prevention. National diabetes fact sheet: National estimates and general information on diabetes and prediabetes in the United States. Atlanta, GA: US. Department of Health and Human Services, 2011.
7. Currie CJ, Peyrot M, Morgan CL, Poole CD, Jenkins-Jones S, Rubin RR, et al. The impact of treatment noncompliance on mortality in people with type 2 diabetes. *Diabetes Care*. 2012;35:1279-84.
8. Muszbek N, Brixner D, Benedict A, Keskinaslan A, Khan ZM. The economic consequences of noncompliance in cardiovascular disease and related conditions: A literature review. *International Journal of Clinical Practice*. 2008;62:338-351.
9. Garcia-Perez LE, Alvarez M, Dilla T, Gil-Guillen V, Orozco-Beltran D. Adherence to therapies in patients with type 2 diabetes. *Diabetes Therapy*. 2013;4:175-194.
10. Hill CJ, Cardwell CR, Patterson CC, Maxwell AP, Magee GM, Young RJ, et al. Chronic kidney disease and diabetes in the national health service: A cross-sectional survey of the U.K. national diabetes audit. *Diabetes Medication*. 2014;31:448-454.
11. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: A systematic analysis for the global burden of disease study 2010. *Lancet*. 2013;380:2095-2128.
12. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qualitative Health Research*. 2005;15:1277-1288.
13. Karimi Moonaghi H, Namdar Areshtanab H, Jouybari L, Arshadi Bostanabad M and McDonal H. Facilitators and barriers of adaptation to diabetes: Experiences of Iranian patients. *Journal of Diabetes & Metabolic Disorders*. 2014;13: 46-55.
14. Chew BH, Shariff-Ghazali S, Fernandez A. Psychological aspects of diabetes care: Effecting behavioral change in patients. *World Journal of Diabetes* . 2014;5:796-808.
15. Collins MM, Bradley CP, O'Sullivan T, Perry IJ. Self-care coping strategies in people with diabetes: A qualitative exploratory study. *BMC Endocrine Disorders*. 2009;9:6-15.
16. Jin J, Sklar GE, Min Sen Oh V, Chuen Li Sh. Factors affecting therapeutic compliance: A review from the patient's perspective. *Therapeutics and Clinical Risk Management*. 2008;4:269-286.
17. Miller TA, DiMatteo MR. Importance of family/social support and impact on adherence to diabetic therapy. *Journal of Diabetes, Metabolic Syndrome and Obesity*. 2013;6:421-426.
18. Abdoli S, Ashktorab T, Ahmadi F, Parvizy S, Dunning T. Religion, faith and the empowerment process: Stories of Iranian people with diabetes. *International Journal of Nursing Practice*. 2011;17:289-298.
19. Carolan M. Women's experiences of gestational diabetes self-management: A qualitative study. *Midwifery*. 2013;29:637-645.
20. Petek D, Rotar-Pavlic D, Kersnik J, svab I. Patients' adherence to treatment of diabetes mellitus. *Slovenian Journal of Public Health*. 2010;49:11-18.
21. Parchman ML, Zeber JE, Palmer RF. Participatory decision making, patient activation, medication adherence, and intermediate clinical outcomes in type 2 diabetes: A STARNet study. *Annals of Family Medicine*. 2010;8:410-417.
22. Booth AO, Lowis C, Dean M, Hunter SJ, McKinley MC. Diet and physical activity in the self-management of type 2 diabetes: Barriers and facilitators identified by patients and health professionals. *Primary Health Care Research & Development*. 2013;14:293-306.
23. Zare Shahabadi A, Hajizadeh Meymand M, Abraham Sadrabadi F. The effect of social support on management and treatment of type II diabetic patients in Yazd. *Journal of Shaheed Sadoughi University of Medical Sciences*. 2010;18:277-228. [Persian]
24. Morowati sharifabad MA, Alizadeh Mradkandi E, Mozaffari Khosravi H, Fallah zadeh H, Momeni Sarvestani M. Comparison of the effect nutrition education by peers and health personnel on knowledge, attitude and nutritional indices of 18-35 years old women of Orumieh health care centers. *Journal of Faculty of Public Health, Yazd*. 2012;1:64-75. [Persian]
25. Marcolino MS, Maia JX, Moreira Alkmim MB, Boersma E, Ribeiro AL. Telemedicine application in the care of diabetes patients: systematic review and meta-analysis. *PLOS ONE*. 2013;8.
26. Lyles CR, Harris LT, Le T, Flowers J, Tufano J, Britt D, et al. Qualitative evaluation of a mobile phone and web-based collaborative

- care intervention for patients with type 2 diabetes. *Diabetes Technology & Therapeutics*. 2011;13:563-569.
27. Petry NM, Cengiz E, Wagner JA, Hood KK, Carria L, Tamborlane WV. Incentivizing behavior change to improve diabetes care. *Diabetes, Obesity and Metabolism*. 2013;15:1071-1076.