Impact of Phone Call Intervention on Glycemic Control in Diabetes Patients: A Systematic Review and Meta-Analysis of Randomized, Controlled Trials

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Abstract

Background: Telephone-delivered intervention can provide many supports in diabetes self-management to improve glycemic control. Several trials showed that telephone intervention was positively associated with glycemic outcomes in diabetes. The objective of this meta-analysis was to assess the impact of telephone contact intervention (intervention group) on glycemic control compared with standard clinical care (control group).

Methods: Randomized control studies of telephone intervention in diabetes were searched on Medline (Pubmed), the Cochrane Central Register of Controlled Trials, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science (ISI), and Scopus. Electronic search was done from inception to April 2013. The following MeSH terms were used: diabetes mellitus, randomized control trials and telemedicine, together with keywords including phone intervention, diabetes, and glycemic control. Historical search was also conducted on the references of relevant articles. The quality of the trials was assessed using Maastricht-Amsterdam scale. Treatment effect was estimated with mean difference in the change of hemoglobin A1c (HbA1c) from baseline between the intervention and control groups.

Results: A total of 203 articles were examined. Five trials involving 953 patients met the inclusion criteria and contributed to the meta-analysis. Telephone contact intervention was no more effective than standard clinical care in improving glycemic control (pooled mean difference in HbA1c −0.38%, 95%CI −0.91 to 0.16%).

Conclusions: This meta-analysis showed that the phone contact intervention was no more effective than standard clinical care in improving glycemic control in diabetes. However, telephone intervention may still have potential benefits especially for low- and middle-income countries; thus further large sample size and well-controlled studies are needed to evaluate the impact of the intervention.

Introduction

Diabetes is a metabolic disorder that is characterized by hyperglycemia resulting from insulin deficiency, insulin resistance or both. The number of diabetes is increasing worldwide. There were 366 millions people with diabetes in 2011, 80% of which are from low- and middle-income countries (LMICs) [1]. For diabetes patients, there are many effective pharmacological and non-pharmacological treatments to improve glycemic control which is key to preventing serious macro- and micro-vascular complications [2]. Self-care activities are important factor to achieve targeted blood glucose levels, while outpatient follow-up is also needed for treatment success. However, many patients fail to achieve glycemic control because of inadequate out-patient services they receive in support of self-care management. They may also experience financial hardship that prevents them from regular follow-up assessment, especially in low-income countries [3,4]. A lack of knowledge about diabetes and management skill also influences glycemic control in diabetes [5].

Telephone is widely used in the world and can be easily used by all age groups [6,7]. International Telecommunication Union reported that the number of mobile-cellular telephone user is increasing worldwide although there was no significant increase in number of fixed-telephone users. In 2011, the number of fixed-telephone users was accounted for 542 millions in developed countries and 622 millions in developing countries. For mobile-cellular telephone, the number of users for developed and developing countries was 1475 and 4487 millions in 2011, and those in 2013 was likely to be 1600 and 5235 millions, respectively [8]. For more than 30 years, healthcare providers have been investigating the use of telemonitoring to improve clinical outcomes. The term “telemonitoring” is defined as the use of audio, video, and other telecommunication and electronic information processing technologies to monitor patient status at
a distance [9]. Telephone support is one way of telemonitoring to
give education related to disease and to support health consumers
in self-management activities, such as medication adherence,
physical exercise and diet [10]. With the use of mobile phone,
many functions, such as short message service (SMS), photos,
video and direct calls, internet access and software application
support, can be used to help with patient self-activities [7].
Telephone monitoring saves time [11] and cost of transportation
for patients living in long distance from healthcare center [3]. It
can also overcome geographical problems [11,12] or the
difficulties facing elderly or disability patients [12]. Nonetheless,
although telesupport may have positive effects in diabetes, phone
intervention with sophisticated function may not be accessible for
every patient, especially for patients with low socioeconomic status [6].

There were two qualitative systematic reviews of phone
intervention in diabetes conducted by Holtz et al [10] and
Krishma et al [13]. The results of both studies [10,13] suggested
that phone intervention may improve glycemic control in diabetes.
One meta-analysis reported that mobile phone intervention
decreased HbA1c by 0.5% [95% CI, 0.3%–0.7%] compared
with control group over 6 months of intervention period [6].

Although these three reports [6,10,13] showed tendency for
positive effects of telesupport intervention in diabetes, these kinds
of intervention were based on modern devices and sophisticated
technologies which cannot be applied in every developing country,
especially for patients with low socioeconomic status. Although
there was a systematic review of randomized controlled trials of
phone calls intervention, it failed to pool the outcome data and
lacked of strong evidence [14]. There has been no meta-analysis to
support the evidence of phone contact intervention which can be
applied to both developing and developed countries. This
systematic review thus exclusively focused on direct phone call
intervention. Phone call intervention with electronic data trans-
mition to healthcare providers, phone call intervention together
with the use of modern devices, such as glucometer and
pedometer, or certain self-care activities that are not feasible in
developing countries or could not be performed by all patient,
such as self-monitoring of glucose and medication dose adjust-
ment, are not considered in this review. We therefore aimed to
assess the effectiveness of telephone call intervention compared
with standard clinical care on glycemic control in diabetic patients.
Methods

The protocol of this systematic review has not been registered.

Literature Searches

A literature search for randomized control trials that evaluated the telephone intervention in diabetes was performed. An electronic searching was done on Medline (Pubmed), the Cochrane Central Register of Controlled Trials, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science (ISI), and Scopus. The reference lists of potentially relevant trials, meta-analyses and systematic reviews were also searched. The electronic databases were searched from inception to April 2013. There was no language restriction. The MeSH terms used were diabetes mellitus, telephone, cellular phone, randomized controlled trial and telemedicine. The following keywords were also used; phone intervention, phone call, diabetes and glycemic control.

Study Selection

Inclusion criteria for systematic review and meta-analysis included randomized control trial of phone contact intervention compared with standard clinical care in diabetes, and report of HbA1c as an outcome measure. We excluded studies that contained electronic transmission of outcomes data from patients to healthcare providers, enrolled gestational diabetes, were conducted in in-patients setting, utilized phone call intervention together with self-monitoring of blood glucose, medication adjustment by patients, or use of modern devices, such as pedometer and accelerometer. Two reviewers independently assessed and selected final eligible studies and disagreements were resolved by a third reviewer.

Quality Assessment

Quality assessment was completed independently by two authors. Disagreements were resolved by a third investigator. Maastricht-Amsterdam scale [15] was used to assess the quality of the included studies. It contains 12 items to estimate the bias of the studies. The items have the ranking system of “yes,” “no,” or

Table 1. Characteristics of the studies included in meta-analysis.

| Study (ref) | Country | Quality score | N (Intervention: Control) | Subjects | Age (years) | Duration of diabetes (years) |
|-------------|---------|---------------|--------------------------|----------|-------------|-----------------------------|
| Bogner 2012 [40] | USA | 7 | 92: 88 | T2DM | 57.5 ± 9.5 | 11.3 ± 11.0 |
| Dale 2009 [41] | UK | 9 | 115: 86 | T2DM | Not reported | Not reported |
| Howells 2002 [42] | UK | 7 | 51: 28 | T1DM | 16.5 | 6.7 |
| Walker 2011 [43] | USA | 5 | 228: 216 | T2DM | 55.6 ± 7.3 | 9.1 ± 6.6 |
| Whittemore 2004 [44] | USA | 5 | 26: 23 | T2DM | 57.6 ± 10.9 | 2.7 ± 3.0 |

Data are mean ± SD or mean.
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Table 2. Description of intervention and control in the included studies.

| Study (ref) | Duration (months) | Intervention | Frequency of calls | Call duration (minutes) | Intervention | Control |
|-------------|-------------------|--------------|-------------------|-------------------------|--------------|---------|
| Bogner 2012 [40] | 3 | Telephone call plus in-person contact | 2 calls | 15 | Education related to diabetes, depression and medication (oral hypoglycemic drugs and antidepressants), side effects and their management | Standard clinical care |
| Dale 2000 [41] | 6 | Telephone call | 4.5 (average) 1–6 (range) | 9.5 (average) 1–37 (range) | Support to follow prescription of physician regularly, especially when treatment changed | A single call during 3 or 5 days and encouragement to follow the treatment prescription |
| Howells 2002 [42] | 12 | Telephone call plus in-person contact | 16 (average) 5–19 (range) | 9 (median) 2–30 (range) | Standard clinical care plus defining the problems and making solutions to solve the problems and goal setting | Standard clinical care in which patients needed to visit clinic every 3 month and received diabetes education. Diabetes nurse also gave suggestion for problem solving by telephone, at hospital or home visits. |
| Walker 2011 [43] | 12 | Telephone call | 10 calls [4–6 weekly interval] | Not reported | Standard clinical care plus giving support individually depending on patients’ need, support to follow medication, clinic visits and lifestyle modification, social encouragement, and goal setting | Standard clinical care in which patients were provided with self-management materials. |
| Whittemore 2004 [44] | 6 | Telephone call plus in-person contact | 2 calls | Not reported | Psychological support, education about diabetes, problem solving, and motivation | Patients needed to meet primary healthcare providers every 3–4 months together with nurse-coaching intervention at the end of the study |

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“unsure”. The item was ranked “yes” when the study met the criterion or “no” when the study did not meet the criteria. If there was no information for the item, it was ranked “unsure”. It can be assumed that the study is of low risk of bias when at least 6 criteria are met or of high risk of bias when fewer than 6 criteria are met.

Data Extraction
Two authors independently extracted data from individual studies using standardized form, and any discrepancies were resolved by a third author. Extracted data included the characteristics of the patients, study characteristics, year of the publication, the country that the study was conducted, the frequency of phone calls, duration of each telephone session, and intervention components. The HbA1c levels in both groups were also extracted.

Statistical Analysis
The change from baseline HbA1c (mean and standard deviation) in the intervention group and the control group was recorded. Treatment effect was estimated with mean difference in the change values between the two groups. When the variances of the change values were not provided, the pooled interstudy variance was imputed from studies reporting variances. The inverse variance-weighted method was used to pool mean difference and estimated 95% confidence interval [16]. Fixed effect model was used if the Chi square for the heterogeneity was not significant. If the heterogeneity was significant (P<0.1), random effect model was used. I² statistic was used to estimate the variability among the included studies. I² value of 0–40% might not be important, 30–60% may represent moderate heterogeneity, 50–90% may represent substantial heterogeneity, and 75–100% represents considerable heterogeneity [16]. Review Manager 5.2.3 (Cochrane Collaboration, Oxford, UK) was used to perform the statistical analysis and the significant level was set at P<0.05. Funnel plot and Egger’s method were performed to assess publication bias.

Results
Characteristics of the Included Studies
Study selection process is presented in Figure 1. We initially identified 287 articles, of which 102 articles were screened. Twenty-nine studies potentially met the inclusion criteria. Of these, 24 studies were further excluded for the following reasons: they either used modern devices including accelerometer [17], log book [18], pedometer [19,20] and glucometer [21], or the patients participating in the study employed self-care activities including self-glucose monitoring [5,22–38] and medication adjustment by patients themselves [39]. Finally, there were five [40–44] studies that met the inclusion criteria and contributed to the meta-analysis.

### Table 3. Quality assessment of the included studies.

| Items                                                                 | Bogner 2012 [40] | Dale 2000 [41] | Howells 2002 [42] | Walker 2011 [43] | Whittemor 2004 [44] |
|-----------------------------------------------------------------------|------------------|----------------|-------------------|------------------|---------------------|
| 1 Was the method of randomization adequate?                          | yes              | yes            | yes               | yes              | unsure              |
| 2 Was the treatment allocation concealed?                            | unsure           | no             | yes               | unsure           | unsure              |
| 3 Was the patient blinded to the intervention?                       | no               | no             | no                | no               | no                  |
| 4 Was the care provider blinded to the intervention?                 | no               | unsure         | unsure            | unsure           | unsure              |
| 5 Was the outcome assessor blinded to the intervention?              | yes              | yes            | unsure            | unsure           | unsure              |
| 6 Was the drop-out rate described and acceptable?                    | unsure           | yes            | unsure            | unsure           | yes                 |
| 7 Were all randomized participants analyzed in the group to which they were allocated? | unsure           | yes            | unsure            | yes              | yes                 |
| 8 Are reports of the study free of suggestion of selective outcome reporting? | yes              | yes            | yes               | yes              | yes                 |
| 9 Were the groups similar at baseline regarding the most important prognostic indicators? | yes              | yes            | unsure            | unsure           | no                  |
| 10 Were co-interventions avoided or similar?                         | yes              | yes            | yes               | unsure           | no                  |
| 11 Was the compliance acceptable in all groups?                      | yes              | yes            | yes               | yes              | yes                 |
| 12 Was the timing of the outcome assessment similar in all groups?    | yes              | yes            | yes               | yes              | yes                 |

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Figure 2. Mean difference (95% CI) in the changes of HbA1c from baseline for phone call intervention and standard clinical care.
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The characteristics of the included studies are shown in Table 1. The number of patient in individual trials varied from 49 to 444. Two studies [41,42] were three-armed randomized trials in which two intervention groups were compared with the control group. One trial [41] compared telephone support by peer supporter (group 1) or by diabetes nurse (group 2) against standard clinical care (group 3). Other study [42] compared two intervention arms with the control group. One intervention group received telesupport plus standard clinical care, while the other received telesupport plus standard clinical care and additional clinics visit. The results of each intervention arm were pooled and exclusively treated as the intervention group.

Table 2 summarizes the characteristics of the intervention and standard clinical care employed in individual studies. Both phone call intervention and standard clinical care greatly varied from trial to trial. For example, the number of phone calls ranged from 2 times to 16 times and each session took 9 minutes to 15 minutes. One study gave no details of standard clinical care while the other described standard clinical care that encompassed 3 or 4 monthly clinic visits and the patient also received the nurse-coaching intervention [44]. Details of study quality assessment are described in Table 3. Of the 5 studies, three studies [40–42] were of low risk of bias and two studies [43,44] were of high risk of bias.

Efficacy

Five randomized control trials [40–44] contributed to the meta-analysis. Telephone intervention did not significantly improve glycemic control as measured by HbA1c compared to standard clinical care (pooled mean difference - 0.38%, 95%CI - 0.91% to 0.16%) (Figure 2). Funnel plot and Egger’s method were performed and no publication bias was observed (Egger: bias = 2.97; 95% CI = -10.83 to 16.77, P = 0.54) (Figure 3).

Discussion

This is the first study that evaluates phone intervention without electronic data in diabetes patient. Our study was designed to evaluate whether the phone contact intervention without electronic data transmission from patients to healthcare providers is effective in keeping glycemic control in diabetes patients. It was aimed to explore whether this intervention would be appropriate and can be considered for use in LMICs. Our meta-analysis included five trials and the result showed that telephone intervention did not significantly improve glycemic control compared to standard clinical care. Our results contrasted with previously published systematic reviews [6,10,13] in which the positive tendency of phone intervention was observed, however, they used modern devices to assess the patients’ outcomes therefore may have limited feasibility in LMICs.

It is noted that heterogeneity was significant among the included studies (I^2 = 85%, P<0.0001). The differences in the characteristics of intervention, for example, frequency and duration of phone calls, components of intervention including information and psychological support provided, and variations in standard clinical care among individual trials, may have a role to play. Heterogeneity may also be attributable to differences in patient characteristics, especially the duration of diabetes. Patients in one of the included study [40] had been diagnosed with diabetes for over 10 years.
years. In contrast, patients in other studies had less than 10 years of diabetes duration. Although the duration of diabetes does not necessarily directly affect glycemic control, it can influence the adherence to treatment regimen, which is strongly related to medication complexity [46].

Our meta-analysis showed no effectiveness of telephone monitoring without electronic data transmission in glycemic control. However, it may be effective in high-income countries because healthcare providers can use telephone monitoring alongside other intervention components available on high cost modern devices. To be more effective in telephone intervention, the supporters need to have good education and on-going training are required [41,47]. Diabetes patients value more the suggestion by diabetes educators compared with peer supporters who were given training to provide the intervention. Healthcare providers should support interventions that are appropriate to the patient settings (urban or rural setting) and background because they may have different knowledge and economic level. The telesupporter should assess patients’conditions and complexity of management regimen and adjust patients’needs before giving intervention to them.

Our meta-analysis is not without limitations. First, it included only five trials with small number of patients. Second, significant heterogeneity existed. However, subgroup analysis was not possible due to the small number of study. This review also excluded gestational diabetes and, thus, our result may not be generalizable to this group of patients. Well-designed, large randomized controlled studies are warranted. Other outcome measures, such as fasting blood glucose level and patient satisfaction, are required to be further assessed. There is also a need to perform subgroup analysis depending on diabetes types, age, number of calls, and duration of phone call session.

Conclusion

In conclusion, our meta-analysis showed that the phone contact intervention was no more effective than the standard clinical care in improving glycemic control in diabetes. However, because telephone intervention may still have potential benefits especially for LMICs, the impacts of the intervention in diabetes need to be further evaluated.

Supporting Information

Checklist S1  PRISMA 2009 Checklist. (DOCX)

Author Contributions

Conceived and designed the experiments: NS NP. Performed the experiments: NS NP YLN. Analyzed the data: NS NP YLN. Wrote the paper: NS NP YLN.

References

1. International Diabetes Federation (2013) IDF diabetes atlas. 5th ed. Available: http://www.idf.org/diabetesatlas/5e/the-global-burden/. Accessed 23 April 2013.

2. Minet L, Moller S, Vach W, Wagner I, Henrikse J (2010) Mediating the effect of self-care management intervention in type 2 diabetes: a meta-analysis of 47 randomized controlled trials. Patient Educ Couns 80:29–41.

3. Piette JD, Weinberger M, McPhee SJ, Mah CA, Kraemer FB, et al. (2000) Do automated calls with nurse follow-up improve self-care and glycemic control among vulnerable patients with diabetes? Am J Med 108:20–25.

4. Piette JD, Weinberger M, Kraemer FB, McPhee SJ (2000) Impact of automated calls with nurse follow-up on diabetes treatment outcomes in a department of veterans affairs health care system: a randomized controlled trial. Diabetes Care 24:202–208.

5. Nesarai M, Zakerinoghadam M, Rajab A, Bassamposar S, Faghihzadeh S (2010) Effect of telephone follow-up on adherence to a diabetes therapeutic regimen. Jpn J Nurs Sci 7:121–128.

6. Liang X, Wang Q, Yang X, Cao J, Chen J, et al. (2011) Effect of mobile phone intervention for diabetes on glycemic control: a meta-analysis. Diabet Med 28:455–463.

7. Free C, Phillips G, Galli L, Watson L, Felix L, et al. (2013) The effectiveness of mobile-health-technology-based health behavior change or disease management interventions for health care consumers: a systematic review. PLoS Med 10:e1001362.

8. International Telecommunication Union: Statistics: aggregate data (2013) Available: http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx. Accessed 30 April 2013.

9. Institute of Medicine (1996) Telemedicine: a guide to assessing telecommunication for health care. Washington, D.C.: National Academy Press. 257 p.

10. Holtz B, Lauckner C (2012) Diabetes management via mobile phones: a systematic review. Telemed J E Health 18:175–184.

11. Jaana M, Paré G (2007) Home telemonitoring of patients with diabetes: a systematic assessment of observed effects. J Eval Clin Pract 13:243–253.

12. Naik AD, White CD, Robertson SM, Armento ME, Lawrence B, et al. (2012) Behavioral health coaching for rural-living older adults with diabetes and depression: an open pilot of the HOPE Study. BMC Geriatrics 12:37.

13. Kirishna S, Roren SA (2008) Diabetes Self-Management Care via cell phone: a systematic review. J Diabetes Sci Technol 2:509–517.

14. Polisen J, Tran K, Cimon K, Hutton B, McGill S, et al. (2009) Home telehealth for diabetes management: a systematic review and meta-analysis. Diabetes Obes Metab 11:913–930.

15. Furlan AD, Pennick V, Bombardier C, van Tulder M (2009) 2009 updated method guidelines for systematic reviews in the Cochrane back review group. Spine 34:1929–1941.

16. Higgins JPT, Green S (2008) Cochrane handbook for systematic reviews of interventions. England: John Wiley & Sons. 672 p.

17. Keyserling TC, Samuel-Hodge CD, Ammernan AS, Ainsworth BE, Henriquez-Roldan CF, et al. (2002) A randomized trial of an intervention to improve self-care behaviors of African-American women with type 2 diabetes: impact on physical activity. Diabetes Care 25:1576–1583.

18. Aubert RE, Herman WH, Waten J, Moore W, Sutton D, et al. (1998) Nurse case management to improve glycemic control in diabetic patients in a health maintenance organization. a randomized, controlled trial. Ann Intern Med 129:605–612.

19. Piette JD, Richardson C, Himle J, Duffey S, Torres T, et al. (2011) A Randomized Trial of Telephone Counseling plus Walking for Depressed Diabetes Patients. Med Care 9:641–648.

20. Eakin EG, Reeves MM, Winkler E, Healy GN, Dunstan DW, et al. (2013) Six-month outcomes from living well with diabetes: a randomized trial of a telephone-delivered weight loss and physical activity intervention to improve glycemic control. Ann Behav Med DOI: 10.1007/s10508-013-9498-2.

21. Thom DH, Ghorob A, Hesper D, De Vos D, Chen E, et al. (2013) Impact of peer health coaching on glycemic control in low-income patients with diabetes: a randomized controlled trial. Ann Fam Med 11:37–44.

22. Krogh KM, Smith SM, White P, McGilloway S, Kelly A, et al. (2011) Psychological family intervention for poorly controlled type 2 diabetes. Ann J Manag Care 17:105–113.

23. Granizo JA, Gross GR (2009) A randomized controlled trial of an automated telephone intervention to improve glycemic control in type 2 diabetes. ANS Adv Nurs Sci 32:E42–57.

24. Skelly AH, Carlson J, Leeman J, Soward A, Burns D (2009) Controlled trial of nursing interventions to improve health outcomes of older African American women with type 2 diabetes. Nurs Res 58:410–418.

25. Moriyama M, Nakano M, Kuroe Y, Nin K, Naitani M, et al. (2009) Efficacy of a self-management education program for people with type 2 diabetes: results of a 12 month trial. Jpn J Nurs Sci 6:61–63.

26. Howe CJ, Jawad AF, Tullee AK, Mose JT, Preis C, et al. (2005) Education and telephone case management for children with type 1 diabetes: a randomized controlled trial. J Pediatr Nurs 20:83–95.

27. Kim HS, Oh JA (2003) Adherence to diabetes control recommendations: impact of nurse telephone calls. J Adv Nurs 41:256–261.
28. Krein SL, Klamerus ML, Vijan S, Lee JL, Fitzgerald JT, et al. (2004) Case management for patients with poorly controlled diabetes: a randomized trial. Am J Med 116:732–739.
29. Nunn E, King B, Smart C, Anderson D (2006). A randomized controlled trial of telephone calls to young patients with poorly controlled type 1 diabetes. Pediatr Diabetes 7:254–259.
30. Young RJ, Taylor J, Friede T, Hollis S, Mason JM, et al. (2005) Pro-active call center treatment support (PACCTS) to improve glucose control in type 2 diabetes: a randomized controlled trial. Diabetes Care 28:278–282.
31. Jarab AS, Alqudah SG, Mukattash TL, Shattat G, Al-Qirim T (2012) Randomized controlled trial of clinical pharmacy management of patients with type 2 diabetes in an outpatient diabetes clinic in Jordan. J Manag Care Pharm 18:516–526.
32. Maljanian R, Grey N, Staff I, Conroy L (2005) Intensive telephone follow-up to a hospital-based disease management model for patients with diabetes mellitus. Dis Manag 8:15–25.
33. Oh JA, Kim HS, Yoon KH, Choi ES (2003) A telephone-delivered intervention to improve glycemic control in type 2 diabetic patients. Yonsei Med J 44:1–8. 
34. Taylor CB, Miller NH, Reilly KR, Greenwald G, Canning D, et al. (2003) Evaluation of a nurse-care management system to improve outcomes in patients with complicated diabetes. Diabetes Care 26:1038–1043.
35. Crowley MJ, Powers BJ, Olsen MK, Grubber MJ, Krolewski AS, et al. (2013) The cholesterol, hypertension, and glucose education (CHANGE) study: results from a randomized controlled trial in African Americans with diabetes. Am Heart J 166:179–186.
36. Williams ED, Bird D, Forbes AW, Russell A, Ash S, et al. (2012) Randomised controlled trial of an automated, interactive telephone intervention (TLC Diabetes) to improve type 2 diabetes management: baseline findings and six-month outcomes. BMC Public Health 12:602.
37. Samuel-Hodge CD, Keyserling TC, France R, Ingram AF, Johnston LF, et al. (2006) A church-based diabetes self-management education program for African Americans with type 2 diabetes. Prev Chronic Dis 3:A95.
38. Song MS, Kim HS (2007) Effect of the diabetes outpatient intensive management programme on glycemic control for type 2 diabetic patients. J Clin Nurs 16:1367–1373.
39. Thompson DM, Kozak SE, Sherp S (1999) Insulin adjustment by a diabetes nurse educator improves glucose control in insulin-requiring diabetic patients: a randomized trial. CMAJ 161:959–962.
40. Bogner HR, Morales KH, de Vries HF, Cappola AR (2012) Integrated management of type 2 diabetes mellitus and depression treatment to improve medication adherence: a randomized controlled trial. Ann Fam Med 10:15–22.
41. Dale J, Carandang I, Sturt J, Friede T, Walker K (2009) Telephone peer-delivered intervention for diabetes motivation and support: the telecare exploratory RCT. Patient Educ Couns 75:91–98.
42. Howells L, Wilson AG, Skinner TC, Newton R, Morris AD, et al. (2002) A randomized controlled trial of the effect of negotiated telephone support on glycemic control in young people with Type 1 diabetes. Diabetic Med 19:643–648.
43. Whitemore R, Melkas GD, Sullivan A, Grey M (2004) A nurse-coaching intervention for women with type 2 diabetes. Diabetic Educ 30:795–804.
44. Khattab M, Khader YS, Al-Khawaldeh A, Ajlouni K (2010) Factors associated with poor glycemic control among patients with type 2 diabetes. J Diabetes Complications 24:48–49.
45. Advan MA, Najjar YW (2013) The relationship between demographic variables and diabetes self-management in diabetic patients in Amman city/Jordan. Glob J Health Sci 5:213–220.
46. Norris AC (2002) Essentials of telemedicine and telecare. Cornwall: John Wiley & Sons, Ltd. 177 p.