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Health Education for Patients with Acute Coronary Syndrome and Type 2 Diabetes Mellitus: An Umbrella Review of Systematic Reviews and Meta-Analyses

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Title page

Health Education for Patients with Acute Coronary Syndrome and Type 2 Diabetes Mellitus: An Umbrella Review of Systematic Reviews and Meta-Analyses

Xian-Liang Liu, RN, MScN

Ph.D. Candidate, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Australia; Ph.D. Candidate, Tenth People's Hospital of Tongji University, China; Lecturer, School of Nursing, Jinggangshan University, China.

Address: 1100 Nudgee Road, Banyo, Brisbane, QLD, Australia

Email: liu.xianliang@myacu.edu.au; 1988_liuxianliang@tongji.edu.cn

Yan Shi, RN, Ph.D., Professor, Executive Director of Nursing Department

Tenth People's Hospital and Tongji University, China

Address: 301, YanChang Road, Shanghai, China

E-mail: shlzk2002@163.com

Karen Willis, Ph.D., Professor, Associate Dean (Learning and Teaching)

Faculty of Health Sciences, Australian Catholic University, Australia

Address: 250 Victoria Parade, Melbourne, Australia

Email: Karen.Willis@acu.edu.au

Chiung-Jung (Jo) Wu, RN, DrHlthSc, FACN

Associate Professor, School of Nursing, Midwifery and Paramedicine, University of the Sunshine Coast;

Visiting Fellow, School of Nursing, Queensland University of Technology;

Honorary Research Fellow, Royal Brisbane and Women's Hospital;

Honorary Research Fellow, Mater Medical Research Institute-University of Queensland (MMRI-

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UQ), Brisbane, Australia;

Postal Address: ML 57, PO Box 1149, Hervey Bay Q 4655, Australia.

Email: cwu@usc.edu.au; c3.wu@qut.edu.au

Maree Johnson, RN, Ph.D., Professor, Associate Dean (Research)

Faculty of Health Sciences, Australian Catholic University, Australia

Address: Tenison Woods House (8 -20 Napier Street), North Sydney, Australia

Email: Maree.Johnson@acu.edu.au

Affiliated with the Ingham Institute of Applied Medical Research, Liverpool. Sydney.

Corresponding author:

Xian-Liang Liu, RN, MScN,

Ph.D. Candidate, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Australia; Ph.D. Candidate, Tenth People's Hospital of Tongji University, China; Lecturer, School of Nursing, Jinggangshan University, China.

Address: 1100 Nudgee Road, Banyo, Brisbane, QLD, Australia

Email: liu.xianliang@myacu.edu.au; 1988_liuxianliang@tongji.edu.cn

Tel: +61 497440830; +86 15921496130

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Abstract

Objectives: This umbrella review aimed to identify the current evidence on health education-related interventions for patients with acute coronary syndrome or type 2 diabetes mellitus; identify the educational content, delivery methods, intensity, duration and setting required. The purpose was to provide recommendations for educational interventions for high risk patients with both acute coronary syndrome and type 2 diabetes mellitus.

Design: Umbrella review of Systematic Reviews and Meta-Analyses.

Setting: Inpatient and post discharge settings.

Participants: Patients with ACS and T2DM.

Data sources: CINAHL, Cochrane Library, Joanna Briggs Institute, Journals@Ovid, EMBase, Medline, PubMed, and Web of Science databases from January 2000 through May 2016.

Outcomes measures: Clinical outcomes (such as HbA1C), behavioral outcomes (such as smoking), psychosocial outcomes (such as anxiety) and medical service use.

Results: Fifty-one eligible reviews (15 for ACS and 36 for T2DM) consisting of 1324 relevant studies involving 288,057 patients (15 papers did not provide the total sample); 30 (58.8%) reviews were rated as high quality. Nurses only and multidisciplinary teams were the most frequent professionals to provide education, and most educational interventions were delivered post-discharge. Face-to-face sessions were the most common delivery formats, and many education sessions were also delivered by telephone or via web contact. The frequency of educational sessions was weekly or monthly, and an average of 3.7 topics was covered per education session. Psychoeducational interventions were generally effective at reducing smoking and admissions for patients with ACS. Culturally appropriate health education, self-management educational interventions, group medical visits and psychoeducational interventions were

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generally effective for T2DM patients.

Conclusions: Results indicate that there is a body of current evidence about the efficacy of health education, its content, and delivery methods for patients with ACS or T2DM. These results provide recommendations about the content for, and approach to, health education intervention for these high risk patients.

KEY WORDS: Health Education; Acute Coronary Syndrome; Type 2 Diabetes Mellitus; Umbrella Review

Strengths and limitations of this review:

- This umbrella review is the first synthesis of systematic reviews or meta-analyses to consider health education-related interventions for patients with ACS or T2DM.
- These results provide recommendations about the content of a health education intervention for patients with ACS and T2DM.
- The diversity of the educational interventions seen in the reviews included in this umbrella review may reflect the uncertainty about the optimal strategy for providing health education to patients
- This umbrella review found no reviews focused on patients with ACS and T2DM the intended target group; instead, all of the systematic reviews and meta-analyses focused on only one of these two diseases.

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Introduction

Acute coronary syndrome (ACS) is the leading cause of death worldwide. The risk of high mortality rates relating to ACS is markedly increased after an initial cardiac ischemic event.[1] Globally, 7.2 million (13%) deaths are caused by coronary artery disease (CAD),[2] and it is estimated that more than 780,000 persons will experience ACS each year in the United States.[3] Moreover, about 20–25% of patients with ACS reportedly also have diabetes mellitus (DM); predominantly type 2 diabetes mellitus [T2DM]).[4 5] Patients with ACS and DM have an increased risk of adverse outcomes such as death, recurrent myocardial infarction (MI), readmission, or heart failure during follow up.[6] Longer median delay times from symptom onset to hospital presentation, have been reported among patients with ACS and DM than patients with ACS alone.[7]

DM is now considered to confer a risk equivalent to that of CAD for patients for future MI and cardiovascular mortality.[8] Mortality was significantly higher among patients with ACS and DM than among patients with ACS only following either ST segment elevation myocardial infarction (STEMI) (8.5% [ACS and DM] versus 5.4% [ACS]) or unstable angina/non-STEMI (NSTEMI) (2.1% [ACS and DM] vs. 1.1% [ACS]).[9] ACS and T2DM are often associated with high-risk factors such as low levels of physical exercise, obesity, smoking, and unhealthy diet.[10] Some of these and other risk factors, specifically glycemia, high blood pressure (BP), lipidemia, and obesity, are frequently addressed by health education interventions.[10]

Health education interventions are comprehensive programs that healthcare providers deliver to patients aimed at improving patients' clinical outcomes through the increase and maintenance of health behaviours.[11] Along with education about, for example, medication adherence, these programs seek to increase behaviors such as physical exercise and a healthy diet thus reducing

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patient morbidity or mortality.[11] Although there are numerous systematic reviews of educational interventions relating to ACS, or T2DM, an umbrella review providing direction on educational interventions for high risk patients with both ACS and T2DM is not available, indicating a need to gather the current evidence and develop an optimal protocol for health education programs for patients with ACS and T2DM. This umbrella review will examine the best available evidence on health education-related interventions for patients with ACS or T2DM. We will synthesize these findings to provide direction for health education-related interventions for high risk patients with both ACS and T2DM.

An umbrella review is a new method to summarize and synthesize the evidence from multiple systematic reviews/meta-analyses into one accessible publication.[12] Our aim is to systematically gather, evaluate and organize the current evidence relating the health education interventions for patients with ACS or T2DM, and proffer recommendations for the scope of educational content and delivery methods that would be suitable for patients with ACS and T2DM.

Methods

Data Sources

This umbrella review performed a literature search to identify systematic reviews and meta-analyses examining health education-related interventions for patients with ACS or T2DM. The search strategies are described in Appendix 1. This umbrella review searched eight databases for articles published from January 2000 to May 2016: CINAHL, Cochrane Library, Joanna Briggs Institute, Journals@Ovid, EMBase, Medline, PubMed, and Web of Science. The search was limited to English language only. The following broad MeSH terms were used: *acute coronary syndrome; angina, unstable; angina pectoris; coronary artery disease; coronary artery bypass; myocardial infarction; diabetes mellitus, type 2; counseling; health education; patient education*

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as topic; and *meta-analysis [publication type];* and *meta-analysis* as a topic.

Inclusion Criteria

Participants

All participants were diagnosed with ACS or T2DM using valid, established diagnostic criteria. The diagnostic standards included those described by the American College of Cardiology/American Heart Association,[3] National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand,[13] World Health Organization,[14] or other associations.

Intervention Types

For this umbrella review, health education-related interventions refer to any planned activities or programs that include behavior modification, counseling, and teaching interventions. Results considered for this review included changes in clinical outcomes (including blood pressure levels, body weight, diabetes complications, HbA1C, lipid levels, mortality rate and physical activity levels), behavioral outcomes (such as diet, knowledge, self-management skills, self-efficacy , and smoking), and psychosocial outcomes (such as anxiety, depression, quality of life, and stress) and medical service use (such as medication use, health care utilization, and cost-effectiveness) for patients with ACS or T2DM. These activities or programs included any educational interventions delivered to patients with ACS or T2DM. The interventions are delivered in any format, including face-to-face, telephone and group-based or one-on-one, and the settings include community, hospital and home. The interventions were delivered by community healthcare workers, doctors, diabetes educators, lay people, nurses, or rehabilitation therapists.

Study Types

Only systematic reviews and meta-analyses were included in this review.

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Eligibility Assessment

The title and abstract of all of the retrieved articles were assessed independently by two reviewers (XL-L, YS) based on the inclusion criteria. All duplicate articles were identified within EndNote version X7[15] and subsequently excluded. If the information from the titles and abstract was not clear, the full articles were retrieved. The decision to include an article was based on an appraisal of the full text of all retrieved articles. Any disagreements during this process were settled by discussion and, if necessary, consensus was sought with a third reviewer. We developed an assessment form in which specific reasons for exclusion were detailed.

Assessment of Methodological Quality

The methodological quality and risk of bias were assessed for each of the included publications using the Assessment of Multiple Systematic Reviews (AMSTAR) ,[16] independently by the same two reviewers (see Table 1). The AMSTAR is an 11-item tool, with each item provided a score of 1 (specific criterion is met) or 0 (specific criterion is not met, unclear, or not applicable).[16 17] An overall score for the review methodological quality is then calculated as the sum of the individual item scores: high quality, 8–11; medium quality, 4–7; or low quality, 0–3.[17] If the required data were not available in the article, the original authors were contacted for more information.

Data Extraction

Data were independently extracted by two reviewers using a predefined data extraction form. For missing or unclear information, the primary authors were contacted for clarification.

Statistical Presentation of Results from Reviews

All of the results were extracted for each included systematic review or meta-analysis, and the

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overall effect estimates are presented in a tabular form. The number of systematic reviews or meta-analyses that reported the outcome, total sample (from included publications), and information of health education interventions is also presented in the Tables (Table 2, 3).[18] A final 'summary of evidence' was developed to present the intervention, included study synthesis, and indication of the findings from the included papers (Table 4).[18]

Synthesizing the Results and Rating the Evidence for Effectiveness

The statements of evidence were based on a rating scheme to gather and rate the evidence across the included publications.[19] The statements of evidence were based on the following rating scheme: *sufficient evidence*, sufficient data to support decisions about the effect of the health education-related interventions.[19] A rating of *sufficient evidence* in this review is obtained when systematic reviews or meta-analyses with a large number of included articles or participants produce a statistically significant result between the health education group and the control group.[19] *Some evidence*, is a less conclusive finding about the effects of the health education-related interventions[19] with statistically significant findings found in only a few included reviews or studies. *Insufficient evidence*, refers to not enough evidence to make decisions about the effects of the health education-related interventions, such as non-significant results between the health education group and the control group in the included systematic reviews or meta-analyses.[19] *Insufficient evidence to determine*, refers to not enough pooled data to be able to determine whether of the health education-related interventions are effective or not based on the included reviews.[19]

Results

Characteristics of Included Trials

The selection process and number of studies at each step was illustrated as presented in Figure 1.

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The database search yielded 692 publications, with removal of 197 duplicates and 372 articles that did not meet the inclusion criteria, 124 full-text articles were retrieved after applying the methodological quality rating (AMSTAR scale), and three studies [20-22] were removed due to low scores ≤3 on the AMSTAR scale. Fifty-one systematic reviews or meta-analyses [23-73] conducted between 2001 and 2016 and published in English were included (Figure 1; Tables 1 –3); 15 relating to ACS and 36 relating to T2DM. None of the articles included patients with both ACS and T2DM. The umbrella review involved a total of 277,493 patients, including 225,034 patients with coronary heart disease or ACS (one article did not report the total sample) and 52,459 patients with T2DM (16 papers did not report the total sample). The average sample size was 8,161 (range, 536–68,556) participants. Of the included systematic reviews or meta-analyses, eleven were published in *The Cochrane Library*. Nine of the articles described meta-analyses, 29 articles described systematic reviews, and the remaining 13 articles were described as systematic reviews and meta-analyses or meta-regressions or narrative reviews.

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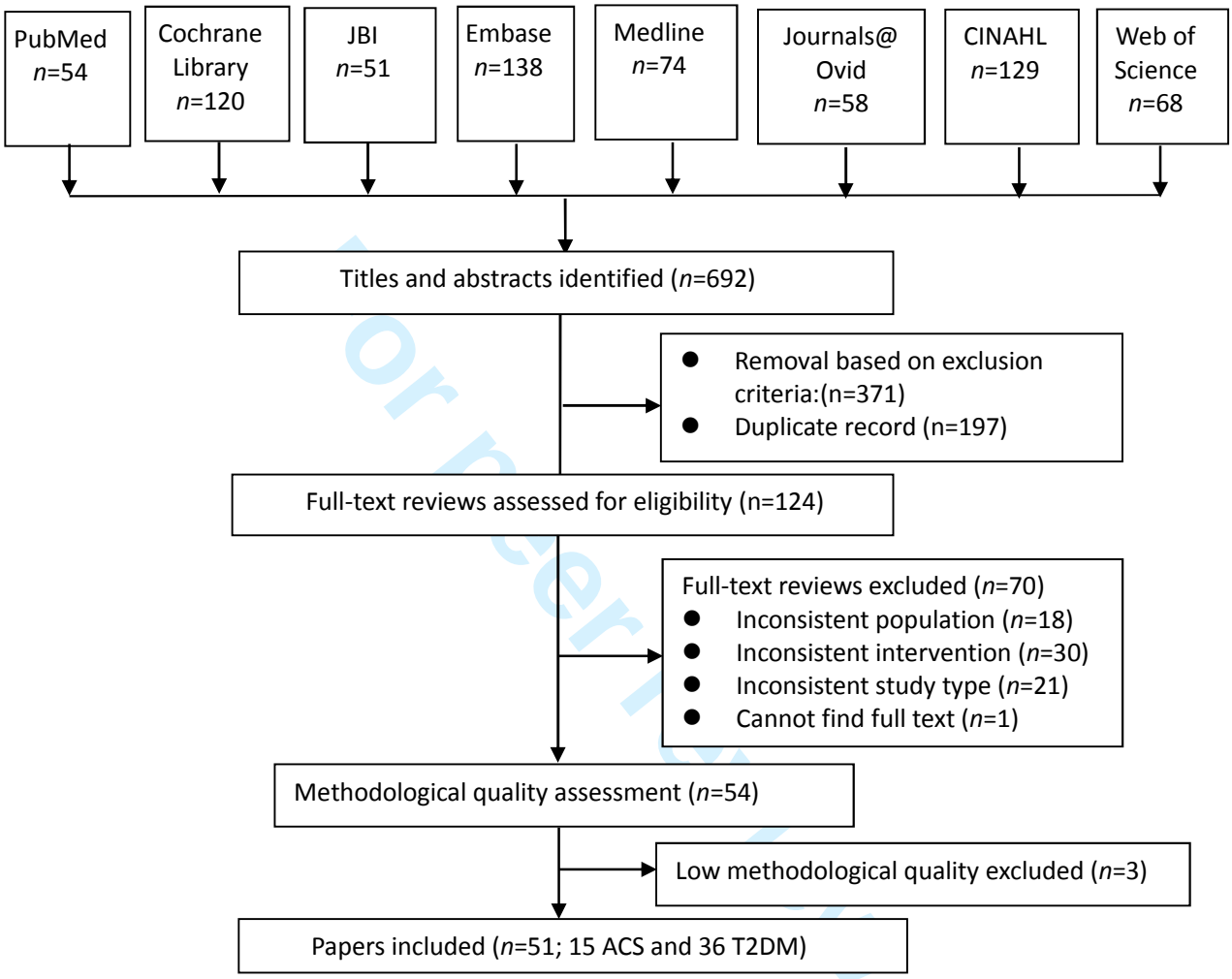

Fig. 1. Flow chart of the systematic reviews and meta-analyses selection process

Electronic database searches were conducted for all systematic reviews or meta-analyses, with an average of 6 databases searched (range, 2–16). The dates searched ranged widely, from inception of the database through December 2014. Most of the included reviews were randomized controlled trials (RCTs), and an average of 25.6 (range, 7–132) studies was included per systematic review or meta-analyses. Of the total 1,308 studies that were included in all of the reviews or meta-analyses, 406 included patients with ACS, and 902 included patients with

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T2DM. The included reviews assessed the risk of bias using the Cochrane risk of bias tool (22 publications), JADA quality score (seven publications), Joanna Briggs quality assessment tool (two publications), PEDro scale (one publication), RCT Critical Appraisal Skills Programme (one publication), and the SIGN-50 checklist (one publication).

Methodological Quality of Included Systematic Reviews and Meta-Analyses

The methodological quality of the included publications is presented in Table 1. Thirty (58.8%) publications were classified as high quality (scores 8–11), and 21 (41.2%) publications were classified as medium quality (scores 4–7). Twenty five (49%) reviews specifically provided an *a priori* design, while the use of such a design was unclear for 26 (51%) publications. The inclusion of other forms of literature (such as grey literature) was described in 18 (35%) reviews. Only 14 out of 51 (27%) reviews included a table of included and excluded studies. Only 2 (4%) reviews did not provide a characteristics table of the included papers. The scientific quality of the included papers was evaluated and documented in 47 (92%) reviews. The scientific quality of the included studies was used appropriately to formulate conclusions in 47 (92%) reviews. The methods to combine the results of the included studies were appropriate in 43 (86%) reviews. Publication bias was assessed in only 19 (37%) reviews. Finally, conflicts of interest were reported in 47 (92%) reviews.

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Table 1. Methodological quality assessment of included systematic reviews and meta-analyses

	Systematic Review/ Meta-analysis	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total score
Systematic reviews and meta-analysis involved ACS patients													
1	Barth, Jacob, Daha, & Critchley, 2015 [73]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
2	Devi et al., 2015 [37]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
3	Ghisi, Abdallah, Grace, Thomas, & Oh, 2014 [43]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	7
4	Kotb, Hsieh, & Wells, 2014 [52]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
5	Brown, Clark, Dalal, Welch, & Taylor, 2013 [30]	Yes	No	Yes	CA	No	Yes	Yes	Yes	Yes	NA	Yes	7
6	Dickens et al., 2013 [38]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
7	Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011[24]	CA	No	Yes	CA	NO	Yes	Yes	Yes	Yes	No	Yes	6
8	Brown, Clark, Dalal, Welch, & Taylor, 2011 [72]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
9	Huttunen-Lenz, Song, & Poland, 2010 [49]	CA	No	Yes	CA	No	Yes	Yes	Yes	Yes	No	No	5
10	Goulding, Furze, & Birks, 2010 [44]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
11	Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008 [27]	CA	Yes	Yes	CA	No	No	Yes	No	Yes	Yes	No	5
12	J. Barth, Critchley, & Bengel, 2008 [29]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
13	Fernandez et al., 2007 [41]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	8
14	J. Barth, Critchley, & Bengel, 2006 [28]	CA	Yes	Yes	CA	No	Yes	CA	Yes	Yes	Yes	Yes	7

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15	Clark, Hartling, Vandermeer, & McAlister, 2005 [34]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Systematic reviews and meta-analysis involved T2DM patients													
16	Choi, Davidson, Walker, Lee, & Palermo, 2016 [33]	CA	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	8
17	Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016 [35]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
18	Huang et al., 2016 [48]	CA	CA	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	7
19	Chen et al., 2015 [32]	CA	CA	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	7
20	Pillay et al., 2015 [62]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	9
21	Terranova, Brakenridge, Lawler, Eakin, & Reeves, 2015 [67]	CA	CA	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
22	Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014 [26]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10
23	Odnoletkova et al., 2014 [59]	Yes	CA	Yes	CA	No	No	Yes	Yes	Yes	Yes	No	6
24	Pal et al., 2014 [60]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
25	Ricci-Cabello et al., 2014 [64]	Yes	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	9
26	Saffari, Ghanizadeh, & Koenig, 2014 [65]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
27	Gucciardi, Chan, Manuel, & Sidani, 2013 [45]	CA	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	7
28	Pal et al., 2013 [61]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10
29	Vugt, Wit, Cleijne, & Snoek, 2013 [69]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	NA	No	Yes	6
30	Amaeshi, 2012 [25]	CA	CA	Yes	No	No	Yes	Yes	Yes	NA	No	No	4
31	Nam, Janson, Stotts, Chesla, &	CA	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8

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	Kroon, 2012 [55]												
32	Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012 [66]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	7
33	Burke et al., 2011 [31]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
34	Kai Lun Gan, Brammer, & Creedy, 2011 [50]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
35	Ramadas, Quek, Chan, & Oldenburg, 2011 [63]	CA	CA	Yes	No	No	Yes	Yes	Yes	NA	No	Yes	5
36	Hawthorne, Robles, Cannings-John, & Edwards, 2010 [47]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	CA	Yes	8
37	Minet, Moller, Vach, Wagner, & Henriksen, 2010 [54]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	9
38	Alam, Sturt, Lall, & Winkley, 2009 [23]	Yes	Yes	No	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
39	Duke, Colagiuri, & Colagiuri, 2009 [39]	Yes	CA	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	8
40	Fan & Sidani, 2009 [40]	Yes	No	Yes	CA	No	Yes	No	No	Yes	No	Yes	5
41	Hawthorne, Robles, Cannings-John, & Edwards, 2008 [46]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
41	Khunti, Camosso-Stefinovic, Carey, Davies, & Stone, 2008 [51]	CA	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	5
42	Loveman, Frampton, & Clegg, 2008 [53]	Yes	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
43	Wens et al., 2008 [70]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	NA	Yes	7
45	Nield et al., 2007 [56]	Yes	Yes	Yes	CA	Yes	Yes	Yes	Yes	Yes	No	Yes	9
46	Zabaleta & Forbes, 2007 [71]	CA	CA	Yes	CA	Yes	Yes	Yes	Yes	NA	No	No	5
47	Deakin, McShane, Cade, & Williams, 2005 [36]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11

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48	Vermeire et al., 2005 [68]	Yes	Yes	Yes	CA	Yes	Yes	Yes	Yes	Yes	No	Yes	9
49	Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003 [42]	CA	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	6
50	Norris, Lau, Smith, Schmid, & Engelgau, 2002 [58]	CA	No	Yes	No	No	Yes	Yes	Yes	CA	No	No	4
51	Norris, Engelgau, & Narayan, 2001 [57]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	NA	No	No	5

Item 1:"Was an 'a priori' design provided?"; **Item 2**: "Was there duplicate study selection and data extraction?"; **Item 3**: "Was a comprehensive literature search performed?"; **Item 4**: "Was the status of publication (ie. grey literature) used as an inclusion criterion?"; **Item 5**: "Was a list of studies (included and excluded) provided?"; **Item 6**: "Were the characteristics of the included studies provided?"; **Item 7**: "Was the scientific quality of the included studies assessed and documented?"; **Item 8**: "Was the scientific quality of the included studies used appropriately in formulating conclusions?"; **Item 9**: "Were the methods used to combine the findings of studies appropriate?"; **Item 10**: "Was the likelihood of publication bias assessed?"; **Item 11**: "Was the conflict of interest stated?"

CA= Cannot Answer; NA= Not Application;

Source: *Shea, B. J., Grimshaw, J. M., Wells, G. A., Boers, M., Andersson, N., Hamel, C., ... & Bouter, L. M. (2007). Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Medical Research Methodology, 7(1), 1.*

Characteristics of Health Educational Interventions

The description of the health educational interventions followed the Workgroup for Intervention Development and Evaluation Research (WIDER) reporting guidelines for behavior change interventions.[74] The characteristics of the recipients, setting, delivery methods, intensity, duration, and educational content of health educational interventions for patients with ACS or T2DM are summarized in Tables 2 and 3. The delivery strategies for health education included face-to-face, internet-based, phone-based, videotape, written educational materials, or mixed. The format included one-on-one (individualized), group, or both. Face-to-face sessions were the most common delivery formats, and many education sessions were also delivered by telephone/web contact or individualized counseling. The number of sessions, total contact hours,

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and durations varied, and there was limited information about the intensity of health education for patients provided. The frequency of educational sessions was weekly or monthly, and an average of 3.7 topics was covered per education session. Nurses and multidisciplinary teams were the most frequent educators, and most education programs were delivered post-discharge.

ACS

The educational content for patients with ACS covered cardiovascular risk factors in 8 reviews (53.33%), psychosocial issues in 8 reviews (53.33%), smoking cessation in 6 reviews (40.00%), exercise in 5 reviews (33.33%), behavioral change in 5 reviews (33.33%), diet in 4 reviews (26.67%), self-management in 3 reviews (20.00%), and medication in 1 review (6.67%). Two reviews only included smoking cessation and cardiovascular risk factors. The most common educational providers were nurses and a multidisciplinary team. Six studies [24 29 41 44 49 73] (6/15, 40%) described the theoretical approach that underpinned the education intervention.

T2DM

The educational content for patients with T2DM included diet in 23 reviews (63.89%), behavioral change in 21 reviews (58.33%), self-management in 20 reviews (55.56%), exercise in 17 reviews (47.22%), glycemic control in 16 reviews (44.45%), medication in 13 reviews (36.11%), psychosocial issues in 9 reviews (25.00%), smoking cessation in 2 reviews (5.56%), cardiovascular risk factors in 2 reviews (5.56%), and DM risks in one review (2.78%). The most common providers were dieticians, nurses, and a multidisciplinary team. The number of sessions, total contact hours, and durations varied. Thirteen reviews [23 26 36 42 45-47 53 57 60 63 66 69] (13/36, 36.11%) described the theoretical approach that underpinned the education intervention.

Effect of Interventions

The outcomes of the included systematic reviews and meta-analyses were summarized in Table

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4.

Patients with Acute Coronary Syndrome

Three major types of health education-related interventions were used for patients with ACS: general health education (only included general health information), psychoeducational interventions, and secondary prevention educational interventions (including strategies to promote a healthy lifestyle, manage medications, and reduce cardiovascular complications) as well as internet-based interventions.

General Health Education

The findings are based on our synthesis of the findings from 6 systematic reviews.[30 41 43 44 52 72] Overall, there were mixed effects of general health education on behavioral change or clinical outcomes in patients with ACS. There was *some evidence* of a positive effect of general health education on knowledge, behavior, psychosocial indicators, beliefs, and risk factor modification, but no effects for key clinical outcomes, such as cholesterol level, hospitalization, mortality, MI, and revascularization. The results for health-related quality of life, healthcare utilization, and costs were mixed; several reviews reported a significant change, and other reviews reported no significant change for these outcomes. Only one review focused on telephone-based health education. There is *some evidence* that telephone-based health education during cardiac rehabilitation might improve all-cause hospitalization, anxiety, depression, smoking cessation, and systolic BP but there is no evidence for improvements in all-cause mortality and reductions in low-density lipoprotein cholesterol.[52]

Psychoeducational Interventions

Strategies for psychoeducational interventions have a specific focus on smoking cessation, and

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depression. The findings are based on synthesis of results from six publications.[24 28 29 38 49 73]

There is *sufficient evidence* that psychoeducational programs are effective at decreasing smoking, achieving smoking abstinence, and reducing depression. One review reported no effect on smoking cessation [24] or total mortality [49].

Secondary Prevention Educational Interventions

The following statements are based on our synthesis of results from three papers.[27 34 37] There is *some evidence* that secondary prevention educational interventions reduce MI readmission rates and improve quality of life, but the intervention was ineffective in reducing revascularization, cholesterol levels, and improving smoking cessation rates. The results are mixed for mortality and re-infarction rates; two reviews [27 34] found positive effects on mortality, while one review [37] did not.

Patients with Type 2 Diabetes Mellitus

Ten types of health education-related interventions were used for patients with T2DM: culturally appropriate health education (tailored to the religious beliefs, culture, literacy, and linguistics of the geographical area), dietary advice, foot health education, group medical visits (a group education component taught by health professionals), general health education (only included general health information), improving adherence to medical treatment recommendations (e.g., promoting oral hypoglycemic adherence), lifestyle interventions (specific focus on dietary changes and increased physical activity, or stress management), psychoeducational interventions and self-management educational interventions (based on self-management skills), and therapeutic education (collaborative process needed to modify behavior and more effectively manage risk factors).

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Culturally Appropriate Health Education

Findings are based on our synthesis of results from 8 publications.[26 35 45-47 51 55 64] Overall, there was *some evidence* of the effects of culturally appropriate health education on clinical outcomes for T2DM. There was *sufficien*t evidence that culturally appropriate health education improves HbA1c control and knowledge scores. There is *some* evidence that physical activity and clinical outcomes (blood glucose, HbA1c, BP) were improved. There was no data relating to adverse events during the intervention and follow-up (such as hypoglycemic events and mortality), and there was insufficient evidence about improvements in quality of life.

General Health Education

The statements are based on our synthesis of results from five papers.[33 39 53 65 71] Overall, there were mixed effects of general health education programs on clinical outcomes for T2DM, including HbA1C, cholesterol level, and triglyceride level. There was *some evidence* of the effectiveness of general health education on glycemic control, weight reduction, and some diabetic control outcomes (HbA1C, diabetes complications). There were no data supporting the effectiveness of general health education on reduced health service utilization, diabetic complications, improved knowledge, psychosocial outcomes, or smoking habits.

Lifestyle Interventions

The following statements are based on our synthesis of results from 6 reviews.[32 42 48 62 63 67] Overall, there were mixed effects of the lifestyle interventions on cholesterol level, HbA1C level, and weight control. There is *some evidence* that lifestyle interventions or behavioral programs are effective for blood glucose and BP management, but they appear ineffective for HbA1c control.

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Improving Adherence to Medical Treatment Recommendations

The statements are based on our synthesis of results from three publications.[50 68 70] There is *some evidence* of the effectiveness of improving adherence to medical treatment recommendations for HbA1C control and oral hypoglycemics.

Self-Management Educational Interventions

The statements are based on our synthesis of results from 9 reviews.[36 40 54 57 58 60 61 66 69] Overall, there was *sufficient evidence* of the effects of self-management education interventions on HbA1c control, knowledge, lifestyle outcomes, and main psychosocial outcomes. However, there was *insufficient* evidence of the benefits of this education intervention on depression, quality of life, and weight control.

Other Health Education-Related Interventions

Other health education-related interventions for patients with T2DM included therapeutic education, foot health education, group medical visits, psychoeducational interventions, and dietary advice. Statements for all of these interventions are based on our synthesis of results from one review.

There is *some evidence* that foot health education is effective in reducing the incidence of lower extremity amputation. [25] There is *some evidence* that group medical visits are effective for improving HbA1c control and systolic BP management [31]. There is also *some evidence* that psychoeducational programs are effective for improving HbA1c control and psychological status.[23]

Finally, there is *insufficient evidence* that dietary advice improves glycemic and weight control or reduces diabetic micro- and macrovascular diseases.[56] There is also *insufficient evidence* for the

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cost-effectiveness of therapeutic education for patients with T2DM.[59]

Discussion

This umbrella review identified 51 systematic reviews or meta-analyses (15 for ACS and 36 for T2DM) that assessed the outcomes of various aspects (such as the duration, contact hours, educational content, delivery mode) of the delivery of health education-related interventions relevant to high risk patients with ACS and T2DM. Health education has become an integral part of the management for people with ACS and T2DM. The most appropriate focus of the education provided to ACS patients with T2DM remains largely undefined in the literature. For example, it remains unknown if the focus should be primarily on cardiovascular risk factors, blood glucose monitoring, or all educational components for patients with both conditions.[66 72] In addition, should cardiovascular risk factors be the focus during the acute inpatient stay with other educational needs such as the smoking cessation occurring within the primary care or outpatient settings.[24 72 73]

It remains challenging to determine the specific strategy or format that is the most effective delivery mode for patients with ACS or T2DM. There is very limited evidence to guide clinicians on the duration, contact hours, educational content, delivery mode, total length, and setting of health education programs for cardiac patients.[43] For patients with DM, one study reported that more successful programs were longer than 6 months (longer duration), consisted of greater than 10 contact sessions (high intensity), and were one-on-one sessions with individualized assessment.[75]

Health Education Interventions for Patients with ACS

Use of theoretical orientation to develop educational intervention

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Use of theory when designing behavioral change interventions may also influence effectiveness.[75] Health education using a cognitive behavioral strategy is most consistently effective in changing maladaptive illness beliefs,[44] and studies using more than 2 behavioral change strategies reported significant differences between the intervention and control groups.[24] In one review, a significant change in smoking cessation was not observed in subgroup analyses between studies that did or did not report using a theory in intervention planning;[49] however, the authors did not suggest that using a theory in program planning should be disregarded but reported that examining actual theories or mechanisms underlying health education programs is required.[49] Owing to the considerable overlap between different theories and the detailed description of the theoretical approach in only approximately 40% of the included papers, it is difficult to determine the most effective theoretical approach, but many models can be used with success, such as the health belief model (HBM), social cognitive theory (SCT) and transtheoretical model (TTM).[49 60 69 73]

Educational content

Most reviews reported that the educational content of the interventions was comprehensive. The most common topics, of the average 3.7 topics per education session, were behavioral change, cardiovascular risk factors management, exercise, psychosocial issues, and smoking cessation. An underlying principle of health education for patients with ACS is that knowledge is necessary, but not enough to develop health behaviors and change risk factors.[24 43] Age, cognitive factors, environmental factors, and social and economic background are also important considerations.[43] While interventions using a behavioral program, telephone-based content, or self-care are effective for smoking cessation, there was insufficient evidence to support that any type of educational program was more efficacious than the others.[73] Psychoeducation, which is

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defined as multimodal, educationally based, self-management interventions,[24] led to enhanced physical activity levels within 6–12 months when added to cardiac rehabilitation (CR) and was more effective than an exercise program or health education alone.[24 49] Moreover, psychoeducational interventions were more effective for patients with ACS than other types of health education.[24 49]

Teaching strategies and outcomes

Most reviews reported that the education was provided using multiple teaching methods and in multiple settings. Nurses and multidisciplinary teams were the most frequent people providing education, and most education programs were delivered post-discharge. Although face-to-face sessions were the most common delivery format, many education sessions were also delivered by telephone or through individualized counseling. Telephone-based health education appeared to be effective for reducing hospitalizations, systolic BP, smoking rates, depression, and anxiety.[52] The educational interventions for patients with ACS focused primarily on clinical outcomes (hospitalization and mortality), modifiable risk factors (BP, low-density lipoprotein levels, and smoking cessation), and other psychological outcomes (anxiety and depression).

Delivery, timing and follow up

Most educational sessions were delivered weekly. Few reviews provided information regarding the duration of education interventions; when the duration was reported, it varied from 4 weeks to 48 months. These findings suggest that there is a significant gap in the evidence in relation to the duration, contact hours, educational content, optimal delivery mode, total length, and setting of health education programs for cardiac patients.[43] For patients with ACS, one systematic review that included 7 studies with a total of 536 participants reported that studies with education lasting at least 6 months resulted in the most significant changes in the primary outcomes (such

as behavioral change, smoking cessation) [24] and that at least 12 months of follow-up is needed to evaluate the impact of telephone-based education.[52] Another review reported that the intensity of education programs is important for efficacy regarding smoking cessation: interventions with a very low intensity and brief interventions, do not have a significant effect,[73] and programs for smoking cessation among patients with coronary heart disease should last >1 month.[73] Most of the reviews were provided for patients with ACS in inpatient settings and then within post discharge settings, five reviews [24 29 38 41 52] did not explicitly state the settings in which the health education related interventions were provided.

Health Educational Interventions for Patients with T2DM

Use of theoretical orientation to develop educational intervention

Although the theoretical approach underpinning the health education program was not always described, there is evidence that health education interventions based on a theoretical model are likely to be effective.[36] Vugt et al suggested that self-care education programs should be based on theories and that theory-based self-care interventions are more effective than non-theory-based programs.[69 76] Theories could help to specify the key target health behaviors and behavioral change techniques required to generate the desired outcomes.[69] The decision regarding the theory should be based on the aim of the program and factor for intervention.[63] Only one review reported that a theoretical approach underpinning the health education program is not necessary for better outcomes.[66]

Educational content

The educational content for patients with T2DM focused more on behavioral change, diet, exercise, glycemic control, medication, and self-management. Health education that was self-management was more effective for patients with T2DM.[33 40] In addition, based on the current

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evidence, the educational content should be culturally sensitive, especially for patients with T2DM; [26 35 47] culturally appropriate diabetes health education may have a greater impact on glycemic control and reduce diabetic complications.[63] The educational interventions for patients with T2DM focused primarily on HbA1C, lipid levels, quality of life, and body weight. HBM and SCT were the most common theories used in the included reviews.

Teaching strategies and outcomes

Mixed health education programs generally included group sessions combined with educator-facilitated individual sessions, covering basic knowledge and problem-solving skills. These programs produced greater benefits and larger effect sizes for blood glucose control and knowledge level in patients with T2DM.[40] In contrast, individual education programs have been reported as more effective in achieving outcomes than group-based education. This may be because education programs might be more efficient at addressing personal needs, with greater participant engagement.[64] Although face-to-face sessions were the most common delivery format, many education sessions were also delivered by telephone or individualized counseling. Face-to-face health education programs were most effective for enhancing blood glucose control and knowledge levels, while mixed delivery models (face-to-face, phone contact, online or web-based, or video) produced a moderate effect for knowledge levels.[40] Another review reported that face-to-face health education programs generated a greater benefit for metabolic control than those delivered using electronic communication technology.[64]

Community workers, dieticians, multidisciplinary teams, and nurses were the most frequent educators, and most of the education programs were delivered post-discharge. Some reviews indicated that health education programs delivered by a group of different educators, with some degree of education reinforcement at additional points of contact, may provide the best results.[53]

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[66] However, based on two studies that reported HbA1C at 12 months, it was showed that the outcomes in studies with only a diabetes nurse as the educator also tended to do better than the outcomes in studies with a multidisciplinary team , while the biggest effect was seen when a dietician was the only educator.[66] Health education programs delivered by one person may focus more on the patient's ability than the educational content or quality of the health education programs.[66] However, no clear conclusion can be drawn whether having one educator delivering the intervention is best due to few information.[53]

Delivery, timing and follow up

Education sessions were delivered weekly or monthly. Longer health education programs for T2DM (>6 months) produced larger effects for all primary outcomes (such as HbA1C).[40] Health education lasting >3 months resulted in the largest effect size compared with health education of a shorter duration (<3 months).[26] For HbA1C, the effect size at 6 months seemed to be significantly greater than at 3 and 12 months; in other words, the effect size peaked at 6 months.[55] In general, health education of a greater intensity (longer duration and more sessions) was more effective for blood glucose control and knowledge level among patients with T2DM.[40] [65] Compared with health education programs covering only one topic, programs that included multiple or mixed educational topics yielded consistently greater benefits in blood glucose control and knowledge levels.[40] In addition, health education programs combined with specific behavioral change strategies (such as self-care strategies) seemed more effective than other programs.[40] Health education related interventions were mainly delivered in hospital settings, primary care settings, diabetes centers or community based settings; although six reviews [25 32 48 51 60 67] did not explicitly state the delivery settings.

Health Education Interventions for Patients with ACS and T2DM

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These results from included systematic reviews and meta-analyses help to provide recommendations about the content of a health education intervention for patients with ACS and T2DM, requiring further evaluation. Future development of educational programs for patients with ACS and T2DM by health care professionals should consider the needs of people with these diseases.[30 33 35 72] Based on the results and findings from this umbrella review, recommendations are made in Table 5.

Table 5 Recommendations of health education programs for ACS and T2DM patients

		ACS patients	T2DM patients	Both ACS and T2DM
Theoretical approach		TTM	HBM; SCT	HBM; SCT and TTM;
Educational content		Behavioral change (such as smoking cessation), cardiovascular risk factors, exercise, and psychosocial issues.	Behavioral change, diet, exercise, glycemic control, medication, and self-management.	Behavioral change (such as smoking cessation), cardiovascular risk factors, diet, exercise, glycemic control, medication, and psychosocial issues. Self- management strategies.
Healthcare professionals to deliver		Nurse or multidisciplinary team	Multidisciplinary team; dietitian or nurse	Nurse or multidisciplinary team
Teaching approaches	Strategies	Face-to-face; telephone or mixed	Face to face, written materials; telephone or mixed	Face to face, written materials; telephone contact or mixed
	Format	Individual (One by one) or mixed	Individual (One by one) or mixed	Individual (One by one) or mixed
Delivery timing	Contact hours	More than 30 min per time per week	More than 30 min per time per week	More than 30 min per time per week
	Duration	At least 6 months	About 6 months	At least 6 months
Duration of follow up		At least 12 months	At least 12 months	At least 12 months
Settings		Inpatient and post-discharge settings	Hospital settings and primary care settings	Inpatient and post-discharge settings

Note: ACS = acute coronary syndrome; T2DM = type 2 diabetes mellitus; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model.

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Overall Completeness and Applicability of Evidence

This overview potentially provides an estimate with the lowest level of bias for the impact of health education-related interventions for patients with ACS or T2DM and could be regarded as an all-inclusive summary of the current evidence base for health education for these patients.

While this umbrella review identified evidence for each of the types of health education, there was only a small number of reviews within some categories (such as psychoeducational intervention [23] and dietary advice [56]), and these studies were not very informative. This umbrella review also found no reviews that systematically analyzed varying doses of health education; therefore, could not examine the dose-response effects. There was insufficient information about the evaluated doses (total contact hours and duration of education) to enable comparison of the benefits of differences in the magnitude of the doses across the different research. This umbrella review found no reviews focused on patients with ACS and T2DM; instead, all of the systematic reviews and meta-analyses focused on only one of these diseases.

Quality of the Evidence

The methodological quality of the included systematic reviews and meta-analyses varied. All of the included reviews or meta-analyses were of moderate to high methodological quality, as assessed using AMSTAR. However, only 30 (58.8%) systematic reviews or meta-analyses were rated as high quality and only three (5.9%) systematic reviews or meta-analyses [36 46 73] adequately met all 11 AMSTAR criteria. This indicates that some of the reviews included in this umbrella review may have limitations in their design, conduct, and/or reporting that could have influenced the findings when considered both individually and collectively.[25 58]

The quality of the primary studies in the included systematic reviews or meta-analyses also

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varied. The main sources of bias were inadequate reporting of allocation concealment and randomization processes, as well as lack of outcome blinding.[26 35 72 73] This bias in the methodological quality led to lower quality assessments, which varied by results within each included review. Other reasons for lower methodological quality included heterogeneity in, or inconsistency of, the effect and imprecise findings. Heterogeneity between studies in this umbrella review was described in terms of the intervention, participant characteristics and length of follow-up. Heterogeneity was an important factor indicating the complexity of the health education interventions.[49] The variability in the approaches, tools or scales used to measure outcomes between the included studies are likely to introduce some heterogeneity.[23] The heterogeneity of the educational interventions seen in the reviews included in this umbrella review may reflect the uncertainty about the optimal strategy for providing health education to patients.[30]

This umbrella review is the first synthesis of systematic reviews or meta-analyses to take a broad perspective on health education-related interventions for patients with ACS or T2DM. Given that health education is complex, the biggest challenge for systematic reviews or meta-analyses of health education is accounting for the potential clinical heterogeneity in health education-related interventions (content and delivery approaches) and the population of patients who receive health education. To facilitate comparisons across systematic reviews of health education and the efficient future update of this umbrella review, future reviews or meta-analyses need high-quality research and to standardize their design and reporting, including the reporting of included study characteristics, assessment criteria for risk of bias, outcomes, and methods to synthesize evidence synthesis.

Conclusions

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For clinicians providing educational interventions to individuals with ACS and T2DM, the results from this review provide a contemporaneous perspective on current evidence on effectiveness of health education (its content, and delivery methods) for this high risk patient group. The current evidence compiled by this umbrella review supports current international clinical guidelines, that theoretically-based education interventions lasting 6 months, delivered in multiple modes (face-to-face, phone contact, online or web-based, or video), and with individualized education delivered weekly are more likely to generate positive outcomes. This review also supports health education- related interventions provided by health professionals, including nurses only and multidisciplinary teams, and the delivery content included specific clinical factors for ACS and T2DM (BP, glycemic control, and medication), modifiable risk factors (unhealthy diet, inactivity, and smoking), and other psychological factors (anxiety and depression). These health education interventions could be delivered post-discharge, such as rehabilitation centers, primary care centers, and the community and should be at least 6 months in duration. The effectiveness of these programs was based on HbA1C levels, knowledge, psychosocial outcomes, readmission rates, and smoking status rather than clear evidence of reduced mortality and MI.

In addition, psychoeducational interventions were more effective for patients with ACS, and health education that was culturally appropriate or taught self-management was more effective for patients with T2DM. We also found that longer durations and high-intensity health education provided in an individualized format were more helpful for patients with ACS or T2DM.

The fact that none of the included reviews included patients with both ACS and T2DM indicates a clear need for further rigorous experimental studies with patients with both diseases. Future research that includes these aspects of education are likely determine the effectiveness of

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educational interventions focusing on cardiovascular and DM risk factors and complications within patients with ACS and T2DM.

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Table 2. Characteristics and interventions of included systematic reviews and meta-analysis involved ACS patients

(First author, Year); Journal	Primary objectives (To assess effect of interventions on….)	Studies details	Intervention					Outcomes (Primary outcomes were bold.) "–" : No change " ↑ " : Increase " ↓ " : decrease	Synthesis methods
			Educational Content		Provider	Number of session(s), delivery mode, time, setting			
(Devi et al., 2015) [37]; The Cochrane Library	Lifestyle changes and medicines management	**Number of studies**:11 completed trials (12 publications); **Types of studies:** RCTs; **Total sample:** 1,392 participants.	All Internet based interventions.	√ BEHA (-) √ CVR (-) √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY(-) √ SMOKING (-) ☐ SELF	Dietitians; exercise specialists; nurse practitioners; physiotherapist rehabilitation specialists, or did not describe.	**Number of session:** Weekly or monthly or unclear; **Total contact hours:** Unclear. **Duration:** From six weeks to one year.	**Strategies:** Internet- and mobile phone-based intervention, such as email access, private-messaging function on the website, one-to-one chat facility, a synchronised group chat, an online discussion forum, or telephone consultations; or video files; **Format:** one-on-one chat sessions; "ask an expert" group chat sessions; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**– Clinical outcomes;** **– Cardiovascular risk factors;** – Lifestyle changes; – Compliance with medication; – Healthcare utilization and costs; ↓ Adverse intervention effects.	Meta-analysis used Review Manager software.
(Barth, Jacob, Daha, & Critchley, 2015) [73]; The Cochrane Library	Smoking cessation	**Number of studies**:40 RCTs; **Types of studies:** RCTs; **Total sample:** 7,928 participants.	Psychosocial smoking cessation interventions	☐ BEHA ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY √ SMOKING ☐ SELF	Cardiologist; general practitioner physician or study nurse.	**Number of session**: Weekly or 2-3 times per week; **Total contact hours:** Unclear. **Duration:** From 8 weeks to one year.	**Strategies:** Face to face, telephone contact, written educational materials, videotape, booklet or unclear; **Format:** One by one counseling; telephone call; group meetings or unclear; **Theoretical approach:** TTM, SCT.	Inpatient settings, post discharge, other	↑ **Abstinence by self-report or validated.**	Meta-analysis used Review Manager software.
(Kotb, Hsieh, & Wells, 2014) [52]; PLoS one	Patients' outcomes.	**Number of studies**: 26 studies; **Types of studies:** RCTs; **Total sample:** 4,081	Telephone-delivered post-discharge interventions.	☐ BEHA √ CVR ☐ DIET ☐ EXERCISE ☐ MED	Dietitians; exercise specialist; health educators; nurses and pharmacists.	**Number of session:** 3-6 sessions/telephone calls and was greater than 6 calls in five	**Strategies:** Telephone calls; **Format:** Unclear, did not describe the format; **Theoretical approach:** Unclear.	Unclear, did not describe the setting.	↓ **All-cause hospitalization;** – **All-cause mortality;** ↓ Depression;	Meta-analysis used Review Manager software.

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		participants.		☐ PSY ☐ SMOKING ☐ SELF		studies; or unclear; **Total contact hours:** 40 mins to 180 mins or unclear; **Duration:** 1.5 - 6 months or unclear.			– Anxiety; ↑ Smoking cessation, ↓ Systolic blood pressure; – LDL-c.	
(Ghisi, Abdallah, Grace, Thomas, & Oh, 2014) [43]; Patient Education and Counseling	knowledge, health behavior change, medication adherence, psychosocial well-being.	**Number of studies**: 42 articles; **Types of studies:** Thirty were experimental: 23 RCTs and 7 quasi-experimental; and 11 observational and 1 used a mixed-methods design. **Total sample:** 16,079 participants.	Any educational interventions.	√ BEHA (+) √ CVR (++) √ DIET (+++) √ EXERCISE (++) √ MED (++) √ PSY(++) √ SMOKING (+) ☐ SELF	Nurses (35.7%), a multidisciplinary team (31%), dietitians (14.3%), and a cardiologist (2.4%).	**Number of session:** 1-24 or unclear. **Total contact hours:** 5–10 min to 3 h as well as a full day of education. **Duration:** 1-24 month; from daily education to every 6 months.	**Strategies:** Did not describe the strategies; **Format:** Group (88.1%) education was delivered by lectures (40.5%), group discussions (40.5%), and question and answer periods (7.1%). Individual education (88.1%), including individual counseling (50%), follow-up telephone contacts (31%) and home visits (7.1%); **Theoretical approach:** Unclear.	Inpatient settings	**– Knowledge,** **– Behavior;** **– Psychosocial indicators.**	Narrative synthesis
(Brown, Clark, Dalal, Welch, & Taylor, 2013) [30]; European Journal of Preventive Cardiology	Mortality, morbidity, HRQoL and healthcare costs.	**Number of studies:** Twenty-four papers reporting on 13 RCTs; **Types of studies:** RCTs; **Total sample:** 68,556 participants.	Patient education.	☐ BEHA √ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	Nurses or other healthcare professionals.	**Number of session and Duration:** From a total of 2 visits to a 4-week residential stay reinforced with 11 months of nurse led follow-up. **Total contact hours:** Unclear.	**Strategies:** Face-to-face education sessions, telephone contact and interactive use of the Internet; **Format:** Group-based sessions, individualized education and four utilized a mixture of both sessions; **Theoretical approach:** Unclear.	Inpatient settings, other	**– Mortality,** **– Non-fatal MI,** **– Revascularizations,** **– Hospitalizations,** **– HRQoL,** – Withdrawals/drop outs; – Healthcare utilization and costs.	Meta-analysis used Review Manager software.
(Dickens et al., 2013) [38]; Psychosomatic Medicine	Depression and depressive symptoms.	**Number of studies:** Sixty-two independent studies. **Types of studies:** RCTs; **Total sample:** 17,397.	Psychological interventions.	√ BEHA (-) ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING	A single health professional or by a unidisciplinary team	**Number of session:** 14.4 (range, 1-156); **Total contact hours:** Varying from 10 to 240 minutes. **Duration:** Unclear.	**Strategies:** Face-to-face sessions, telephone contact or unclear; **Format:** Group or unclear; **Theoretical approach:** Unclear.	Unclear, did not describe.	**↓ Depression;** – Adverse cardiac outcomes; – Ongoing cardiac symptoms.	Univariate analyses using Comprehensive Meta-Analysis, multivariate

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				√ SELF (-)						meta-regression using SPSS 15.0
(Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011) [14]; Journal of Cardiopulmonary Rehabilitation & Prevention	Health behavior change.	**Number of studies:** 7 trials. **Types of studies:** Six randomized controlled trials and a quasi-experimental trial. **Total sample:** 536 participants.	All psychoeducational or behavioral intervention.	☐ BEHA √ CVR (-) ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Appropriately trained health care workers.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 2-12 months.	**Strategies:** Did not describe the strategies; **Format:** Group setting, combination of group and one-on-one education and one-on-one format only; **Theoretical approach:** TTM, interactionist role theory, Bandura's self-efficacy theory, Gordon's relapse prevention model and a cognitive behavioral approach.	Unclear, did not describe.	**↓ Smoking rates; medication use; − Supplemental oxygen use; ↑ Physical activity;** ↑ Nutritional habits.	Meta-analysis and narrative presentation
(Brown, Clark, Dalal, Welch, & Taylor, 2011) [12]; The Cochrane Library	Mortality, morbidity, HRQofL and healthcare costs.	**Number of studies:** 24 papers reporting on 13 studies. **Types of studies:** RCTs; **Total sample:** 68,556 participants.	Patient education.	√ BEHA (-) √ CVR (-) ☐ DIET √ EXERCISE (-) ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	Nurse or did not describe.	**Number of session and Duration:** two 2 visits to 4 week residential 11 months of nurse led folluw up **Total contact hours:** Unclear.	**Strategies:** face-to-face sessions, telephone contact and interactive use of the Internet; **Format:** Four studies involved group sessions, five involved individualized education and three utilized both session types, with one study comparing the two approaches; **Theoretical approach:** did not describe.	Post discharge, other	**− Total mortality; − Cardiovascular − mortality; − Non-cardiovascular mortality; − Total cardiovascular (CV) events; − Fatal and/or non-fatal MI;** − Other fatal and/or non-fatal CV events	Meta-analysis used Review Manager software.
(Moulding, Furze, & Birks, 2010) [10]; Journal of Advanced Nursing	Change maladaptive illness.	**Number of studies: 13 studies; Types of studies:** RCTs; **Total sample:** Unclear.	Interventions to change maladaptive illness beliefs	√ BEHA (-) ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING	Cardiologist, nurse, psychologist or did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 4 days to two weeks or unclear.	**Strategies:** Face-to-face sessions, telephone contact and written self-administered; **Format:** Unclear; **Theoretical approach:** Common Sense Model, Leventhal's framework.	Inpatient settings, post discharge, other	**− Beliefs (or other illness cognition);** − QoL; − Behaviour; − Anxiety or depression; − Psychological	A descriptive data synthesis.

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				☐ SELF					wellbeing; − Modifiable risk factors; protective factors.	
(Huttunen-Lenz, Song, & Poland, 2010) [49]; British Journal of Health Psychology	Smoking cessation.	**Number of studies:** A total of 14 studies were included. **Types of studies:** RCTs; **Total sample:** 1,792 participants.	Psychoeducational cardiac rehabilitation intervention.	☐ BEHA ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	Cardiologist, nurse psychologist, or did not describe.	**Number of session:** 4-20 or unclear. **Total contact hours:** 10-720 mins or unclear. **Duration:** 4-29 weeks or unclear.	**Strategies:** Face-to-face counselling, self-help materials; home visit, booklet, video and telephone contact. **Format:** individual or unclear. **Theoretical approach:** Social learning theory; ASE model; TTM; Behavioural multicomponent approach.	Inpatient settings, post discharge, other	**↑ Prevalent smoking cessation, ↑ Continuous smoking cessation,** − Mortality.	Subgroup meta-analysis was used software.
(Bauer, Gaume, Rodondi, Zdrnuz, & Ghali, 2008) [27]; Circulation	Multiple cardiovascular risk factors and all-cause mortality.	**Number of studies:** 27 articles reporting 26 studies. **Types of studies:** 16 clinical controlled trials and 10 before-after studies. **Total sample:** 2,467 patients in CCTs and 38, 581 patients in before-after studies.	In-Hospital Multidimensional Interventions of Secondary Prevention	☐ BEHA ☐ CVR √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY (-) √ SMOKING (-) ☐ SELF	Cardiac nurses; physician, or did not describe.	**Number of session:**1-5 or unclear; **Total contact hours:** 30-240mins or unclear; **Duration:** 4 weeks – 12 months.	**Strategies:** Written material; audiotapes; presentations; face-to-face; **Format:** Group or unclear; **Theoretical approach:** Unclear.	Inpatient settings.	**↓ All-cause mortality; ↓ Readmission rates; − Reinfarction rates.**	Stata version 9.1.
(Barth, Critchley, & Bengel, 2008) [29]; The Cochrane Library	Smoking cessation.	**Number of studies:** Forty trials; **Types of studies:** RCTs; **Total sample:** 7,682 patients.	Psychosocial intervention	√ BEHA (+++) √ CVR (++) ☐ DIET ☐ EXERCISE ☐ MED √ PSY (+) √ SMOKING (+++)	Cardiologist, nurse, physician or study nurse.	**Number of session:** 1-5 or unclear; **Total contact hours:** 15 mins - 9 hours. **Duration:** within 4 weeks or did not report on the duration.	**Strategies:** Face to face; information booklets, audio- or videotapes. **Format:** Group sessions or individual counselling; **Theoretical approach:** TTM.	Inpatient settings	**↑ Abstinence by self-report or validated.**	Meta-analysis used Review Manager software.

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				√ SELF(+++)						
(Fernandez et al., 2007) [41]; International Journal of Evidence-Based Healthcare	Risk factor modification.	**Number of studies:** Seventeen trials; **Types of studies:** randomised, quasi-RCTs and clustered trials; **Total sample:** 4,725 participants.	Brief structured intervention.	√ BEHA (-) √ CVR (-) ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Case manager; dieticians; health educator; nurses; psychologist; and research assistants.	**Number of session:** supportive counselling ranged from 1 to 7 calls for the duration of the study; **Total contact hours:** varied from 10 to 30 mins; **Duration:** Unclear.	**Strategies:** Written, visual, audio, telephone contact; **Format:** did not describe; **Theoretical approach:** theoretical behaviour change principles.	Unclear, did not describe.	**↓ Smoking;** **− Cholesterol level;** **− Physical activity;** **↑ Dietary habits;** **↓ Blood sugar levels;** **− BP levels;** **↓ BMI;** − Incidence of admission.	Cochrane statistical package Review Manager.
(J. Barth, Critchley, & Bengel, 2006) [28]; Annals of Behavioral Medicine	Smoking cessation.	**Number of studies:** Nineteen trials; **Types of studies:** RCTs; **Total sample:** 2,548 patients.	Psychosocial interventions.	√ BEHA (+++) √ CVR (++) ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING √ SELF (+++)	Unclear, did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face to face, telephone contact or unclear; **Format:** Unclear; **Theoretical approach:** Unclear.	Unclear, did not describe.	**↑ Abstinence;** **↓ Smoking status**.	Data analyses were carried out in Review Manager 4.2.
(Clark, Hartling, Vandermeer, & McAlister, 2005) [34]; Annals of Internal Medicine	Mortality, MI	**Number of studies:** 63 randomized trials; **Types of studies:** RCTs; **Total sample:** 21,295 patients.	Secondary prevention programs	☐ BEHA ☐ CVR √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Nurse, multidisciplinary team, or did not describe.	**Number of session:** 1-12 or unclear; **Total contact hours:** did not describe. **Duration:** 0.75-48 months.	**Strategies:** Face to face, telephone contact and home visit; **Format:** Group and individual or unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ Mortality,** **↓ MI,** − Hospitalization rates.	Performed analyses by using Review Manager 4.2 and Qualitative Data Synthesis

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SMOKING= Smoking cessation; CVR= Cardiovascular risk factors; PSY =Psychosocial issues (depression, anxiety); DIET =Diet; EXERCISE= Exercise; MED= Medication; BEHA = Behavioral charge (including lifestyle modification); SELF = Self-management (including problems solving); GC= glycemic control; DR =Diabetes risks; CHD= Coronary heart disease; CAD = Coronary Artery Disease; CHW=Community Health Worker; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; LDL = Low-density Lipoprotein Cholesterol; SMS = Short Message Service; BCTs = Behavioral Change Techniques; LEA = Lower Extremity Amputation; PRIDE = Problem Identification, Researching one's routine, Identifying a management goal, Developing a plan to reach it, Expressing one's reactions and Establishing rewards for making progress; ASE = Attitude-social influence-efficacy; CVRF= Cardiovascular Risk Factors; SMS = Short Message System; PA = Physical Activity; EDU = Patient Education; GP= General Practice; RCTs =Randomized controlled trials; CCTS = controlled clinical trials; HRQoL = Health Related Quality of Life; QoL = Quality of Life; MI = Myocardial Infarction; CAD = Coronary Artery Disease; CABG= Coronary Artery Bypass Graft Surgery; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model; SAT=Social Action Theory;

In the educational content: “+”: minor focus; “++”:moderate focus; “+++” major focus; “-“ =unclear what the intensity of the education was for any topic;

In the outcomes: arrow up (“ ↑ ”) for improvement, arrow down (“ ↓ ”) for reduction; a dash (“−”) for no change or inconclusive evidence. Primary outcomes were bold.

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Table 3. Characteristics and interventions of included systematic reviews and meta-analysis involved T2DM patients

(First author, Year); Journal	Primary objectives (To assess effect of interventions on….)	Studies details	Intervention					Outcomes (Primary outcomes were bold.) "–" : No change " ↑ " : Increase " ↓ " : decrease	Synthesis methods
			Educational Content		Provider	Number of session(s), delivery mode, time, setting			
(Choi, Davidson, Walker, Lee, & Palermo, 2016) [33]; Diabetes Research and Clinical Practice	Glycemic effect	**Number of studies:** 53 studies(five in English, 48 in Chinese); **Types of studies:** RCTs; **Total sample:** Unclear.	Diabetes education intervention.	☐ BEHA √ DIET (-) ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Unclear, did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 30–150 min or unclear.	**Strategies:** Face to face, written materials; telephone contact and home visit; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c (glycated haemoglobin).**	STATAversion 12 and Review Manager version 5.3
(Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016) [35]; Diabetic Medicine	successful outcomes and to suggest directions for future research.	**Number of studies: 33; Types of studies:** RCTs; **Total sample:** 7,453 participants.	Culturally appropriate health education.	√ BEHA (-) √ DIET (-) √ DR (-) √ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	CHWs, clinical pharmacists dieticians, Nurses, podiatrists, physiotherapists, and psychologists.	**Number of session:** one to ten or unclear; **Total contact hours:** unclear; **Duration:** from a single session to 24 months.	**Strategies:** Face-to-face; Phone contact; **Format:** group sessions (10 studies), individual sessions (13) or a combination of both; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c,** **– HRQoL,** **– Adverse events,** – BP, – BMI, – Lipid levels, – diabetes complications, – Economic analyses, – Mortality and diabetes knowledge, – Empowerment, – Self-efficacy and satisfaction.	Meta-analysis using the Review Manager statistical program.

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(Huang et al., 2016) [48]; European Journal of Internal Medicine	Clinical markers of cardiovascular disease	**Number of studies:** 17 studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Lifestyle interventions.	☐ BEHA √ DIET (-) √ CVR (-) √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Nurse, Pharmacist or unclear.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 6 month – 8 years.	**Strategies:** Unclear; **Format:** Individual; Group and Mixed. **Theoretical approach:** Unclear;	Unclear, did not describe.	**Cardiovascular risk factors** (such as, − BMI, ↓ HbA1c, − BP, ↓ The level of cholesterol.)	Review Manager 5.1.
(Chen et al., 2015) [32]; Metabolism-Clinical and Experimental	Clinical markers.	**Number of studies:** 16 studies; **Types of studies:** RCTs; **Total sample:** per study ranged from 23 to 2575;	Lifestyle intervention.	√ BEHA (-) ☐ DIET √ CVR (-) ☐ EXERCISE ☐ GC √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Unclear, did not describe.	**Number of session:** Monthly; **Total contact hours:** Unclear; **Duration:** < 6 months -8 years.	**Strategies:** Unclear; **Format:** Individual; Group and Mixed; **Theoretical approach:** Unclear.	Unclear, did not describe.	**Cardiovascular risk factors** including ↓ BMI, ↓ HbA1c, ↓ SBP, DBP, − HDL-c, and LDL-c.	All analyses were performed using Comprehensive Meta-Analysis statistical software.
(Terranova, Brakenridge, Lawler, Eakin, & Reeves, 2015) [67]; Diabetes, Obesity and Metabolism	Weight loss.	**Number of studies:** 10 individual studies (from 13 papers); **Types of studies:** RCTs; **Total sample:** ranging from 27 to 5145 participants.	Lifestyle-based-only intervention.	√ BEHA (-) √ DIET (-) ☐ DR (-) √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Dietician; diabetes educator; general physician; multidisciplinary team; or nutritionist; nurse.	**Number of session:** 1-42; **Total contact hours:** Unclear; **Duration:** ranged from 16 weeks to 9 years.	**Strategies and Format:** Face-to-face individual or group-based sessions, or a combination of those. One study delivered the intervention via the telephone **Theoretical approach:** Unclear.	Unclear, did not describe.	**↓ Weight change; − HbA1c.**	Meta-analyses - Review Manager and meta-regression analysis - stata version
(Pillay et al., 2015) [62]; Annals of	HbAlc level.	**Number of studies:** 132; **Types of studies:**	Behavioral Programs.	√ BEHA (-) √ DIET (-) ☐ DR	Trained individuals.	**Number of session:** Unclear; **Total contact hours:**	**Strategies:** Unclear; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge,	**− HbA1c; ↓ BMI.**	The analysis was conducted

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internal medicine		RCTs; **Total sample:** Unclear.	√ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)		range,17 to 40.5 hours; **Duration:** 4 or more weeks.		other		by using a Bayesian network model.
(Pal et al., 2014) [60]; Diabetes Care	Health status, cardiovascular risk factors, and QoL.	**Number of studies:** 20 papers describing 16 studies; **Types of studies:** RCTs; **Total sample:** 3,578 participants.	Computer-based self-management interventions.	☐ BEHA ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF	Unclear, did not describe.	**Number of session:** 1-8 ; **Total contact hours:** 10 mins - 6 hours; **Duration:** 8 weeks – 12 months;	**Strategies:** Online/web-based; Phone contact. **Format:** Individual; Group and Mixed. **Theoretical approach:** TTM, social ecological theory, SCT, and self-determination theory.	Unclear, did not describe.	**− HRQoL, ↓ HbA1c, − Death;** ↓ Cognitions, behaviors, − Social support, ↓ Cardiovascular risk factors, − Complications, − Emotional outcomes, − Hypoglycemia, − Adverse effects, − CE and economic data.	Meta-analysis using Review Manager software or narrative presentatio.
Ricci-Cabello et al., 2014) [64]; BMC endocrine disorders	Knowledge, behaviors and clinical outcomes.	**Number of studies:** Thirty-seven studies; **Types of studies:** Almost two thirds of the studies were RCTs, 27% studies were Quasi-experimental design. **Total sample:** Unclear.	DSM educational programs.	☐ BEHA √ DIET(+++) ☐ DR √ EXERCISE (+++) √ GC(+++) √ MED(++) √ PSY(++) ☐ SMOKING ☐ SELF	Dietitian; Nurse; Psychologist; Physician; Research team or staff;	**Number of session:** 13.1; **Total contact hours:** 0.25-180 hours; **Duration:** 0.25-48 months.	**Strategies:** Face-to-face; Telecommunication; Both. **Format:** One on one; Group and Mixed. **Theoretical approach:** Unclear.	Post discharge, other	**− Diabetes knowledge; − Self-management; − Behaviors; − Clinical outcomes;** ↓ Glycated hemoglobin; − Cost-effectiveness analysis.	Meta-analyses and bivariate meta-regression were conducted with Stata, version 12.0.

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(Saffari, Ghanizadeh, & Koenig, 2014) [65]; Primary Care Diabetes	Glycemic control.	**Number of studies:** 10; **Types of studies:** RCTs; **Total sample:** 960 patients.	An educational intervention using SMS.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Unclear, did not describe.	**Number of session:** Weekly; or 2 messages daily or unclear; **Total contact hours:** Unclear. **Duration:** 3 months – 1 year	**Strategies:** SMS: sending and receiving data. Receive data through text-messaging by patients only. Used a website along with SMS; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↑ **Glycemic control**.	Comprehensive Meta-analysis Software Version 2.0.
(Odnoletkova et al., 2014) [66]; Journal of Diabetes & Metabolism	Cost-effectiveness (CE).	**Number of studies:** Seventeen studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Therapeutic education.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	General physician; nutritionists or unclear.	**Number of session:** ~ 16; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face-to-face or unclear; **Format:** individual and group lessons; **Theoretical approach:** Unclear.	Inhospital or unclear.	− **CE.**	Incremental Cost-Effectiveness Ratio.
(Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014) [26]; The Cochrane Library	HbAlc level, Knowledge and clinical outcomes.	**Number of studies:** 33 trials; **Types of studies:** RCTs and quasi-RCTs; **Total sample:** 7453 participants.	'Culturally appropriate' health education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	CHWs; dieticians; exercise physiologists; lay workers; nurses; podiatrists; and psychologists;.	**Number of session:** one session to 24 months; **Total contact hours:** Unclear; **Duration:** The median duration of interventions was six months.	**Strategies:** **Format:** Group intervention method, one-to-one sessions and a mixture of the two methods. Or a purely interactive patient-centred method. **Theoretical approach:** empowerment theories; behaviour change theories, TTM of behaviour change and SCT.	Inpatient settings, post discharge, other	↓ **HbA1c;** − **HRQoL;** − **Adverse events;** − Mortality; − Complications; −Satisfaction; ↑ Empowerment; ↑ Self-efficacy; − Attitude; knowledge;	Meta-analyses used Review Manager software.

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									−BP; −BMI; ↓ Lipid levels; −Health economics.	
(Vugt, Wit, Cleijne, & Snoek, 2013)[69]; Journal of Medical Internet Research	Health outcomes.	**Number of studies:** 13 studies; **Types of studies:** RCTs; **Total sample:** 3813 patients.	BCTs are being used in online self-management interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Health care professional.	**Number of session:** 6 weekly sessions or unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Online/web-based; **Format:** Unclear; **Theoretical approach:** self-efficacy theory, social support theory, TTM, SCT, social-ecological model, and cognitive behavioral therapy.	Post discharge	**− Health behavior change,** **− Psychological well-being;** − Clinical parameters.	Unclear.
(Cucciardi, Chan, Manuel, & Sidani, 2013)[48]; Patient Education and Counseling	HbAIc level,physical activity and diet outcomes.	**Number of studies:** Thirteen studies; **Types of studies:** RCTs and comparative studies; **Total sample:** Unclear.	DSME interventions.	☐ BEHA √ DIET (+++); ☐ DR √ EXERCISE (+++); ☐ GC √ MED (+); √ PSY (+) ☐ SMOKING √ SELF (++).	Dietitians (n = 7/13); Multidisciplinary Team (n = 7/13); Nurse (n = 5/13); Community Peer Worker (n = 3/13).	**Number of session:** Low Intensity: <10 education sessions (n = 7); High Intensity: ≥ 10 education sessions (n = 6); **Total contact hours:** Unclear; **Duration:** < 6 months (n = 7/13); ⩾6months (n = 6/13).	**Strategies:** Face-to-face(n = 13/13); Written Literature: (e.g., handbook) (n = 4/13);Telephone(n = 4/13);Audio-Visual(n = 1/13); **Format:** One-on-one: (n = 11/13);Group (n = 9/13); **Theoretical approach:** SAT; Empowerment Behavior Change Model; modification theories; Pharmaceutical Care Model; Behavior Change Theory; PATHWAYS Program; Symptom-Focused Management Model; Motivational interviewing.	Inpatient settings, post discharge	**− HbA1c levels,** − Anthropometrics, − Physical activity; − Diet outcomes.	Arecently described method.
(Pal et al., 2013)[61]; The Cochrane Library	Health status and HRQoL.	**Number of studies:** 16 studies; **Types of studies:** RCTs; **Total sample:** 3,578	Computer-based diabetes self-management intervention.	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-)	Nurse or other healthcare professionals.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** One session –	**Strategies:** Online/web-based; phone contact **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**− HRQoL;** **− Death from any cause;** **↓ HbA1c;**	Formal meta-analyses and narrative

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		participants.		√ MED (-) √ PSY (-) ☐ SMOKING ☐ SELF		18 months.			− Cognitions; − Behaviours; −Social support; −Biological markers; − Complications.	synthesis.
(Nam, Janson, Stotts, Chesla, & Kroon, 2012)[55]; Journal of Cardiovascular Nursing	Glycemic control.	**Number of studies:** 12 RCTs; **Types of studies:** RCTs; **Total sample:** 1,495 participants.	Diabetes educational interventions (no drug intervention).	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) √ PSY (-) ☐ SMOKING √ SELF (-)	Nurses (36%), dieticians (36%), diabetes educators (5%), other professionals (9%) and nonprofessional staff (14%).	**Number of session:** 1 month or less; 1 to 3 months; and 12 months; **Total contact hours:** most studies did not describe, or from 1 session to more than 30 hours; **Duration:** from 1 session to 12 months, frequency: 1 session to 25 weekly or biweekly education.	**Strategies:** Teaching or counseling; home-based support; and visual aids. **Format:** group education or a combination of group education and individual counseling; or only individual counseling; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c level.**	Meta-analysis.
(Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012)[66]; BMC Health Services Research	Clinical, lifestyle and psychosocial outcomes.	**Number of studies:** 21 studies (26 publications). **Types of studies:** RCTs; **Total sample:** 2,833 participants.	Group-based education.	Did not describe the content of the intervention.	Community workers; dietician; lay health advisors nurse and nutritionist.	**Number of session and Total contact hours:** 30 hours over 2.5 months, 52 hours over one year,and 36 hours or 96 hours over 6 months. **Duration:** Six months to two years.	**Strategies:** Face to face; **Format:** 5 to 8 participants group to 40 patients group. **Theoretical approach:** empowerment model and the discovery learning theory, the SCT and the social ecological theory, the self-efficacy and self-management theories and operant reinforcement theory.	Inpatient settings, post discharge, other	**↓ HbA1c,** **↑ Lifestyle outcomes,** **↑ Diabetes knowledge,** ↑ Self-management skills, ↑ Psychosocial outcomes, ↓ Mortality rate, ↓ BMI, ↓ Blood pressure; ↓ Lipid profile.	Meta-analysis using Review manager v5.
(Amaeshi,	Increasing	**Number of studies:**	Foot health	Food care.	Podiatrist,	**Number of session:**	**Strategies:** Face to face;	Unclear, did	**↓ LEA;**	Narrative

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2012) [25]; Podiatry Now	good foot health practices that will ultimately reduce LEA.	8 studies; **Types of studies:** RCT or clinical controlled trial (CCT); **Total sample:** Unclear.	education:		psychotogist or unclear.	Unclear; **Total contact hours:** between 15min and 14 hours; **Duration:** 3-30 months.	**Format:** In three of the studies, educational interventions were delivered to the participants in groups, while the other five provided individualized (one-to-one) foot-care education to the participants; **Theoretical approach:** Unclear.	not describe.	↑ Self-care.	synthesis.
Kai Lun Gan, Brammer, & Kzeedy, 2011) [50]; JBI Library of Systematic Reviews	Oral hypoglycaemic adherence.	**Number of studies:** Seven studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Educational interventions.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) √ PSY (-) ☐ SMOKING √ SELF (-)	Nurses; pharmacists; other skilled healthcare professionals.	**Number of session:** 1-12 or unclear; **Total contact hours:** 2.5 hours or unclear; **Duration:** 4-12 months.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↓ **HbA1c,** **– Medication adherence;** ↓ Blood glucose; – Tablet count; – Medication containers; – Diabetes complications; – Health service utilization.	Narrative summary form.
Burke et al., 2011) [31]; JBI Database of Systematic Reviews and Implementation Reports	HbAlc level,BP.	**Number of studies:** 11 RCTs and 4 quasi-experimental trials; **Types of studies:** RCTs and quasi-experimental trials; **Total sample:** 2,240 patients.	Group medical visits.	√ BEHA (-) √ DIET (-) ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Dndocrinologists ; DM nurse; family physician; nutritionist and rehab therapist.	**Number of session:** 1-4 or unclear; **Total contact hours:** 2-4 hours or unclear; **Duration:** One session to 2 years.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↓ **HbA1c;** **– Systolic and diastolic BP;** – LDL measurements.	Meta-analysis.
(Ramadas, Quek, Chan, & Oldenburg, 2011) [63];	HbAlc level.	**Number of studies:** 13 different studies; **Types of studies:** RCTs and quasi-experimental studies;	Web-based behavioural interventions.	√ BEHA (-) √ DIET (-) ☐ DR ☐ EXERCISE	Dietician; endocrinologist; physicians; researchers or research staff	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** ranged	**Strategies:** E-mail and SMS technologies that were commonly used together with the websites to reinforce the intervention, and Website, print material.	Inpatient settings, post discharge, other	**– Self-monitoring blood sugar,** – Weight-loss, – Dietary behaviour,	Not statistically combined and re-analyzed;

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International Journal of Medical Informatics		**Total sample:** Unclear.		√ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	members and study nurse.	between 12 and 52 weeks, with an average of 27.2 ± 18.3 weeks.	**Format:** Unclear; **Theoretical approach:** Wagner's Chronic Care Model; Self-efficacy theory/Social support theory; TTM; HBM; SCT.		− Physical activity.	
(Minet, Moller, Vach, Wagner, & Henriksen, 2010) [54]; Patient Education and Counseling	Glycaemic control.	**Number of studies:** Forty-seven studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Self-care management interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Case nurse manager; group facilitator; nurse educator; multidisciplinary team; physiologist; physician; peer counsellor; researcher; and pharmacist.	**Number of session:** 3-26; **Total contact hours:** Unclear; **Duration:** 4 weeks to 4 years.	**Strategies:** Face to face; home visit; phone calls; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c.**	Meta-analyses and meta-regression used Stata's meta command.
(Hawthorne, Robles, Cannings-John, & Edwards, 2010) [47]; Diabetic Medicine	Effects of culturally appropriate health education	**Number of studies:** 10 trials; **Types of studies:** RCTs; **Total sample:** 1603 patients.	Culturally appropriate health education	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Exercise physiologists; dieticians; diabetes nurses; link workers, and podiatrists.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** one session to 12 months;	**Strategies:** Face to face; visual aids, leaflets and teaching materials; **Format:** group approach, one-to-one interviews and a mixed approach; **Theoretical approach:** SAT, Empowerment Behaviour Change Model, SCT, Management model and the Theory of Planned Behaviour.	Inpatient settings, post discharge, other	**−QoL;** **↓ HbA1c;** **− BP;** ↑ Knowledge; − BMI; ↓ Lipid levels, − Diabetic complications, − Mortality rates, hospital admissions, hypoglycaemia.	Meta - analysis using the Review Manager and narrative review.
(Pan & Sidani, 2009) [49]; Canadian Journal of	Knowledge, self-management	**Number of studies: 50 studies;** **Types of studies:** RCTs;	DSME intervention:	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE	Unclear, did not describe.	**Number of session:** 10 (range 1 to 28); **Total contact hours:** 17 contact hours (range 1 to	**Strategies:** Online/web-based (4%); video (2%); face-to-face (60%); phone contact (4%); Mixed (30%). **Format:** One-on-one (32%); Group	Inpatient settings, post discharge, other	**↑ Diabetes knowledge,** **↑ Self-management behaviours;**	Comprehensive Meta-Analysis (version

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Diabetes	behaviours and metabolic control.	**Total sample:** **Unclear.**		☐ GC ☐ MED √ PSY (-) ☐ SMOKING √ SELF (-)		52); ⩽ 10 (46%); 11-20 (21%); > 20 (33%); **Duration:** 22 weeks (range 1 to 48); ⩽ 8 weeks (26%); 9–24 weeks (37%); > 24 weeks (37%).	(40%); Mixed (28%). **Theoretical approach:** Unclear.		**↓ HbA1c,** 20).
(Duke, Colagiuri, & Colagiuri, 2009) [39]; The Cochrane Library	Metabolic control, diabetes knowledge and psychosocial outcomes.	**Number of studies:** Nine studies; **Types of studies:** RCTs; **Total sample:** 1,359 participants.	Individual patient education.	√ BEHA (-) ☐ DIET ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Diabetes educators and dieticians.	**Number of session:** 1-6; **Total contact hours:** 20 min – 7 hours; **Duration:** 4 weeks – 1 year.	**Strategies:** Face to face; telephone; **Format:** Individual; **Theoretical approach:** Unclear.	Inpatient settings	**– HbA1c;** **– Diabetes complications;** – Health service utilisation and health care costs; – Psychosocial outcomes; – Diabetes knowledge; patient self-care behaviours; – Physical measures; metabolic.	Meta-analysis.
(Alam, Sturt, Hall, & Winkley, 2009) [23]; Patient Education and Counseling	Glycaemic control and psychological status.	**Number of studies:** 35 trials; **Types of studies:** RCTs; **Total sample:** 1431 patients.	Psycho-educational Interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Generalists; psychological specialists; or did not report the specialist	**Number of session:** 1-16; **Total contact hours:** 20 min – 28 hours; **Duration:** about 13.7 (±11.06) weeks.	**Strategies:** Face to face; telephone calls; **Format:** group format; a single format and used a combination; **Theoretical approach:** TTM; motivational interviewing;	Inpatient settings, other	**↓ HbAIc;** **↓ Psychological distress.**	Meta-analysis.
(Khunti, Camosso-	Knowledge and	**Number of studies:** nine studies;	Any educational	☐ BEHA √ DIET ☐	Unclear, did not describe.	**Number of session:** Unclear;	**Strategies:** Face to face; **Format:** Group and individual;	Unclear, did not describe.	**– Knowledge;** **– Psychological and**	Unclear.

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Stevanovic, Carey, Davies, & Stone, 2008)[51]; Diabetic Medicine	biomedical outcomes.	**Types of studies:** RCTs and RCT was followed by a before-and-after study; **Total sample:** 1004 patients.	intervention.	DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING ☐ SELF		**Total contact hours:** Unclear; **Duration:** 3- 12 months.	**Theoretical approach:** Unclear.		**biomedical outcome measures.**	
(Loveman, Hampton, & Clegg, 2008)[53]; Health Technology Assessment	Clinical effectiveness.	**Number of studies:** Twenty-one published trials; **Types of studies:** RCTs and CCTs; **Total sample:** Unclear.	Educational interventions.	√ BEHA (++) √ DIET (+++) ☐ DR √ EXERCISE (+++) √ GC (+++) ☐ MED ☐ PSY ☐ SMOKING √ SELF (+++)	Community workers; diabetes research technician; diabetes nurse, dieticians; educationalist; medical students; nurses; pharmacists; physician, or physician assistant.	**Number of session:** Two to four intensive education of 1.5 to 2 hours followed up with additional education at, 3 and 6 months; **Total contact hours and Duration:** about 150 mins over a 6-month or 61 to 52 hours over one year.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** cognitive-behavioural strategies; pedagogical principle.	Inpatient settings, post discharge, other	**– Diabetic control outcomes**; – Diabetic end-points; – QoL and cognitive measures.	Narrative review
(Wens et al., 2008)[70]; Diabetes Research and Clinical Practice	Improving adherence to medical treatment recommendations.	**Number of studies:** 8 studies; **Types of studies:** RCTs and controlling before and after studies. **Total sample:** 772 patients.	Interventions aimed at improving adherence to medical treatment.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Diabetes educator; nurse or did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** ~ 9 months or unclear.	**Strategies:** Face-to-face; telephone; **Format:** face-to-face; group based and telemedicine; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**– Adherence;** – HbA1c; – Blood glucose.	Cochrane Review Manager software.

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(Hawthorne, Robles, Cannings-John, & Edwards, 2008) [46]; The Cochrane Library	HbAlc level, Knowledge and clinical outcomes.	**Number of studies:** A total of 11 trials; **Types of studies:** RCTs; **Total sample:** 1,603 patients.	Culturally appropriate (or adapted) health education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	Dieticians, diabetes nurses, exercise physiologists; link workers; podiatrists; psychologist and and non-professional link worker.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** one session to 12 months.	**Strategies:** Face-to-face; booklet; **Format:** Group intervention method; one to one interviews; mixture of the two methods; purely interactive patient-centred method; semi-structured didactic format and combination of the 2 approaches. **Theoretical approach:** SAT; Empowerment Behaviour Change Model; Behaviour Change Theory; SCT, Management Model and the Theory of Planned Behaviour.	Inpatient settings, post discharge, other	**↓ HbA1c** **↑ Knowledge scores** − Other outcome measures	Narrative presentation and meta-analysis.
(Field et al., 2007) [56]; The Cochrane Library	Metablic control.	**Number of studies:** 36 articles (18 trials); **Types of studies:** RCTs; **Total sample:** 1,467 participants.	Dietary advice.	☐ BEHA √ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	exercise physiologist; dietitian; group facilitator; nutritionist; nurse educator; and physician.	**Number of session:** 1-12; **Total contact hours:** 20 min-22 hours; **Duration:** 11 weeks – 6months or unclear.	**Strategies:** Face-to-face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**− Weight;** **− Diabetic complications;** **− HbA1c;** − QoL; − Medication use; − Cardiovascular disease risk;	Meta-analysis.
Zabaleta & Forbes, 2007) [71]; British Journal of Community Nursing	Clinical effectiveness.	**Number of studies:** 21 studies; **Types of studies:** Controlled trials; **Total sample:** Unclear.	Structured group diabetes education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Diabetes nurse educator; physician's assistant; and physicians;	**Number of session:** 4-6 or unclear; **Total contact hours:** 6-12 hours or unclear; **Duration:** 1-6 months or unclear.	**Strategies:** Face to face; **Format:** Group; **Theoretical approach:** Unclear.	Post discharge.	**−HbA1c.**	A tabulative synthesis.

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(Siddiqui, McShane, Cade, & Williams, 2005) [36]; The Cochrane Library	Clinical, lifestyle and psychosocial outcomes.	**Number of studies:** 14 publications, reporting 11 studies; **Types of studies:** RCTs, and CCTs; **Total sample:** 1,532 participants.	Group-based educational programmes.	Did not describe the content of the intervention.	Health professionals, lay health advisors.	**Number of session:** Unclear; **Total contact hours:** from 6 to 52 hours; **Duration:** 3 hours per year for 2 years and 3 or 4 hours per year for 4 years.	**Strategies:** Unclear; **Format:** Group; **Theoretical approach:** the Diabetes Treatment and Teaching Programme (DTTP); empowerment model; adult learning model, public health model, HBM and TTM.	Inpatient settings, post discharge	**↓ Metabolic control;** **↑ Diabetes knowledge;** ↑ QoL; ↑ Empowerment/self-efficacy.	Summarized statistically
(Vermeire et al., 2005) [68]; The Cochrane Library	Improving adherence to treatment recommendations.	**Number of studies:** 21 articles; **Types of studies:** RCTs; cross-over study; controlled trial; controlled before and after studies; **Total sample:** 4,135 patients.	Interventions that were aimed at improving the adherence to treatment recommendations.	☐ BEHA ☐ DIET ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Nurse, pharmacist and other healthcare professionals.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face to face; telephone; home visit; video; mailed educational materials; **Format:** Unclear. **Theoretical approach:** Unclear.	Inpatient settings, post discharge	**Direct indicators,** such as ↓ Blood glucose level; **–** Indirect indicators, such as pill counts; **–**Health outcomes.	A descriptive review and sub-group meta-analysis.
(Leary, Genkinger, Ruallar, Peyrot, & Brancati, 2003) [42]; The Diabetes Educator	Body weight and glycaemic control.	**Number of studies:** Sixty-three RCTs; **Types of studies:** RCTs; **Total sample:** 2,720 patients.	Educational and behavioural component interventions.	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Nurse (39%); dietitian (26%); physician (17%); other or not specified (23%); other professional (13%); psychologist (9%); Exercise psychologist (9%); and health educator (4%).	**Number of session:** Unclear; **Total contact hours:** Unclear. **Duration:** 1 month to 19.2 months.	**Strategies:** Unclear; **Format:** Unclear; **Theoretical approach:** SAT, contracting model and patient empowerment.	Inpatient settings, post discharge	**– Glycaemic control;** **– Weight.**	Sufficient data were combined using meta-analysis.
(Norris, Lau, Smith,	Total GHb.	**Number of studies:** 31 studies	Self-management	√ BEHA (-) √ DIET (-)	Dietitian; lay health care	**Number of session:** 6 (1–36);	**Strategies:** Online/web-based; video ; face-to-face; phone contact;	Inpatient settings, post	**↓ Total GHb,**	Meta-analysis and

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Schmid, & Engelgau, (2002) [58]; Diabetes Care		**Types of studies:** RCTs. **Total sample:** 4,263 patients.	education.	☐DR ☐EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	worker; nurse; physician with team; self (e.g. computer assisted instruction); and team (nurse, dietitian, etc.).	**Total contact hours:** 9.2 (1–28) hours; **Duration:** 6 (1.0–27) months.	**Format: Group;** individual and mixed; **Theoretical approach:** Unclear	discharge, other		meta regression.
(Norris, Engelgau, & Narayan, (2001) [57]; Diabetes Care	Clinical outcomes,Knowledge, Metablic control.	**Number of studies:** 72 studies (84 papers); **Types of studies:** RCTs; **Total sample:** Unclear.	Self-management training interventions.	√ BEHA (-) √ DIET (-) ☐ DR ☐EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	CHWs; nurse; or other healthcare professionals.	**Number of session:** 1-16; **Total contact hours:** ～22 hours; **Duration:** ～26 months.	**Strategies:** Online/web-based; video (2%); face-to-face; phone contact; **Format:** Group; individual and mixed; **Theoretical approach:** SAT; Fishbein and Ajzen HBM.	Inpatient settings, post discharge, other	**↑ Knowledge; ↑ Lifestyle behaviors; −Psychological and QoL outcomes; ↑ Glycemic control; −** Cardiovascular disease risk factors.	Outcomes are summarized in a qualitative fashion.

NOTE:

SMOKING= Smoking cessation; CVR= Cardiovascular risk factors; PSY =Psychosocial issues (depression, anxiety); DIET =Diet; EXERCISE= Exercise; MED= Medication; BEHA = Behavioral charge (including lifestyle modification); SELF = Self-management (including problems solving); GC= glycemic control; DR =Diabetes risks; CHD= Coronary heart disease; CAD = Coronary Artery Disease; CHW=Community Health Worker; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; LDL = Low-density Lipoprotein Cholesterol; SMS = Short Message Service; BCTs = Behavioral Change Techniques; LEA = Lower Extremity Amputation; PRIDE = Problem Identification, Researching one's routine, Identifying a management goal, Developing a plan to reach it, Expressing one's reactions and Establishing rewards for making progress; ASE = Attitude-social influence-efficacy; CVRF= Cardiovascular Risk Factors; SMS = Short Message System; PA = Physical Activity; EDU = Patient Education; GP= General Practice; RCTs =Randomized controlled trials; CCTS = controlled clinical trials; HRQoL = Health Related Quality of Life; QoL = Quality of Life; MI = Myocardial Infarction; CAD = Coronary Artery Disease; CABG= Coronary Artery Bypass Graft Surgery; T2DM = Type 2 Diabetes Mellitus; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; DSME = Diabetes Self-management Education; DSM = Diabetes Self-management; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model; SAT=Social Action Theory;

In the educational content: "+": minor focus; "++":moderate focus; "+++" major focus; "-" =unclear what the intensity of the education was for any topic;

In the outcomes: arrow up (" ↑ ") for improvement, arrow down (" ↓ ") for reduction; a dash ("−") for no change or inconclusive evidence.

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Table 4. Summary of evidence from quantitative research syntheses

Intervention	Number of systematic reviews/meta-analysis, Total participants	First author, Year	Primary Results/findings		Rating the evidence of effectiveness
Acute Coronary Syndrome Patients					
General health education	Six/161,997patients (Goulding et al., 2010 did not given the total sample size)	Ghisi et al., 2014 [43]	Knowledge	91% studies (+)	Some evidence
			Behavior	77%/84%/65% studies (+)	
			Psychosocial indicators	43% studies (+)	
		Brown et al., , 2013 [30]	Mortality		
			MI		
			Revascularizations		
			Hospitalizations		
			HRQoL		
			Withdrawals/drop outs		
			Healthcare utilization and costs		
		Brown et al., 2011 [72]	Total mortality		
			MI		
			CABG		
			Hospitalisations		
			HRQoL	63.6% studies (+)	
			Healthcare costs	40% studies (+)	
			Withdrawal/drop out		
		Goulding et al., 2010 [44]	Beliefs	30.08% studies (+)	
			Secondary outcomes		
			Smoking		
			Cholesterol level		

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		Fernandez et al., 2007 [41]	Multiple risk factor modification		
		Kotb, Hsieh, & Wells, 2014 [52]	All-cause hospitalization		
			All-cause mortality		
			Smoking cessation		
			Depression		
			Systolic blood pressure		
			Low-density lipoprotein		
			Anxiety		
Psychoeducational interventions	Six/ 37,883 patients	Barth et al., 2015 [73]	Abstinence by self-report or validated		Sufficient evidence
		Dickens et al., 2013 [38]	Depression		
		Aldcroft et al., 2011 [24]	Smoking cessation		
			Physical activity		
		Huttunen-Lenz et al.,2010 [49]	Prevalent smoking cessation		
			Continuous smoking cessation		
			Total mortality		
		Barth et al., 2008 [29]	Abstinence by self-report or validated		
			Smoking status		
		Barth et al., 2006 [28]	Abstinence		
			Smoking status		
Secondary prevention educational interventions	Three/25,154 patients	Devi et al., 2015 [37]	Mortality		
			Revascularisation		
			Total Cholesterol		
			HDL cholesterol		
			Triglycerides		
			HRQOL		
			All-cause mortality		

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(including Internet based secondary prevention)		Auer et al., 2008 [27]	Readmission rates		Some evidence
			Reinfarction rates		
			Smoking cessation rates		
		Clark et al., 2005 [34]	Mortality		
			MI		
			Quality of life	Most of the included studies (+)	
Type 2 Diabetes Mellitus Patients					
General health education	Five/2,319 patients (Choi et al., 2016; Loveman et al., 2008; Zabaleta et al., 2007 did not given the total sample size)	Choi et al., 2016 [33]	HbA1c		Some evidence
		Saffari et al., 2014 [65]	Glycemic control		
		Duke et al., 2009 [39]	HbA1c		
			BP		
			Knowledge, psychosocial outcomes and smoking habits	No Data	
			Diabetes complications or health service utilization and cost analysis	No Data	
		Loveman et al., 2008 [53]	Diabetic control outcomes	46.15% studies (+)	
			Weight	66.67% studies (+)	
			Cholesterol or triglycerides	40.00% studies (+)	
		Zabaleta et al., 2007 [71]	HbA1c	4.8% studies (+)	
		Creamer et al., 2016 [35]	HbA1c		
			HRQoL		
			AEs	No AEs	
		Ricci-Cabello et al., 2014 [64]	HbA1c		
			Diabetes knowledge	73.3% studies (+)	
			Behaviors	75% studies (+)	
			Clinical outcomes	Fasting blood glucose, HbA1c	

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				and BP improved in 71%, 59%, and 57% of the studies.	
Culturally appropriate health education	Eight/ 20,622 patients (Ricci-Cabello et al., 2014 and Gucciardi et al., 2013 did not given the total sample size)	Attridge et al., 2014 [26]	HbA1c		Some evidence
			Knowledge scores		
			Clinical outcomes		
			Other outcome measures	Showed neutral effects.	
		Gucciardi et al., 2013 [45]	HbA1c levels	Three of ten studies (+)	
			Anthropometrics	Three of eleven studies (+)	
			Physical activity	One of five studies (+)	
			Diet outcomes	Two of six studies (+)	
		Nam et al., 2012 [55]	HbA1c level		
		Hawthorne et al., 2010 [47]	HbA1c		
			Knowledge scores		
		Khunti et al., 2008 [51]	Knowledge levels	Only one study reporting a significant improvement	
			Biomedical outcomes	Only one study reporting a significant improvement.	
		Hawthorne et al., 2008 [46]	HbA1c		
			Knowledge scores		
			Other outcome measures		
		Huang et al., 2016 [48]	HbA1c		
			BMI		
			LDL-c and HDL-c		
		Chen et al., 2015 [32]	HbA1c		
			BMI		
			SBP		
			DBP		
			HDL-c		

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Lifestyle interventions + behavioral program	Six/10,440 patients (Huang et al., 2016; Pillay et al., 2015 and Ramadas et al., 2011 did not given the total sample size)	Terranova et al., 2015 [67]	HbA1c level		Some evidence
			Weight		
		Pillay et al., 2015 [62]	HbA1c levels		
			BMI		
		Ramadas et al., 2011 [63]	HbA1c	46.2% studies (+)	
		Gary et al., 2003 [42]	Fast blood sugar		
			Glychemoglobin		
			HbA1		
			HbA1c		
			Weight		
Self-management educational interventions	Nine/19,597 patients (Minet et al., 2010;Fan et al., 2009 and Norris et al., 2001 did not given the total sample size)	Pal et al., 2014 [60]	Cardiovascular Risk Factors		
			Cognitive Outcomes		
			Behavioral Outcomes	Only one study reporting a significant improvement.	
			AEs	No AEs	
		Vugt et al., 2013 [69]	Health behaviors	Seven of 13 studies (+)	
			Clinical outcomes measures	Nine studies (+)	
			Psychological outcomes	Nine studies (+)	
		Pal et al., 2013 [61]	HbA1c		
			Depression		
			Quality of life		
			Weight		
		Steinsbekk, et al., 2012 [66]	HbA1c		
			Main lifestyle outcomes		
			Main psychosocial outcomes		
		Minet et al., 2010 [54]	Glycaemic control		
			Diabetes knowledge		
			Overall self-management		

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		Fan et al., 2009 [40]	behaviours		
			Overall metabolic outcomes		
			Overall weighted mean effect sizes		Sufficient evidence
		Deakin et al., 2005 [36]	Metabolic control (HbA1c)		
			Fasting blood glucose levels		
			Weight		
			Diabetes knowledge		
			SBP		
			Diabetes medication		
		Norris et al.,, 2002 [58]	Total GHb		
		Norris et al., 2001 [57]	Knowledge		
			Self-monitoring of blood glucose		
			Self-reported dietary habits		
			Glycemic control		
Therapeutic education	One/Total sample: Unclear.	Odnoletkova et al., 2014 [59]	Cost-effectiveness	Overall high in studies on prediabetes and varied in studies on T2DM.	Insufficient evidence
Foot health education	One/ Total sample: Unclear.	Amaeshi, 2012 [25]	Diabetes complications		
			Incidence of LEA		Some evidence
Group medical visit	One/2,240 patients.	Burke et al., 2011 [31]	HbA1c		
			BP and DBP		
			SBP		
			Cholesterol - LDL		Some evidence
Psychoeducational intervention.	One/1.431 patients.	Alam et al., 2009 [23]	HbA1c		
			Psychological status		Some evidence
Interventions aimed at improving adherence to	Three/ 4,907 patients (Kai Lun Gan et al., 2011 did not	Kai Lun Gan et al., 2011 [50]	Oral hypoglycaemic adherence	Five of seven studies (+)	

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medical treatment recommendations	given the total sample size)	Wens et al., 2008 [70]	Adherence	General conclusions could not be drawn.	Some evidence
		Vermeire et al., 2005 [68]	HbA1c		
Dietary advice	One/1,467 patients	Nield et al., 2007 [56]	Glycaemic control (addition of exercise to dietary advice)		Insufficient evidence to determine
			Weight	Limited Data	
			Diabetic micro- and macrovascular diseases	Limited Data	

NOTE:

RCTs =Randomized controlled trials; HRQoL = Health Related Quality of Life; MI = Myocardial Infarction; CABG= Coronary Artery Bypass Graft Surgery; T2DM = Type 2 Diabetes Mellitus; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP = Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; LEA = Lower Extremity Amputation; Adverse Events = AEs.

（+）：Intervention Group is Significantly Better than Control Group; For example: “91% studies (+)” means 91% studies reported a significant better compared with control group;

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Appendix 1. Searching Strategies

Items	Searching Strategy	Results
	PubMed	
#1	((((((((((Acute Coronary Syndrome[MeSH Terms]) OR Myocardial Infarction[MeSH Terms]) OR Angina, Unstable[MeSH Terms]) OR Coronary Artery Disease[MeSH Terms]) OR Coronary Artery Bypass[MeSH Terms]) OR Angina Pectoris[MeSH Terms]) OR "Myocardial Infarct*"[Title/Abstract]) OR "Unstable Angina*"[Title/Abstract]) OR "coronary heart diseas*"[Title/Abstract]) OR "Coronary Artery Disease*"[Title/Abstract]) OR "Unstable Angina Pectori*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	145310
#2	(((((Diabetes Mellitus, Type 2[MeSH Terms]) OR "Type 2 Diabetes Mellitus"[Title/Abstract]) OR "type 2 diabete*"[Title/Abstract]) OR "type ii diabet*"[Title/Abstract]) OR T2DM[Title/Abstract]) OR Adult-Onset Diabetes Mellitus[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	80218
#3	#1 OR #2	222103
#4	(((((((Health Education[MeSH Terms]) OR Patient Education as Topic[MeSH Terms]) OR Counseling[MeSH Terms]) OR Social Support[MeSH Terms]) OR "Community Health Education*"[Title/Abstract]) OR "Educational Activit*"[Title/Abstract]) OR "Education* intervention*"[Title/Abstract]) OR "Education* program*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	122323
#5	(((Meta-Analysis [Publication Type]) OR Meta-Analysis as Topic[MeSH Terms]) OR "Systematic Revie*"[Title/Abstract]) OR "Meta-analys*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	165265
#6	#3 AND #4 AND #5 Filters: Publication date from 2000/01/01 to 2016/04/31; English	54
	Cochrane Library	
#1	MeSH descriptor: [Acute Coronary Syndrome] explode all trees	1070
#2	MeSH descriptor: [Myocardial Infarction] explode all trees	9450
#3	MeSH descriptor: [Angina, Unstable] explode all trees	1015
#4	MeSH descriptor: [Coronary Artery Disease] explode all trees	3469
#5	MeSH descriptor: [Coronary Artery Bypass] explode all trees	5321
#6	MeSH descriptor: [Angina Pectoris] explode all trees	4240

#7	"acute coronary syndrome":ti,ab,kw or Unstable Angina*:ti,ab,kw or Myocardial Infarct*:kw or coronary heart diseas*:ti,ab,kw or Coronary Artery Disease*:ti,ab,kw (Word variations have been searched)	29379
#8	#1 or #2 or #3 or #4 or #5 or #6 or #7	34062
#9	MeSH descriptor: [Diabetes Mellitus, Type 2] explode all trees	10474
#10	Type 2 Diabetes Mellitus:ti,ab,kw or type ii diabet*:ti,ab,kw or noninsulin dependent:ti,ab,kw or type 2 diabet*:ti,ab,kw or Adult-Onset Diabetes Mellitus:ti,ab,kw (Word variations have been searched)	20935
#11	#9 or #10	20937
#12	#8 or #11	53777
#13	MeSH descriptor: [Health Education] explode all trees	11291
#14	MeSH descriptor: [Patient Education as Topic] explode all trees	7507
#15	MeSH descriptor: [Counseling] explode all trees	4026
#16	MeSH descriptor: [Rehabilitation Nursing] explode all trees	55
#17	Education*:ti,ab,kw or Community Health Education:ti,ab,kw or Self-Management*:ti,ab,kw or Cardiac Rehabilitation:ti,ab,kw (Word variations have been searched)	40078
#18	#13 or #14 or #15 or #16 or #17	42943
#19	#12 and #18 Publication Year from 2000 to 2016, in Cochrane Reviews (Reviews only) and Other Reviews	120
#20	Cochrane reviews + other reviews	49 + 71=120
	Joanna Briggs Institute, Embase, MEDLINE	
#1	Acute Coronary Syndrome.m_titl.	16727
#2	Myocardial Infarction.m_titl.	151398
#3	Unstable Angina.m_titl.	6933
#4	Coronary Artery Disease.m_titl.	54621
#5	Coronary Artery Bypass.m_titl.	30449
#6	Angina Pectoris.m_titl.	17997
#7	Coronary Heart Disease.m_titl.	35397
#8	#1 or #2 or #3 or #4 or #5 or #6	305035
#9	Type 2 Diabetes Mellitus.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	64926

#10	"type 2 diabet*".m_titl.	102596
#11	"type ii diabet*".m_titl.	6139
#12	Adult-Onset Diabetes Mellitus.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	307
#13	#9 or #10 or #11 or #12	136982
#14	#8 or #13	439243
#15	Health Education.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	177285
#16	Patient Education.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	185631
#17	Counseling.m_titl.	23527
#18	Social Support.m_titl.	11535
#19	"Education*".m_titl.	247901
#20	#15 or #16 or #17 or #18 or #19	577203
#21	#14 and #20	6480
#22	Systematic Review.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	212014
#23	Meta-Analysis.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	262009
#24	#22 or #23	381113
#25	#21 and #24	288
#26	limit 25 to English and yr="2000 - 2016"	**263**
	Cumulative Index to Nursing and Allied Health Literature (CINAHL)	
#1	TI Acute Coronary Syndrome OR AB Acute Coronary Syndrome	4826
#2	TI Myocardial Infarction OR AB Myocardial Infarction	24578
#3	TI Unstable Angina OR AB Unstable Angina	1353
#4	TI Coronary Artery Disease OR AB Coronary Artery Disease	12930
#5	TI Coronary Heart Disease OR AB Coronary Heart Disease	12321
#6	#1 OR #2 OR #3 OR #4 OR #5	46436
#7	TI Type 2 Diabetes Mellitus OR AB Type 2 Diabetes Mellitus	8952
#8	TI type 2 diabet* OR AB type 2 diabet*	33085
#9	TI Adult-Onset Diabetes Mellitus OR AB Adult-Onset Diabetes Mellitus	23
#10	#7 OR #8 OR #9	33097

#11	#6 OR #10	77923
#12	TI Health Education OR AB Health Education	53415
#13	TI Patient Education OR AB Patient Education	37789
#14	TI Counseling OR AB Counseling	17673
#15	TI Social Support OR AB Social Support	30093
#16	TI Education* OR AB Education*	188291
#17	#12 OR #13 OR #14 OR #15 OR #16	227269
#18	#11 AND #17	4707
#19	TI Systematic Review OR AB Systematic Review	48830
#20	TI Meta-Analysis OR AB Meta-Analysis	28776
#21	#19 OR #20	64611
#22	S18 AND S21 Limiters - Published Date: 20000101-20160431; English Language	**129**
	Web of Science	
#1	TS=("Acute Coronary Syndrome*") OR TS=("Myocardial Infarct*") OR TS=("Unstable Angina") OR TS=("Coronary Artery Disease*") OR TS=("Coronary heart disease*") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	404699
#2	TS=("Type 2 Diabetes Mellitus") OR TS=("type 2 diabete*") OR TS=("Noninsulin-Dependent Diabete*") OR TS=("Adult-Onset Diabetes Mellitus") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	103548
#3	#2 OR #1 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	495081
#4	TS=("Health Education") OR TS=("Patient Education") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	29830
#5	#4 AND #3	1290

	Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	
#6	TS=("Systematic Review*") OR TS=("Meta-analysis*") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	149663
#7	(#6 AND #5) AND LANGUAGE: (English) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2016	68
	Journals@Ovid	
#1	Acute Coronary Syndrome.m_titl.	3021
#2	Myocardial Infarction.m_titl.	24269
#3	Unstable Angina.m_titl.	1038
#4	Coronary Artery Disease.m_titl.	10106
#5	Coronary Artery Bypass.m_titl.	6546
#6	Angina Pectoris.m_titl.	1480
#7	Coronary Heart Disease.m_titl.	6487
#8	#1 or #2 or #3 or #4 or #5 or #6	51548
#9	Type 2 Diabetes Mellitus. m_titl.	5097
#10	"type 2 diabet*".m_titl.	26434
#11	"type ii diabet*".m_titl.	980
#12	Adult-Onset Diabetes Mellitus. m_titl.	391
#13	#9 or #10 or #11 or #12	27795
#14	#8 or #13	78792
#15	Health Education. m_titl.	1135
#16	Patient Education. m_titl.	1556
#17	Counseling.m_titl.	5532
#18	Social Support.m_titl.	2667
#19	"Education*".m_titl.	50950

#20	#15 or #16 or #17 or #18 or #19	58969
#21	#14 and #20	510
#22	Systematic Review.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	117790
#23	Meta-Analysis.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	215069
#24	#22 or #23	282984
#25	#21 and #24	61
#26	limit 26 to yr="2000 - 2016"	**58**

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	5-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	NA
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6-7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8-9
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	8-9
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8-9
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	9

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	8-10
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9-11
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-12
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	12-13
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	16-21
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	16-21
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	13-16
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	22,29-30
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	4,29-30
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	31-32
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	32

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Title page

Health Education for Patients with Acute Coronary Syndrome and Type 2 Diabetes Mellitus: An Umbrella Review of Systematic Reviews and Meta-Analyses

Xian-Liang Liu, RN, MScN

Ph.D. Candidate, Tenth People's Hospital of Tongji University, China; Ph.D. Candidate, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Australia;

Lecturer, School of Nursing, Jinggangshan University, China.

Address: 1100 Nudgee Road, Banyo, Brisbane, QLD, Australia

Email: liu.xianliang@myacu.edu.au; 1988_liuxianliang@tongji.edu.cn

Yan Shi, RN, Ph.D., Professor, Executive Director of Nursing Department

Tenth People's Hospital and Tongji University, China

Address: 301, YanChang Road, Shanghai, China

E-mail: shlzk2002@163.com

Karen Willis, Ph.D., Professor, Associate Dean (Learning and Teaching)

Faculty of Health Sciences, Australian Catholic University, Australia

Address: 250 Victoria Parade, Melbourne, Australia

Email: Karen.Willis@acu.edu.au

Chiung-Jung (Jo) Wu, RN, DrHlthSc, FACN

Associate Professor, School of Nursing, Midwifery and Paramedicine, University of the Sunshine Coast;

Visiting Fellow, School of Nursing, Queensland University of Technology;

Honorary Research Fellow, Royal Brisbane and Women's Hospital;

Honorary Research Fellow, Mater Medical Research Institute-University of Queensland (MMRI-

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UQ), Brisbane, Australia;

Postal Address: ML 57, PO Box 1149, Hervey Bay Q 4655, Australia.

Email: cwu@usc.edu.au; c3.wu@qut.edu.au

Maree Johnson, RN, Ph.D., Professor, Associate Dean (Research)

Faculty of Health Sciences, Australian Catholic University, Australia

Address: Tenison Woods House (8 -20 Napier Street), North Sydney, Australia

Email: Maree.Johnson@acu.edu.au

Affiliated with the Ingham Institute of Applied Medical Research, Liverpool. Sydney.

Corresponding author:

Xian-Liang Liu, RN, MScN,

Ph.D. Candidate, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Australia; Ph.D. Candidate, Tenth People's Hospital of Tongji University, China; Lecturer, School of Nursing, Jinggangshan University, China.

Address: 1100 Nudgee Road, Banyo, Brisbane, QLD, Australia

Email: liu.xianliang@myacu.edu.au; 1988_liuxianliang@tongji.edu.cn

Tel: +61 497440830; +86 15921496130

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Abstract

Objectives: This umbrella review aimed to identify the current evidence on health education-related interventions for patients with acute coronary syndrome or type 2 diabetes mellitus; identify the educational content, delivery methods, intensity, duration and setting required. The purpose was to provide recommendations for educational interventions for high risk patients with both acute coronary syndrome and type 2 diabetes mellitus.

Design: Umbrella review of Systematic Reviews and Meta-Analyses.

Setting: Inpatient and post discharge settings.

Participants: Patients with ACS and T2DM.

Data sources: CINAHL, Cochrane Library, Joanna Briggs Institute, Journals@Ovid, EMBase, Medline, PubMed, and Web of Science databases from January 2000 through May 2016.

Outcomes measures: Clinical outcomes (such as HbA1C), behavioral outcomes (such as smoking), psychosocial outcomes (such as anxiety) and medical service use.

Results: Fifty-one eligible reviews (15 for ACS and 36 for T2DM) consisting of 1324 relevant studies involving 288,057 patients (15 papers did not provide the total sample); 30 (58.8%) reviews were rated as high quality. Nurses only and multidisciplinary teams were the most frequent professionals to provide education, and most educational interventions were delivered post-discharge. Face-to-face sessions were the most common delivery formats, and many education sessions were also delivered by telephone or via web contact. The frequency of educational sessions was weekly or monthly, and an average of 3.7 topics was covered per education session. Psychoeducational interventions were generally effective at reducing smoking and admissions for patients with ACS. Culturally appropriate health education, self-management educational interventions, group medical visits and psychoeducational interventions were

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generally effective for T2DM patients.

Conclusions: Results indicate that there is a body of current evidence about the efficacy of health education, its content, and delivery methods for patients with ACS or T2DM. These results provide recommendations about the content for, and approach to, health education intervention for these high risk patients.

KEY WORDS: Health Education; Acute Coronary Syndrome; Type 2 Diabetes Mellitus; Umbrella Review

Strengths and limitations of this review:

- This umbrella review is the first synthesis of systematic reviews or meta-analyses to consider health education-related interventions for patients with ACS or T2DM.
- These results provide recommendations about the content of a health education intervention for patients with ACS and T2DM.
- The diversity of the educational interventions seen in the reviews included in this umbrella review may reflect the uncertainty about the optimal strategy for providing health education to patients.
- This umbrella review found no reviews focused on patients with ACS and T2DM the intended target group; instead, all of the systematic reviews and meta-analyses focused on only one of these two diseases.

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Introduction

Acute coronary syndrome (ACS) is the leading cause of death worldwide. The risk of high mortality rates relating to ACS is markedly increased after an initial cardiac ischemic event.[1] Globally, 7.2 million (13%) deaths are caused by coronary artery disease (CAD),[2] and it is estimated that more than 780,000 persons will experience ACS each year in the United States. [3] Moreover, about 20–25% of patients with ACS reportedly also have diabetes mellitus (DM); predominantly type 2 diabetes mellitus [T2DM]). [4 5] Patients with ACS and DM have an increased risk of adverse outcomes such as death, recurrent myocardial infarction (MI), readmission, or heart failure during follow up. [6] Longer median delay times from symptom onset to hospital presentation, have been reported among patients with ACS and DM than patients with ACS alone. [7]

DM is now considered to confer a risk equivalent to that of CAD for patients for future MI and cardiovascular mortality. [8] Mortality was significantly higher among patients with ACS and DM than among patients with ACS only following either ST segment elevation myocardial infarction (STEMI) (8.5% [ACS and DM] versus 5.4% [ACS]) or unstable angina/non-STEMI (NSTEMI) (2.1% [ACS and DM] vs. 1.1% [ACS]).[9] ACS and T2DM are often associated with high-risk factors such as low levels of physical exercise, obesity, smoking, and unhealthy diet. [10] Some of these and other risk factors, specifically glycemia, high blood pressure (BP), lipidemia, and obesity, are frequently addressed by health education interventions. [10]

Health education interventions are comprehensive programs that healthcare providers deliver to patients aimed at improving patients' clinical outcomes through the increase and maintenance of health behaviours.[11] Along with education about, for example, medication adherence, these programs seek to increase behaviors such as physical exercise and a healthy diet thus reducing

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patient morbidity or mortality. [11] Most diabetes education is provided through programs within outpatient services or physicians' practices. [12] Many recent education programs have been designed to meet national or international education standards [13-15] with diabetes education being individualized to consider patients' existing needs and health conditions. [16] Patients with T2DM have reported feelings of hopelessness and fatigue with low levels of self-efficacy, after experiencing an acute coronary episode. [17]

Although there are numerous systematic reviews of educational interventions relating to ACS, or T2DM, an umbrella review providing direction on educational interventions for high risk patients with both ACS and T2DM is not available, indicating a need to gather the current evidence and develop an optimal protocol for health education programs for patients with ACS and T2DM. This umbrella review will examine the best available evidence on health education-related interventions for patients with ACS or T2DM. We will synthesize these findings to provide direction for health education-related interventions for high risk patients with both ACS and T2DM.

An umbrella review is a new method to summarize and synthesize the evidence from multiple systematic reviews/meta-analyses into one accessible publication. [18] Our aim is to systematically gather, evaluate and organize the current evidence relating the health education interventions for patients with ACS or T2DM, and proffer recommendations for the scope of educational content and delivery methods that would be suitable for patients with ACS and T2DM.

Methods

Data Sources

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This umbrella review performed a literature search to identify systematic reviews and meta-analyses examining health education-related interventions for patients with ACS or T2DM. The search strategies are described in Supplementary Annex 1. This umbrella review searched eight databases for articles published from January 2000 to May 2016: CINAHL, Cochrane Library, Joanna Briggs Institute, Journals@Ovid, EMBase, Medline, PubMed, and Web of Science. The search was limited to English language only. The following broad MeSH terms were used: *acute coronary syndrome; angina, unstable; angina pectoris; coronary artery disease; coronary artery bypass; myocardial infarction; diabetes mellitus, type 2; counseling; health education; patient education as topic; meta-analysis [publication type];* and *meta-analysis* as a topic.

Inclusion Criteria

Participants

All participants were diagnosed with ACS or T2DM using valid, established diagnostic criteria. The diagnostic standards included those described by the American College of Cardiology or American Heart Association, [3] National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand, [19] World Health Organization, [20] or other associations.

Intervention Types

For this umbrella review, health education-related interventions refer to any planned activities or programs that include behavior modification, counseling, and teaching interventions. Results considered for this review included changes in clinical outcomes (including blood pressure levels, body weight, diabetes complications, HbA1C, lipid levels, mortality rate and physical activity levels), behavioral outcomes (such as diet, knowledge, self-management skills, self-efficacy, and smoking), and psychosocial outcomes (such as anxiety, depression, quality of life, and stress) and medical service use (such as medication use, health care utilization, and cost-

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effectiveness) for patients with ACS or T2DM. These activities or programs included any educational interventions delivered to patients with ACS or T2DM. The interventions are delivered in any format, including face-to-face, telephone and group-based or one-on-one, and the settings include community, hospital and home. The interventions were delivered by nurses (including diabetes nurse educators), physicians, community health care workers, dietitians, lay people, rehabilitation therapists, or multidisciplinary teams.

Study Types

Only systematic reviews and meta-analyses were included in this review.

Eligibility Assessment

The title and abstract of all of the retrieved articles were assessed independently by two reviewers (XL-L, YS) based on the inclusion criteria. All duplicate articles were identified within EndNote version X7 [21] and subsequently excluded. If the information from the titles and abstract was not clear, the full articles were retrieved. The decision to include an article was based on an appraisal of the full text of all retrieved articles. Any disagreements during this process were settled by discussion and, if necessary, consensus was sought with a third reviewer. We developed an assessment form in which specific reasons for exclusion were detailed.

Assessment of Methodological Quality

The methodological quality and risk of bias were assessed for each of the included publications using the Assessment of Multiple Systematic Reviews (AMSTAR),[22] independently by the same two reviewers (see Table 1). The AMSTAR is an 11-item tool, with each item provided a score of 1 (specific criterion is met) or 0 (specific criterion is not met, unclear, or not applicable). [22 23] An overall score for the review methodological quality is then calculated as the sum of the individual item scores: high quality, 8-11; medium quality, 4-7; or low quality, 0-3. [23] If the

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required data were not available in the article, the original authors were contacted for more information. The low quality reviews (AMSTAR scale: 0-3) were excluded in this umbrella review.

Data Extraction

Data were independently extracted by two reviewers using a predefined data extraction form. For missing or unclear information, the primary authors were contacted for clarification.

Statistical Presentation of Results from Reviews

All of the results were extracted for each included systematic review or meta-analysis, and the overall effect estimates are presented in a tabular form. The number of systematic reviews or meta-analyses that reported the outcome, total sample (from included publications), and information of health education interventions is also presented in the Tables (Table 2, 3). [24] A final 'summary of evidence' was developed to present the intervention, included study synthesis, and indication of the findings from the included papers (Table 4). [24] This umbrella review calculated the Corrected Covered Area (CCA) (Appendix 2, 3). The CCA statistic is a measure of overlap of trials (the repeated inclusion of the same trial in subsequent systematic reviews included in an umbrella systematic review). A detailed description of the calculation is provided by the authors who note slight CCA as 0-5%, moderate CCA as 6-10%, high CCA as 11-15% and very high CCA is more than 15%. [25] The lower the CCA the lower the likelihood of overlap of trials included in the umbrella review.

Synthesizing the Results and Rating the Evidence for Effectiveness

The statements of evidence were based on a rating scheme to gather and rate the evidence across the included publications.[26] The statements of evidence were based on the following rating

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scheme: *sufficient evidence*, sufficient data to support decisions about the effect of the health education-related interventions. [26] A rating of *sufficient evidence* in this review is obtained when systematic reviews or meta-analyses with a large number of included articles or participants produce a statistically significant result between the health education group and the control group. [26] *Some evidence*, is a less conclusive finding about the effects of the health education-related interventions[26] with statistically significant findings found in only a few included reviews or studies. *Insufficient evidence*, refers to not enough evidence to make decisions about the effects of the health education-related interventions, such as non-significant results between the health education group and the control group in the included systematic reviews or meta-analyses. [26] *Insufficient evidence to determine*, refers to not enough pooled data to be able to determine whether of the health education-related interventions are effective or not based on the included reviews. [26]

Results

Characteristics of Included reviews

The selection process and number of studies at each step was illustrated as presented in Figure 1. The database search yielded 692 publications, with removal of 197 duplicates and 371 articles that did not meet the inclusion criteria, 124 full-text articles were retrieved after applying the methodological quality rating (AMSTAR scale), and three studies [27-29] were removed due to low scores ≤3 on the AMSTAR scale. Fifty-one systematic reviews or meta-analyses [30-80] conducted between 2001 and 2016 and published in English were included (Figure 1; Tables 1 –3); 15 relating to ACS. The overlap of the trials included in the 15 reviews and meta-analyses related to ACS was slight (CCA = 2.6%). For the 36 systematic reviews relating to T2DM, the overlap of trials within these 35 reviews and meta-analyses (one review [47] did not report the included

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studies) was slight (CCA = 2.1%). None of the articles included patients with both ACS and T2DM. The umbrella review involved a total of 277,493 patients, including 225,034 patients with coronary heart disease or ACS (one article did not report the total sample) and 52,459 patients with T2DM (16 papers did not report the total sample). The average sample size of included articles was 8,161 (range, 536–68,556) participants, however, 63 studies related to ACS and 177 studies related to T2DM, were included in more than one systematic review or meta-analysis (see Appendix 2 and 3 and CCA statistics). The sample of these studies would therefore be included more than once. Of the included systematic reviews or meta-analyses, eleven were published in *The Cochrane Library*. Nine of the articles described meta-analyses, 29 articles described systematic reviews, and the remaining 13 articles were described as systematic reviews and meta-analyses or meta-regressions or narrative reviews.

Electronic database searches were conducted for all systematic reviews or meta-analyses, with an average of 6 databases searched (range, 2–16). The dates searched ranged widely, from inception of the database through December 2014. Most of the included reviews were randomized controlled trials (RCTs), and an average of 25.6 (range, 7–132) studies was included per systematic review or meta-analyses. Of the total, 818 unique (non-repeated) studies were included in all of the reviews or meta-analyses, 286 included patients with ACS, and 532 included patients with T2DM (Appendix 2, 3). The included reviews assessed the risk of bias using the Cochrane risk of bias tool (22 publications), JADA quality score (seven publications), Joanna Briggs quality assessment tool (two publications), PEDro scale (one publication), RCT Critical Appraisal Skills Programme (one publication), and the SIGN-50 checklist (one publication).

Methodological Quality of Included Systematic Reviews and Meta-Analyses

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The methodological quality of the included publications is presented in Table 1. Thirty (58.8%) publications were classified as high quality (scores 8–11), and 21 (41.2%) publications were classified as medium quality (scores 4–7). Twenty five (49%) reviews specifically provided an *a priori* design, while the use of such a design was unclear for 26 (51%) publications. The inclusion of other forms of literature (such as grey literature) was described in 18 (35%) reviews. Only 14 out of 51 (27%) reviews included a table of included and excluded studies. Only 2 (4%) reviews did not provide a characteristics table of the included papers. The scientific quality of the included papers was evaluated and documented in 47 (92%) reviews. The scientific quality of the included studies was used appropriately to formulate conclusions in 47 (92%) reviews. The methods to combine the results of the included studies were appropriate in 43 (86%) reviews. Publication bias was assessed in only 19 (37%) reviews. Finally, conflicts of interest were reported in 47 (92%) reviews.

Characteristics of Health Educational Interventions

The description of the health educational interventions followed the Workgroup for Intervention Development and Evaluation Research (WIDER) reporting guidelines for behavior change interventions. [81] The characteristics of the recipients, setting, delivery methods, intensity, duration, and educational content of health educational interventions for patients with ACS or T2DM are summarized in Tables 2 and 3. The delivery strategies for health education included face-to-face, internet-based, phone-based, videotape, written educational materials, or mixed. The format included one-on-one (individualized), group, or both. Face-to-face sessions were the most common delivery formats, and many education sessions were also delivered by telephone/web contact or individualized counseling. The number of sessions, total contact hours, and durations varied, and there was limited information about the intensity of health education

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for patients provided. The frequency of educational sessions was weekly or monthly, and an average of 3.7 topics was covered per education session. Nurses and multidisciplinary teams were the most frequent educators, and most education programs were delivered post-discharge.

Acute Coronary Syndrome

The educational content for patients with ACS covered cardiovascular risk factors in 8 reviews (53.33%), psychosocial issues in 8 reviews (53.33%), smoking cessation in 6 reviews (40.00%), exercise in 5 reviews (33.33%), behavioral change in 5 reviews (33.33%), diet in 4 reviews (26.67%), self-management in 3 reviews (20.00%), and medication in 1 review (6.67%). Two reviews only included smoking cessation and cardiovascular risk factors. The most common educational providers were nurses and a multidisciplinary team. Six studies [31 36 48 51 56 69] (6/15, 40%) described the theoretical approach that underpinned the education intervention.

Type 2 Diabetes Mellitus

The educational content for patients with T2DM included diet in 23 reviews (63.89%), behavioral change in 21 reviews (58.33%), self-management in 20 reviews (55.56%), exercise in 17 reviews (47.22%), glycemic control in 16 reviews (44.45%), medication in 13 reviews (36.11%), psychosocial issues in 9 reviews (25.00%), smoking cessation in 2 reviews (5.56%), cardiovascular risk factors in 2 reviews (5.56%), and DM risks in one review (2.78%). The most common providers were dieticians, nurses, and a multidisciplinary team. The number of sessions, total contact hours, and durations varied. Thirteen reviews [30 33 43 49 52-54 60 64 67 75-77] (13/36, 36.11%) described the theoretical approach that underpinned the education intervention.

Effect of Interventions

The outcomes of the included systematic reviews and meta-analyses were summarized in Table

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Patients with Acute Coronary Syndrome

Three major types of health education-related interventions were used for patients with ACS: general health education (only included general health information), psychoeducational interventions, and secondary prevention educational interventions (including strategies to promote a healthy lifestyle, manage medications, and reduce cardiovascular complications) as well as internet-based interventions.

General Health Education

The findings are based on our synthesis of the findings from 6 systematic reviews. [37 48 50 51 59 70] Overall, there were mixed effects of general health education on behavioral change or clinical outcomes in patients with ACS. There was *some evidence* of a positive effect of general health education on knowledge, behavior, psychosocial indicators, beliefs, and risk factor modification, but no effects for key clinical outcomes, such as cholesterol level, hospitalization, mortality, MI, and revascularization. The results for health-related quality of life, healthcare utilization, and costs were mixed; several reviews reported a significant change, and other reviews reported no significant change for these outcomes. Only one review focused on telephone-based health education. There is *some evidence* that telephone-based health education during cardiac rehabilitation might improve all-cause hospitalization, anxiety, depression, smoking cessation, and systolic BP but there is no evidence for improvements in all-cause mortality and reductions in low-density lipoprotein cholesterol. [59]

Psychoeducational Interventions

Strategies for psychoeducational interventions have a specific focus on smoking cessation, and

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depression. The findings are based on synthesis of results from six publications. [31 35 36 45 56 69] There is *sufficient evidence* that psychoeducational programs are effective at decreasing smoking, achieving smoking abstinence, and reducing depression. One review reported no effect on smoking cessation [31] or total mortality [56].

Secondary Prevention Educational Interventions

The following statements are based on our synthesis of results from three papers. [34 41 44] There is *some evidence* that secondary prevention educational interventions reduce MI readmission rates and improve quality of life, but the intervention was ineffective in reducing revascularization, cholesterol levels, and improving smoking cessation rates. The results are mixed for mortality and re-infarction rates; two reviews [34 41] found positive effects on mortality, while one review [44] did not.

Patients with Type 2 Diabetes Mellitus

Ten types of health education-related interventions were used for patients with T2DM: culturally appropriate health education (tailored to the religious beliefs, culture, literacy, and linguistics of the geographical area), dietary advice, foot health education, group medical visits (a group education component taught by health professionals), general health education (only included general health information), improving compliance with taking medications (e.g., promoting oral hypoglycemic adherence), lifestyle interventions (specific focus on dietary changes and increased physical activity, or stress management), psychoeducational interventions and self-management educational interventions (activities that promote or maintain the behaviors to manage T2DM often based on the National Standards for Diabetes Self-Management Education [13]), and therapeutic education (collaborative process needed to modify behavior and more effectively manage risk factors).

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Culturally Appropriate Health Education

Findings are based on our synthesis of results from 8 publications. [33 42 52-54 58 62 72] Overall, there was *some evidence* of the effects of culturally appropriate health education on clinical outcomes for T2DM. There was *sufficien*t evidence that culturally appropriate health education improves HbA1c control and knowledge scores. There is *some* evidence that physical activity and clinical outcomes (blood glucose, HbA1c, BP) were improved. There were no data relating to adverse events during the intervention and follow-up (such as hypoglycemic events and mortality), and there was insufficient evidence about improvements in quality of life.

General Health Education

The statements are based on our synthesis of results from five papers. [40 46 60 74 79] Overall, there were mixed effects of general health education programs on clinical outcomes for T2DM, including HbA1C, cholesterol level, and triglyceride level. There was *some evidence* of the effectiveness of general health education on glycemic control, weight reduction, and some diabetes control outcomes (HbA1C, diabetes complications). There were no data supporting the effectiveness of general health education on reduced health service utilization, diabetes complications, improved knowledge, psychosocial outcomes, or smoking habits.

Lifestyle Interventions

The following statements are based on our synthesis of results from 6 reviews. [39 49 55 71 72 77] Overall, there were mixed effects of the lifestyle interventions on cholesterol level, HbA1C level, and weight control. There is *some evidence* that lifestyle interventions or behavioral programs are effective for blood glucose and BP management, but they were ineffective for reductions in HbA1c scores [71 72].

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Improving Adherence to Medication Regimes

The statements are based on our synthesis of results from three publications. [57 78 80] There is *some evidence* of the effectiveness of improving adherence to taking medications for HbA1C control including oral hypoglycemic agents.

Self-Management Educational Interventions

The statements are based on our synthesis of results from 9 reviews. [43 47 61 64 65 67 68 75 76] Overall, there was *sufficient evidence* of the effects of self-management education interventions on HbA1c control, knowledge, lifestyle outcomes, and main psychosocial outcomes. However, there was *insufficient* evidence of the benefits of this education intervention on depression, quality of life, and weight control.

Other Health Education-Related Interventions

Other health education-related interventions for patients with T2DM included therapeutic education, foot health education, group medical visits, psychoeducational interventions, and dietary advice. Statements for all of these interventions are based on our synthesis of results from one review.

There is *some evidence* that foot health education is effective in reducing the incidence of lower extremity amputation. [32] There is *some evidence* that group medical visits are effective for improving HbA1c control and systolic BP management [38]. There is also *some evidence* that psychoeducational programs are effective for improving HbA1c control and psychological status. [30]

Finally, there is *insufficient evidence* that dietary advice improves glycemic and weight control or reduces micro- and macrovascular diseases. [63] There is also *insufficient evidence* for the cost-

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effectiveness of therapeutic education for patients with T2DM. [66]

Discussion

This umbrella review identified 51 systematic reviews or meta-analyses (15 for ACS and 36 for T2DM) that assessed the outcomes of various aspects (such as the duration, contact hours, educational content, delivery mode) of the delivery of health education-related interventions relevant to high risk patients with ACS and T2DM. Health education has become an integral part of the management for people with ACS and T2DM. The most appropriate focus of the education provided to ACS patients with T2DM remains largely undefined in the literature. For example, it remains unknown if the focus should be primarily on cardiovascular risk factors, blood glucose monitoring, or all educational components for patients with both conditions. [70 76] In addition, should cardiovascular risk factors be the focus during the acute inpatient stay with other educational needs such as the smoking cessation occurring within the primary care or outpatient settings. [31 69 70]

It remains challenging to determine the specific strategy or format that is the most effective delivery mode for patients with ACS or T2DM. There is very limited evidence to guide clinicians on the duration, contact hours, educational content, delivery mode, total length, and setting of health education programs for cardiac patients. [50] For patients with DM, one study reported that more successful programs were longer than 6 months (longer duration), consisted of greater than 10 contact sessions (high intensity), and were one-on-one sessions with individualized assessment. [82]

Use of Theoretical Orientation to Develop Educational Intervention

For patients with Acute Coronary Syndrome

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Use of theory when designing behavioral change interventions may also influence effectiveness.[75] Health education using a cognitive behavioral strategy is most consistently effective in changing maladaptive illness beliefs, [51] and studies using more than 2 behavioral change strategies reported significant differences between the intervention and control groups. [31] In one review, a significant change in smoking cessation was not observed in subgroup analyses between studies that did or did not report using a theory in intervention planning; [56] however, the authors did not suggest that using a theory in program planning should be disregarded but reported that examining actual theories or mechanisms underlying health education programs is required. [56] Owing to the considerable overlap between different theories and the detailed description of the theoretical approach in only approximately 40% of the included papers, it is difficult to determine the most effective theoretical approach, but many models can be used with success, such as the health belief model (HBM), social cognitive theory (SCT) and transtheoretical model (TTM). [56 67 69 75] Three reviews [31 41 44] noted that some included studies used behavioural strategies such as goal setting. These strategies were found to be beneficial for patients with coronary heart disease.

For patients with Type 2 Diabetes Mellitus

Although the theoretical approach underpinning the health education program was not always described, 13 of the 36 reviews (36.11%) related to T2DM reported the theoretical approach used in their included studies. The most common theories were SCT (including self-efficacy), empowerment theories (eg., Empowerment Behavior Change Model, Self-determination and Autonomy Motivation Theory, Middle-range Theory of Community Empowerment) and TTM. There is evidence that health education interventions based on a theoretical model are likely to be effective. [43] Vugt et al suggested that self-care education programs should be based on

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theories and that theory-based self-care interventions are more effective than non-theory-based programs. [75 83] Theories could help to specify the key target health behaviors and behavioral change techniques required to generate the desired outcomes. [75] The decision regarding the theory should be based on the aim of the program and factor for intervention. [77] Only one review reported that a theoretical approach underpinning the health education program is not necessary for better outcomes. [76] Fourteen reviews [30 33 40 46 52 57 60 63 64 67 68 73 75 77] reported that goal setting was conducted in the included studies. Goal setting by patients, health professionals or mutually-agreed goals were linked to improved patient outcomes.

Educational Content

For Patients with Acute Coronary Syndrome

Most reviews reported that the educational content of the interventions was comprehensive. The most common topics, of the average 3.7 topics per education session, were behavioral change, cardiovascular risk factors management, exercise, psychosocial issues, and smoking cessation. An underlying principle of health education for patients with ACS is that knowledge is necessary, but not enough to develop health behaviors and change risk factors. [31 50] Age, cognitive factors, environmental factors, and social and economic background are also important considerations. [50] While interventions using a behavioral program, telephone-based content, or self-care are effective for smoking cessation, there was insufficient evidence to support that any type of educational program was more efficacious than the others. [69] Psychoeducation, which is defined as multimodal, educationally based, self-management interventions,[31] led to enhanced physical activity levels within 6–12 months when added to cardiac rehabilitation (CR) and was more effective than an exercise program or health education alone. [31 56] Moreover, psychoeducational interventions were more effective for patients with ACS than other types of

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health education. [31 56]

For Patients with Type 2 Diabetes Mellitus

The educational content for patients with T2DM focused more on behavioral change, diet, exercise, glycemic control, medication, and self-management. Health education that was self-management was more effective for patients with T2DM. [40 47] In addition, based on the current evidence, the educational content should be culturally sensitive, especially for patients with T2DM; [33 42 54] culturally appropriate diabetes health education may have a greater impact on glycemic control and reduce diabetes complications. [77] The educational interventions for patients with T2DM focused primarily on HbA1C, lipid levels, quality of life, and body weight. HBM and SCT were the most common theories used in the included reviews.

Teaching Strategies and Outcomes

For Patients with Acute Coronary Syndrome

Most reviews reported that the education was provided using multiple teaching methods and in multiple settings. Nurses and multidisciplinary teams were the most frequent people providing education, and most education programs were delivered post-discharge. Although face-to-face sessions were the most common delivery format, many education sessions were also delivered by telephone or through individualized counseling. Telephone-based health education appeared to be effective for reducing hospitalizations, systolic BP, smoking rates, depression, and anxiety. [59] The educational interventions for patients with ACS focused primarily on clinical outcomes (hospitalization and mortality), modifiable risk factors (BP, low-density lipoprotein levels, and smoking cessation), and other psychological outcomes (anxiety and depression).

For Patients with Type 2 Diabetes Mellitus

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Mixed health education programs generally included group sessions combined with educator-facilitated individual sessions, covering basic knowledge and problem-solving skills. These programs produced greater benefits and larger effect sizes for blood glucose control and knowledge level in patients with T2DM. [47] In contrast, individual education programs have been reported as more effective in achieving outcomes than group-based education. This may be because education programs might be more efficient at addressing personal needs, with greater participant engagement. [73] However, one systematic review reported that individual and group patient education, demonstrated similar outcomes among T2DM patients. [46]

Although face-to-face sessions were the most common delivery format, many education sessions were also delivered by telephone or individualized counseling. Face-to-face health education programs were most effective for enhancing blood glucose control and knowledge levels, while mixed delivery models (face-to-face, phone contact, online or web-based, or video) produced a moderate effect for knowledge levels. [47] Another review reported that face-to-face health education programs generated a greater benefit for metabolic control than those delivered using electronic communication technology. [73]

Nurses (including diabetes nurses educators), community workers, dieticians and multidisciplinary teams were the most frequent educators, and most of the education programs were delivered post-discharge. Some reviews indicated that health education programs delivered by a group of different educators, with some degree of education reinforcement at additional points of contact, may provide the best results. [60 76] However, based on two studies that reported HbA1C at 12 months, it is indicated that the outcomes in studies with only a diabetes nurse as the educator also tended to do better than the outcomes in studies with a multidisciplinary team , while the biggest effect was seen when a dietician was the only educator. [76] Health education

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programs delivered by one person may focus more on the patient's ability than the educational content or quality of the health education programs. [76] However, no clear conclusion can be drawn whether having one educator delivering the intervention is best due to few information. [60]

Delivery, Timing and Follow up

For Patients with Acute Coronary Syndrome

Most educational sessions were delivered weekly. Few reviews provided information regarding the duration of education interventions; when the duration was reported, it varied from 4 weeks to 48 months. These findings suggest that there is a significant gap in the evidence in relation to the duration, contact hours, educational content, optimal delivery mode, total length, and setting of health education programs for cardiac patients. [50] For patients with ACS, one systematic review that included 7 studies with a total of 536 participants reported that studies with education lasting at least 6 months resulted in the most significant changes in the primary outcomes (such as behavioral change, smoking cessation) [31] and that at least 12 months of follow-up is needed to evaluate the impact of telephone-based education. [59] Another review reported that the intensity of education programs is important for efficacy regarding smoking cessation: interventions with a very low intensity and brief interventions, do not have a significant effect, [69] and programs for smoking cessation among patients with coronary heart disease should last >1 month. [69] Most of the reviews were provided for patients with ACS in inpatient settings and then within post discharge settings, five reviews [31 36 45 48 59] did not explicitly state the settings in which the health education related interventions were provided.

For Patients with Type 2 Diabetes Mellitus

Education sessions were delivered weekly or monthly. Longer health education programs for T2DM (>6 months) produced larger effects for all primary outcomes (such as HbA1C). [47]

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Health education lasting >3 months resulted in the largest effect size compared with health education of a shorter duration (<3 months). [33] For HbA1C, the effect size at 6 months seemed to be significantly greater than at 3 and 12 months; in other words, the effect size peaked at 6 months. [62] In general, health education of a greater intensity (longer duration and more sessions) was more effective for blood glucose control and knowledge level among patients with T2DM. [47 74] Compared with health education programs covering only one topic, programs that included multiple or mixed educational topics yielded consistently greater benefits in blood glucose control and knowledge levels. [47] In addition, health education programs combined with specific behavioral change strategies (such as self-care strategies) seemed more effective than other programs. [47] Health education related interventions were mainly delivered in hospital settings, primary care settings, diabetes centers or community based settings; although six reviews [32 39 55 58 67 72] did not explicitly state the delivery settings.

Recommendations about Health Education Interventions for Patients with ACS and T2DM

These results from included systematic reviews and meta-analyses help to provide recommendations about the content of a health education intervention for patients with ACS and T2DM, requiring further evaluation. Future development of educational programs for patients with ACS and T2DM by health care professionals should consider the needs of people with these diseases. [37 40 42 70] Based on the results and findings from this umbrella review, recommendations are made in Table 5. The acute life-threatening nature of ACS requires that increased emphasis should be placed on cardiovascular risk factors in any combined education program. Both ACS and T2DM have common lifestyle factors such as inactivity and high fat diet requiring modifications.

Overall Completeness and Applicability of Evidence

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This overview potentially provides an estimate with the lowest level of bias for the impact of health education-related interventions for patients with ACS or T2DM and could be regarded as an all-inclusive summary of the current evidence base for health education for these patients. While this umbrella review identified evidence for each of the types of health education, there was only a small number of reviews within some categories (such as psychoeducational intervention [30] and dietary advice [63]), and these studies were not very informative. This umbrella review also found no reviews that systematically analyzed varying doses of health education; therefore, could not examine the dose-response effects. There was insufficient information about the evaluated doses (total contact hours and duration of education) to enable comparison of the benefits of differences in the magnitude of the doses across the different research. This umbrella review found no reviews focused on patients with ACS and T2DM; instead, all of the systematic reviews and meta-analyses focused on only one of these diseases.

Quality of the Evidence

The methodological quality of the included systematic reviews and meta-analyses varied. All of the included reviews or meta-analyses were of moderate to high methodological quality, as assessed using AMSTAR. However, only 30 (58.8%) systematic reviews or meta-analyses were rated as high quality and only three (5.9%) systematic reviews or meta-analyses [43 53 69] adequately met all 11 AMSTAR criteria. This indicates that some of the reviews included in this umbrella review may have limitations in their design, conduct, and/or reporting that could have influenced the findings when considered both individually and collectively. [32 65]

The quality of the primary studies in the included systematic reviews or meta-analyses also varied. The main sources of bias were inadequate reporting of allocation concealment and randomization processes, as well as lack of outcome blinding. [33 42 69 70] This bias in the

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methodological quality led to lower quality assessments, which varied by results within each included review. Other reasons for lower methodological quality included heterogeneity in, or inconsistency of, the effect and imprecise findings. Heterogeneity between studies in this umbrella review was described in terms of the intervention, participant characteristics and length of follow-up. Heterogeneity was an important factor indicating the complexity of the health education interventions. [56] The variability in the approaches, tools or scales used to measure outcomes between the included studies are likely to introduce some heterogeneity. [30] The heterogeneity of the educational interventions seen in the reviews included in this umbrella review may reflect the uncertainty about the optimal strategy for providing health education to patients. [37] In addition, 240 studies were included more than once in the included reviews and meta-analyses. However, the overall overlap of studies among reviews and meta-analyses related ACS and T2DM was slight, CCA of 2.6% and 2.1%, respectively. [25]

This umbrella review is the first synthesis of systematic reviews or meta-analyses to take a broad perspective on health education-related interventions for patients with ACS or T2DM. Given that health education is complex, the biggest challenge for systematic reviews or meta-analyses of health education is accounting for the potential clinical heterogeneity in health education-related interventions (content and delivery approaches) and the population of patients who receive health education. To facilitate comparisons across systematic reviews of health education and the efficient future update of this umbrella review, future reviews or meta-analyses need high-quality research and to standardize their design and reporting, including the reporting of included study characteristics, assessment criteria for risk of bias, outcomes, and methods to synthesize evidence synthesis.

Conclusions

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For clinicians providing educational interventions to individuals with ACS and T2DM, the results from this review provide a contemporaneous perspective on current evidence on the effectiveness of health education (its content, and delivery methods) for this high risk patient group. The current evidence compiled by this umbrella review supports current international clinical guidelines, that theoretically-based education interventions lasting 6 months, delivered in multiple modes (face-to-face, phone contact, online or web-based, or video), and with individualized education delivered weekly, are more likely to generate positive outcomes. This review also supports health education- related interventions provided by health professionals, including nurses and multidisciplinary teams, delivering content including specific clinical factors for ACS and T2DM (BP, glycemic control, and medication), modifiable risk factors (unhealthy diet, inactivity, and smoking), and other psychological factors (anxiety and depression). These health education interventions could be delivered post-discharge, such as rehabilitation centers, primary care centers, and the community and should be at least 6 months in duration. The effectiveness of these programs was based on HbA1C levels, knowledge, psychosocial outcomes, readmission rates, and smoking status rather than clear evidence of reduced mortality, MI, or short and long-term complications. In addition, psychoeducational interventions were more effective for patients with ACS, and health education that was culturally appropriate or taught self-management was more effective for patients with T2DM. We also found that longer durations and high-intensity health education provided in an individualized format were more helpful for patients with ACS or T2DM.

The fact that none of the included reviews included patients with both ACS and T2DM indicates a clear need for further rigorous experimental studies with patients with both diseases. Future research that includes these aspects of education are likely determine the effectiveness of

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educational interventions focusing on cardiovascular and DM risk factors and complications within patients with ACS and T2DM.

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Table 1. Methodological quality assessment of included systematic reviews and meta-analyses

	Systematic Review/ Meta-analysis	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total score
Systematic reviews and meta-analysis involved ACS patients													
1	Barth, Jacob, Daha, & Critchley, 2015 [69]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
2	Devi et al., 2015 [44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
3	Ghisi, Abdallah, Grace, Thomas, & Oh, 2014 [50]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	7
4	Kotb, Hsieh, & Wells, 2014 [59]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
5	Brown, Clark, Dalal, Welch, & Taylor, 2013 [37]	Yes	No	Yes	CA	No	Yes	Yes	Yes	Yes	NA	Yes	7
6	Dickens et al., 2013 [45]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
7	Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011 [31]	CA	No	Yes	CA	NO	Yes	Yes	Yes	Yes	No	Yes	6
8	Brown, Clark, Dalal, Welch, & Taylor, 2011 [70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
9	Huttunen-Lenz, Song, & Poland, 2010 [56]	CA	No	Yes	CA	No	Yes	Yes	Yes	Yes	No	No	5
10	Goulding, Furze, & Birks, 2010 [51]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
11	Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008 [34]	CA	Yes	Yes	CA	No	No	Yes	No	Yes	Yes	No	5
12	J. Barth, Critchley, & Bengel, 2008 [36]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
13	Fernandez et al., 2007 [48]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	8
14	J. Barth, Critchley, & Bengel, 2006 [35]	CA	Yes	Yes	CA	No	Yes	CA	Yes	Yes	Yes	Yes	7

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15	Clark, Hartling, Vandermeer, & McAlister, 2005 [41]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Systematic reviews and meta-analysis involved T2DM patients													
16	Choi, Davidson, Walker, Lee, & Palermo, 2016 [40]	CA	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	8
17	Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016 [42]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
18	Huang et al., 2016 [55]	CA	CA	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	7
19	Chen et al., 2015 [39]	CA	CA	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	7
20	Pillay et al., 2015 [71]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	9
21	Terranova, Brakenridge, Lawler, Eakin, & Reeves, 2015 [72]	CA	CA	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
22	Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014 [33]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10
23	Odnoletkova et al., 2014 [66]	Yes	CA	Yes	CA	No	No	Yes	Yes	Yes	Yes	No	6
24	Pal et al., 2014 [67]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
25	Ricci-Cabello et al., 2014 [73]	Yes	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	9
26	Saffari, Ghanizadeh, & Koenig, 2014 [74]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
27	Gucciardi, Chan, Manuel, & Sidani, 2013 [52]	CA	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	7
28	Pal et al., 2013 [68]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10
29	Vugt, Wit, Cleijne, & Snoek, 2013 [75]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	NA	No	Yes	6
30	Amaeshi, 2012 [32]	CA	CA	Yes	No	No	Yes	Yes	Yes	NA	No	No	4
31	Nam, Janson, Stotts, Chesla, &	CA	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8

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	Kroon, 2012 [62]												
32	Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012 [76]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	7
33	Burke et al., 2011 [38]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
34	Kai Lun Gan, Brammer, & Creedy, 2011 [57]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
35	Ramadas, Quek, Chan, & Oldenburg, 2011 [77]	CA	CA	Yes	No	No	Yes	Yes	Yes	NA	No	Yes	5
36	Hawthorne, Robles, Cannings-John, & Edwards, 2010 [54]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	CA	Yes	8
37	Minet, Moller, Vach, Wagner, & Henriksen, 2010 [61]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	9
38	Alam, Sturt, Lall, & Winkley, 2009 [30]	Yes	Yes	No	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
39	Duke, Colagiuri, & Colagiuri, 2009 [46]	Yes	CA	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	8
40	Fan & Sidani, 2009 [47]	Yes	No	Yes	CA	No	Yes	No	No	Yes	No	Yes	5
41	Hawthorne, Robles, Cannings-John, & Edwards, 2008 [53]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
42	Khunti, Camosso-Stefinovic, Carey, Davies, & Stone, 2008 [58]	CA	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	5
43	Loveman, Frampton, & Clegg, 2008 [60]	Yes	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
44	Wens et al., 2008 [78]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	NA	Yes	7
45	Nield et al., 2007 [63]	Yes	Yes	Yes	CA	Yes	Yes	Yes	Yes	Yes	No	Yes	9
46	Zabaleta & Forbes, 2007 [79]	CA	CA	Yes	CA	Yes	Yes	Yes	Yes	NA	No	No	5
47	Deakin, McShane, Cade, &	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11

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	Williams, 2005 [43]												
48	Vermeire et al., 2005 [80]	Yes	Yes	Yes	CA	Yes	Yes	Yes	Yes	Yes	No	Yes	9
49	Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003 [49]	CA	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	6
50	Norris, Lau, Smith, Schmid, & Engelgau, 2002 [65]	CA	No	Yes	No	No	Yes	Yes	Yes	CA	No	No	4
51	Norris, Engelgau, & Narayan, 2001 [64]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	NA	No	No	5

Item 1:"Was an 'a priori' design provided?"; **Item 2**: "Was there duplicate study selection and data extraction?"; **Item 3**: "Was a comprehensive literature search performed?"; **Item 4**: "Was the status of publication (ie. grey literature) used as an inclusion criterion?"; **Item 5**: "Was a list of studies (included and excluded) provided?"; **Item 6**: "Were the characteristics of the included studies provided?"; **Item 7**: "Was the scientific quality of the included studies assessed and documented?"; **Item 8**: "Was the scientific quality of the included studies used appropriately in formulating conclusions?"; **Item 9**: "Were the methods used to combine the findings of studies appropriate?"; **Item 10**: "Was the likelihood of publication bias assessed?"; **Item 11**: "Was the conflict of interest stated?"

CA= Cannot Answer; NA= Not Application;

Source: *Shea, B. J., Grimshaw, J. M., Wells, G. A., Boers, M., Andersson, N., Hamel, C., ... & Bouter, L. M. (2007). Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Medical Research Methodology, 7(1), 1.*

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Table 2. Characteristics and interventions of included systematic reviews and meta-analysis involved ACS patients

(First author, Year); Journal	Primary objectives (To assess effect of interventions on….)	Studies details	Intervention					Outcomes (Primary outcomes were bold.) "–" : No change " ↑ " : Increase " ↓ " : decrease	Synthesis methods
			Educational Content		Provider	Number of session(s), delivery mode, time, setting			
(Devi et al., 2015) [44]; The Cochrane Library	Lifestyle changes and medicines management	**Number of studies**:11 completed trials (12 publications); **Types of studies:** RCTs; **Total sample:** 1,392 participants.	All Internet based interventions.	√ BEHA (-) √ CVR (-) √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY(-) √ SMOKING (-) ☐ SELF	Dietitians; exercise specialists; nurse practitioners; physiotherapist rehabilitation specialists, or did not describe.	**Number of session:** Weekly or monthly or unclear; **Total contact hours:** Unclear. **Duration:** From six weeks to one year.	**Strategies:** Internet- and mobile phone-based intervention, such as email access, private-messaging function on the website, one-to-one chat facility, a synchronised group chat, an online discussion forum, or telephone consultations; or video files; **Format:** one-on-one chat sessions; "ask an expert" group chat sessions; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**– Clinical outcomes;** **– Cardiovascular risk factors;** – Lifestyle changes; – Compliance with medication; – Healthcare utilization and costs; ↓ Adverse intervention effects.	Meta-analysis used Review Manager software.
(Barth, Jacob, Daha, & Critchley, 2015) [69]; The Cochrane Library	Smoking cessation	**Number of studies**:40 RCTs; **Types of studies:** RCTs; **Total sample:** 7,928 participants.	Psychosocial smoking cessation interventions	☐ BEHA ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY √ SMOKING ☐ SELF	Cardiologist; general practitioner physician or study nurse.	**Number of session**: Weekly or 2-3 times per week; **Total contact hours:** Unclear. **Duration:** From 8 weeks to one year.	**Strategies:** Face to face, telephone contact, written educational materials, videotape, booklet or unclear; **Format:** One by one counseling; telephone call; group meetings or unclear; **Theoretical approach:** TTM, SCT.	Inpatient settings, post discharge, other	**↑ Abstinence by self-report or validated.**	Meta-analysis used Review Manager software.
(Kotb, Hsieh, & Wells, 2014) [59]; PloS one	Patients' outcomes.	**Number of studies**: 26 studies; **Types of studies:** RCTs; **Total sample:** 4,081	Telephone-delivered post-discharge interventions.	☐ BEHA √ CVR ☐ DIET ☐ EXERCISE ☐ MED	Dietitians; exercise specialist; health educators; nurses and pharmacists.	**Number of session:** 3-6 sessions/telephone calls and was greater than 6 calls in five	**Strategies:** Telephone calls; **Format:** Unclear, did not describe the format; **Theoretical approach:** Unclear.	Unclear, did not describe the setting.	**↓ All-cause hospitalization;** **– All-cause mortality;** ↓ Depression;	Meta-analysis used Review Manager software.

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		participants.		☐ PSY ☐ SMOKING ☐ SELF		studies; or unclear; **Total contact hours:** 40 mins to 180 mins or unclear; **Duration:** 1.5 - 6 months or unclear.			– Anxiety; ↑ Smoking cessation, ↓ Systolic blood pressure; – LDL-c.	
(Ghisi, Abdallah, Grace, Thomas, & Oh, 2014)[50]; Patient Education and Counseling	knowledge, health behavior change, medication adherence, psychosocial well-being.	**Number of studies**: 42 articles; **Types of studies:** Thirty were experimental: 23 RCTs and 7 quasi-experimental; and 11 observational and 1 used a mixed-methods design. **Total sample:** 16,079 participants.	Any educational interventions.	√ BEHA (+) √ CVR (++) √ DIET (+++) √ EXERCISE (++) √ MED (++) √ PSY(++) √ SMOKING (+) ☐ SELF	Nurses (35.7%), a multidisciplinary team (31%), dietitians (14.3%), and a cardiologist (2.4%).	**Number of session:** 1-24 or unclear. **Total contact hours:** 5–10 min to 3 h as well as a full day of education. **Duration:** 1-24 month; from daily education to every 6 months.	**Strategies:** Did not describe the strategies; **Format:** Group (88.1%) education was delivered by lectures (40.5%), group discussions (40.5%), and question and answer periods (7.1%). Individual education (88.1%), including individual counseling (50%), follow-up telephone contacts (31%) and home visits (7.1%); **Theoretical approach:** Unclear.	Inpatient settings	**– Knowledge,** **– Behavior;** **– Psychosocial indicators.**	Narrative synthesis
(Brown, Clark, Dalal, Welch, & Taylor, 2013)[37]; European Journal of Preventive Cardiology	Mortality, morbidity, HRQoL and healthcare costs.	**Number of studies:** Twenty-four papers reporting on 13 RCTs; **Types of studies:** RCTs; **Total sample:** 68,556 participants.	Patient education.	☐ BEHA √ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	Nurses or other healthcare professionals.	**Number of session and Duration:** From a total of 2 visits to a 4-week residential stay reinforced with 11 months of nurse led follow-up. **Total contact hours:** Unclear.	**Strategies:** Face-to-face education sessions, telephone contact and interactive use of the Internet; **Format:** Group-based sessions, individualized education and four utilized a mixture of both sessions; **Theoretical approach:** Unclear.	Inpatient settings, other	**– Mortality,** **– Non-fatal MI,** **– Revascularizations,** **– Hospitalizations,** **– HRQoL,** – Withdrawals/drop outs; – Healthcare utilization and costs.	Meta-analysis used Review Manager software.
(Dickens et al., 2013)[45]; Psychosomatic Medicine	Depression and depressive symptoms.	**Number of studies:** Sixty-two independent studies. **Types of studies:** RCTs; **Total sample:** 17,397.	Psychological interventions.	√ BEHA (-) ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING	A single health professional or by a unidisciplinary team	**Number of session:** 14.4 (range, 1-156); **Total contact hours:** Varying from 10 to 240 minutes. **Duration:** Unclear.	**Strategies:** Face-to-face sessions, telephone contact or unclear; **Format:** Group or unclear; **Theoretical approach:** Unclear.	Unclear, did not describe.	**↓ Depression;** – Adverse cardiac outcomes; – Ongoing cardiac symptoms.	Univariate analyses using Comprehensive Meta-Analysis, multivariate

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				√ SELF (-)						Meta-regression using SPSS 15.0
(Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011) [20]; Journal of Cardiopulmonary Rehabilitation & Prevention	Health behavior change.	**Number of studies:** 7 trials. **Types of studies:** Six randomized controlled trials and a quasi-experimental trial. **Total sample:** 536 participants.	All psychoeducational or behavioral intervention.	☐ BEHA √ CVR (-) ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Appropriately trained health care workers.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 2-12 months.	**Strategies:** Did not describe the strategies; **Format:** Group setting, combination of group and one-on-one education and one-on-one format only; **Theoretical approach:** TTM, interactionist role theory, Bandura's self-efficacy theory, Gordon's relapse prevention model and a cognitive behavioral approach.	Unclear, did not describe.	**↓ Smoking rates; medication use; − Supplemental oxygen use; ↑ Physical activity;** ↑ Nutritional habits.	Meta-analysis and narrative presentation
(Brown, Clark, Dalal, Welch, & Taylor, 2011) [70]; The Cochrane Library	Mortality, morbidity, HRQofL and healthcare costs.	**Number of studies:** 24 papers reporting on 13 studies. **Types of studies:** RCTs; **Total sample:** 68,556 participants.	Patient education.	√ BEHA (-) √ CVR (-) ☐ DIET √ EXERCISE (-) √ MED ☐ PSY ☐ SMOKING ☐ SELF	Nurse or did not describe.	**Number of session and Duration:** two 2 visits to 4 week residential 11 months of nurse led folluw up **Total contact hours:** Unclear.	**Strategies:** face-to-face sessions, telephone contact and interactive use of the Internet; **Format:** Four studies involved group sessions, five involved individualized education and three utilized both session types, with one study comparing the two approaches; **Theoretical approach:** did not describe.	Post discharge, other	**− Total mortality; − Cardiovascular − mortality; − Non-cardiovascular mortality; − Total cardiovascular (CV) events; − Fatal and/or non-fatal MI;** − Other fatal and/or non-fatal CV events	Meta-analysis used Review Manager software.
(Goulding, Furze, & Birks, 2010) [51]; Journal of Advanced Nursing	Change maladaptive illness.	**Number of studies: 13 studies; Types of studies:** RCTs; **Total sample:** Unclear.	Interventions to change maladaptive illness beliefs	√ BEHA (-) ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING	Cardiologist, nurse, psychologist or did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 4 days to two weeks or unclear.	**Strategies:** Face-to-face sessions, telephone contact and written self-administered; **Format:** Unclear; **Theoretical approach:** Common Sense Model, Leventhal's framework.	Inpatient settings, post discharge, other	**− Beliefs (or other illness cognition);** − QoL; − Behaviour; − Anxiety or depression; − Psychological	A descriptive data synthesis.

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				☐ SELF					wellbeing; − Modifiable risk factors; protective factors.	
(Huttunen-Lenz, Song, & Poland, 2010) [56]; British Journal of Health Psychology	Smoking cessation.	**Number of studies:** A total of 14 studies were included. **Types of studies:** RCTs; **Total sample:** 1,792 participants.	Psychoeducational cardiac rehabilitation intervention.	☐ BEHA ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	Cardiologist, nurse psychologist, or did not describe.	**Number of session:** 4-20 or unclear. **Total contact hours:** 10-720 mins or unclear. **Duration:** 4-29 weeks or unclear.	**Strategies:** Face-to-face counselling, self-help materials; home visit, booklet, video and telephone contact. **Format:** individual or unclear. **Theoretical approach:** Social learning theory; ASE model; TTM; Behavioural multicomponent approach.	Inpatient settings, post discharge, other	**↑ Prevalent smoking cessation, ↑ Continuous smoking cessation,** − Mortality.	Subgroup meta-analysis was used software.
(Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008) [34]; Circulation	Multiple cardiovascular risk factors and all-cause mortality.	**Number of studies:** 27 articles reporting 26 studies. **Types of studies:** 16 clinical controlled trials and 10 before-after studies. **Total sample:** 2,467 patients in CCTs and 38, 581 patients in before-after studies.	In-Hospital Multidimensional Interventions of Secondary Prevention	☐ BEHA ☐ CVR √ DIET (-) √ EXERCISE (-) √ MED √ PSY (-) √ SMOKING (-) ☐ SELF	Cardiac nurses; physician, or did not describe.	**Number of session:**1-5 or unclear; **Total contact hours:** 30-240mins or unclear; **Duration:** 4 weeks – 12 months.	**Strategies:** Written material; audiotapes; presentations; face-to-face; **Format:** Group or unclear; **Theoretical approach:** Unclear.	Inpatient settings.	**↓ All-cause mortality; ↓ Readmission rates; − Reinfarction rates.**	Stata version 9.1.
(Barth, Critchley, & Bengel, 2008) [36] ; The Cochrane Library	Smoking cessation.	**Number of studies:** Forty trials; **Types of studies:** RCTs; **Total sample:** 7,682 patients.	Psychosocial intervention	√ BEHA (+++) √ CVR (++) ☐ DIET ☐ EXERCISE ☐ MED √ PSY (+) √ SMOKING (+++)	Cardiologist, nurse, physician or study nurse.	**Number of session:** 1-5 or unclear; **Total contact hours:** 15 mins - 9 hours. **Duration:** within 4 weeks or did not report on the duration.	**Strategies:** Face to face; information booklets, audio- or videotapes. **Format:** Group sessions or individual counselling; **Theoretical approach:** TTM.	Inpatient settings	**↑ Abstinence by self-report or validated.**	Meta-analysis used Review Manager software.

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				√ SELF(+++)						
(Fernandez et al., 2007) [48]; International Journal of Evidence-Based Healthcare	Risk factor modification.	**Number of studies:** Seventeen trials; **Types of studies:** randomised, quasi-RCTs and clustered trials; **Total sample:** 4,725 participants.	Brief structured intervention.	√ BEHA (-) √ CVR (-) ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Case manager; dieticians; health educator; nurses; psychologist; and research assistants.	**Number of session:** supportive counselling ranged from 1 to 7 calls for the duration of the study; **Total contact hours:** varied from 10 to 30 mins; **Duration:** Unclear.	**Strategies:** Written, visual, audio, telephone contact; **Format:** did not describe; **Theoretical approach:** theoretical behaviour change principles.	Unclear, did not describe.	**↓ Smoking;** **− Cholesterol level;** **− Physical activity;** **↑ Dietary habits;** **↓ Blood sugar levels;** **− BP levels;** **↓ BMI;** − Incidence of admission.	Cochrane statistical package Review Manager.
(J. Barth, Critchley, & Bengel, 2006) [35]; Annals of Behavioral Medicine	Smoking cessation.	**Number of studies:** Nineteen trials; **Types of studies:** RCTs; **Total sample:** 2,548 patients.	Psychosocial interventions.	√ BEHA (+++) √ CVR (++) ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING √ SELF (+++)	Unclear, did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face to face, telephone contact or unclear; **Format:** Unclear; **Theoretical approach:** Unclear.	Unclear, did not describe.	**↑ Abstinence;** **↓ Smoking status**.	Data analyses were carried out in Review Manager 4.2.
(Clark, Hartling, Vandermeer, & McAlister, 2005) [41]; Annals of Internal Medicine	Mortality, MI	**Number of studies:** 63 randomized trials; **Types of studies:** RCTs; **Total sample:** 21,295 patients.	Secondary prevention programs	☐ BEHA ☐ CVR √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Nurse, multidisciplinary team, or did not describe.	**Number of session:** 1-12 or unclear; **Total contact hours:** did not describe. **Duration:** 0.75-48 months.	**Strategies:** Face to face, telephone contact and home visit; **Format:** Group and individual or unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ Mortality,** **↓ MI,** − Hospitalization rates.	Performed analyses by using Review Manager 4.2 and Qualitative Data Synthesis

NOTE:

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SMOKING= Smoking cessation; CVR= Cardiovascular risk factors; PSY =Psychosocial issues (depression, anxiety); DIET =Diet; EXERCISE= Exercise; MED= Medication; BEHA = Behavioral charge (including lifestyle modification); SELF = Self-management (including problems solving); GC= glycemic control; DR =Diabetes risks; CHD= Coronary heart disease; CAD = Coronary Artery Disease; CHW=Community Health Worker; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; LDL = Low-density Lipoprotein Cholesterol; SMS = Short Message Service; BCTs = Behavioral Change Techniques; LEA = Lower Extremity Amputation; PRIDE = Problem Identification, Researching one's routine, Identifying a management goal, Developing a plan to reach it, Expressing one's reactions and Establishing rewards for making progress; ASE = Attitude-social influence-efficacy; CVRF= Cardiovascular Risk Factors; SMS = Short Message System; PA = Physical Activity; EDU = Patient Education; GP= General Practice; RCTs =Randomized controlled trials; CCTS = controlled clinical trials; HRQoL = Health Related Quality of Life; QoL = Quality of Life; MI = Myocardial Infarction; CAD = Coronary Artery Disease; CABG= Coronary Artery Bypass Graft Surgery; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model; SAT=Social Action Theory;

In the educational content: “+”: minor focus; “++”:moderate focus; “+++” major focus; “-“ =unclear what the intensity of the education was for any topic;

In the outcomes: arrow up (“ ↑ ”) for improvement, arrow down (“ ↓ ”) for reduction; a dash (“−”) for no change or inconclusive evidence. Primary outcomes were bold.

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Table 3. Characteristics and interventions of included systematic reviews and meta-analysis involved T2DM patients

(First author, Year); Journal	Primary objectives (To assess effect of interventions on….)	Studies details	Intervention					Outcomes (Primary outcomes were bold.) "–" : No change " ↑ " : Increase " ↓ " : decrease	Synthesis methods
			Educational Content		Provider	Number of session(s), delivery mode, time, setting			
Choi, Davidson, Walker, Lee, & Palermo, 2016) [40]; Diabetes Research and Clinical Practice	Glycemic effect	**Number of studies:** 53 studies(five in English, 48 in Chinese); **Types of studies:** RCTs; **Total sample:** Unclear.	Diabetes education intervention.	☐ BEHA √ DIET (-) ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Unclear, did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 30–150 min or unclear.	**Strategies:** Face to face, written materials; telephone contact and home visit; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c (glycated haemoglobin).**	STATAversion 12 and Review Manager version 5.3
Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016) [42]; Diabetic Medicine	successful outcomes and to suggest directions for future research.	**Number of studies: 33; Types of studies:** RCTs; **Total sample:** 7,453 participants.	Culturally appropriate health education.	√ BEHA (-) √ DIET (-) √ DR (-) √ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	CHWs, clinical pharmacists dieticians, Nurses, podiatrists, physiotherapists, and psychologists.	**Number of session:** one to ten or unclear; **Total contact hours:** unclear; **Duration:** from a single session to 24 months.	**Strategies:** Face-to-face; Phone contact; **Format:** group sessions (10 studies), individual sessions (13) or a combination of both; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c,** **– HRQoL,** **– Adverse events,** – BP, – BMI, – Lipid levels, – diabetes complications, – Economic analyses, – Mortality and diabetes knowledge, – Empowerment, – Self-efficacy and satisfaction.	Meta-analysis using the Review Manager statistical program.

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(Huang et al., 2016) [55]; European Journal of Internal Medicine	Clinical markers of cardiovascular disease	**Number of studies:** 17 studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Lifestyle interventions.	☐ BEHA √ DIET (-) √ CVR (-) √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Nurse, Pharmacist or unclear.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 6 month – 8 years.	**Strategies:** Unclear; **Format:** Individual; Group and Mixed. **Theoretical approach:** Unclear;	Unclear, did not describe.	**Cardiovascular risk factors** (such as, − BMI, ↓ HbA1c, − BP, ↓ The level of cholesterol.)	Review Manager 5.1.
(Chen et al., 2015) [39]; Metabolism-Clinical and Experimental	Clinical markers.	**Number of studies:** 16 studies; **Types of studies:** RCTs; **Total sample:** per study ranged from 23 to 2575;	Lifestyle intervention.	√ BEHA (-) ☐ DIET √ CVR (-) ☐ EXERCISE ☐ GC √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Unclear, did not describe.	**Number of session:** Monthly; **Total contact hours:** Unclear; **Duration:** < 6 months -8 years.	**Strategies:** Unclear; **Format:** Individual; Group and Mixed; **Theoretical approach:** Unclear.	Unclear, did not describe.	**Cardiovascular risk factors** including ↓ BMI, ↓ HbA1c, ↓ SBP, DBP, − HDL-c, and LDL-c.	All analyses were performed using Comprehensive Meta-Analysis statistical software.
(Terranova, Brakenridge, Lawler, Eakin, & Reeves, 2015) [72]; Diabetes, Obesity and Metabolism	Weight loss.	**Number of studies:** 10 individual studies (from 13 papers); **Types of studies:** RCTs; **Total sample:** ranging from 27 to 5145 participants.	Lifestyle-based-only intervention.	√ BEHA (-) √ DIET (-) ☐ DR (-) √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Dietician; diabetes educator; general physician; multidisciplinary team; or nutritionist; nurse.	**Number of session:** 1-42; **Total contact hours:** Unclear; **Duration:** ranged from 16 weeks to 9 years.	**Strategies and Format:** Face-to-face individual or group-based sessions, or a combination of those. One study delivered the intervention via the telephone **Theoretical approach:** Unclear.	Unclear, did not describe.	**↓ Weight change; − HbA1c.**	Meta-analyses - Review Manager and meta-regression analysis - stata version
(Pillay et al., 2015) [71]; Annals of	HbAlc level.	**Number of studies:** 132; **Types of studies:**	Behavioral Programs.	√ BEHA (-) √ DIET (-) ☐ DR	Trained individuals.	**Number of session:** Unclear; **Total contact hours:**	**Strategies:** Unclear; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge,	**− HbA1c; ↓ BMI.**	The analysis was conducted

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internal medicine		RCTs; **Total sample:** Unclear.		√ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)		range,17 to 40.5 hours; **Duration:** 4 or more weeks.		other		by using a Bayesian network model.
(Pal et al., 2014) [67]; Diabetes Care	Health status, cardiovascular risk factors, and QoL.	**Number of studies:** 20 papers describing 16 studies; **Types of studies:** RCTs; **Total sample:** 3,578 participants.	Computer-based self-management interventions.	☐ BEHA ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF	Unclear, did not describe.	**Number of session:** 1-8 ; **Total contact hours:** 10 mins - 6 hours; **Duration:** 8 weeks – 12 months;	**Strategies:** Online/web-based; Phone contact. **Format:** Individual; Group and Mixed. **Theoretical approach:** TTM, social ecological theory, SCT, and self-determination theory.	Unclear, did not describe.	**− HRQoL, ↓ HbA1c, − Death;** ↓ Cognitions, behaviors, − Social support, ↓ Cardiovascular risk factors, − Complications, − Emotional outcomes, − Hypoglycemia, − Adverse effects, − CE and ecfonomic data.	Meta-analysis using Review Manager software or narrative presentatio.
(Ricci-Cabello et al., 2014) [73]; BMC endocrine disorders	Knowledge, behaviors and clinical outcomes.	**Number of studies:** Thirty-seven studies; **Types of studies:** Almost two thirds of the studies were RCTs, 27% studies were Quasi-experimental design. **Total sample:** Unclear.	DSM educational programs.	☐ BEHA √ DIET(+++) ☐ DR √ EXERCISE (+++) √ GC(+++) √ MED(++) √ PSY(++) ☐ SMOKING ☐ SELF	Dietitian; Nurse; Psychologist; Physician; Research team or staff;	**Number of session:** 13.1; **Total contact hours:** 0.25-180 hours; **Duration:** 0.25-48 months.	**Strategies:** Face-to-face; Telecommunication; Both. **Format:** One on one; Group and Mixed. **Theoretical approach:** Unclear.	Post discharge, other	**− Diabetes knowledge; − Self-management; − Behaviors; − Clinical outcomes;** ↓ Glycated hemoglobin; − Cost-effectiveness analysis.	Meta-analyses and bivariate meta-regression were conducted with Stata, version 12.0.

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(Saffari, Ghanizadeh, & Koenig, 2014) [74]; Primary Care Diabetes	Glycemic control.	**Number of studies:** 10; **Types of studies:** RCTs; **Total sample:** 960 patients.	An educational intervention using SMS.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Unclear, did not describe.	**Number of session:** Weekly; or 2 messages daily or unclear; **Total contact hours:** Unclear. **Duration:** 3 months – 1 year	**Strategies:** SMS: sending and receiving data. Receive data through text-messaging by patients only. Used a website along with SMS; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↑ **Glycemic control**.	Comprehensive Meta-analysis Software Version 2.0.
(Odnoletkova et al., 2014) [66]; Journal of Diabetes & Metabolism	Cost-effectiveness (CE).	**Number of studies:** Seventeen studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Therapeutic education.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	General physician; nutritionists or unclear.	**Number of session:** ~ 16; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face-to-face or unclear; **Format:** individual and group lessons; **Theoretical approach:** Unclear.	Inhospital or unclear.	− **CE.**	Incremental Cost-Effectiveness Ratio.
(Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014) [33]; The Cochrane Library	HbAIc level, Knowledge and clinical outcomes.	**Number of studies:** 33 trials; **Types of studies:** RCTs and quasi-RCTs; **Total sample:** 7453 participants.	'Culturally appropriate' health education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	CHWs; dieticians; exercise physiologists; lay workers; nurses; podiatrists; and psychologists;.	**Number of session:** one session to 24 months; **Total contact hours:** Unclear; **Duration:** The median duration of interventions was six months.	**Strategies:** **Format:** Group intervention method, one-to-one sessions and a mixture of the two methods. Or a purely interactive patient-centred method. **Theoretical approach:** empowerment theories; behaviour change theories, TTM of behaviour change and SCT.	Inpatient settings, post discharge, other	↓ **HbA1c;** − **HRQoL;** − **Adverse events;** − Mortality; − Complications; −Satisfaction; ↑ Empowerment; ↑ Self-efficacy; − Attitude; knowledge;	Meta-analyses used Review Manager software.

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									−BP; −BMI; ↓ Lipid levels; −Health economics.	
(Vugt, Wit, Cleijne, & Snoek, 2013) [75] ; Journal of Medical Internet Research	Health outcomes.	**Number of studies:** 13 studies; **Types of studies:** RCTs; **Total sample:** 3813 patients.	BCTs are being used in online self-management interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Health care professional.	**Number of session:** 6 weekly sessions or unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Online/web-based; **Format:** Unclear; **Theoretical approach:** self-efficacy theory, social support theory, TTM, SCT, social-ecological model, and cognitive behavioral therapy.	Post discharge	**− Health behavior change,** **− Psychological well-being;** − Clinical parameters.	Unclear.
(Gucciardi, Chan, Manuel, & Sidani, 2013) [52]; Patient Education and Counseling	HbAIc level,physical activity and diet outcomes.	**Number of studies:** Thirteen studies; **Types of studies:** RCTs and comparative studies; **Total sample:** Unclear.	DSME interventions.	☐ BEHA √ DIET (+++); ☐ DR √ EXERCISE (+++); ☐ GC √ MED (+); √ PSY (+) ☐ SMOKING √ SELF (++).	Dietitians (n = 7/13); Multidisciplinary Team (n = 7/13); Nurse (n = 5/13); Community Peer Worker (n = 3/13).	**Number of session:** Low Intensity: <10 education sessions (n = 7); High Intensity: ≥ 10 education sessions (n = 6); **Total contact hours:** Unclear; **Duration:** < 6 months (n = 7/13); ⩾6months (n = 6/13).	**Strategies:** Face-to-face(n = 13/13); Written Literature: (e.g., handbook) (n = 4/13);Telephone(n = 4/13);Audio-Visual(n = 1/13); **Format:** One-on-one: (n = 11/13);Group (n = 9/13); **Theoretical approach:** SAT; Empowerment Behavior Change Model; modification theories; Pharmaceutical Care Model; Behavior Change Theory; PATHWAYS Program; Symptom-Focused Management Model; Motivational interviewing.	Inpatient settings, post discharge	**− HbA1c levels,** − Anthropometrics, − Physical activity; − Diet outcomes.	Arecently described method.
(Pal et al., 2013) [68]; The Cochrane Library	Health status and HRQoL.	**Number of studies:** 16 studies; **Types of studies:** RCTs; **Total sample:** 3,578	Computer-based diabetes self-management intervention.	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-)	Nurse or other healthcare professionals.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** One session –	**Strategies:** Online/web-based; phone contact **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**− HRQoL;** **− Death from any cause;** **↓ HbA1c;**	Formal meta-analyses and narrative

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		participants.		√ MED (-) √ PSY (-) ☐ SMOKING ☐ SELF		18 months.			− Cognitions; − Behaviours; −Social support; −Biological markers; − Complications.	synthesis.
(Nam, Janson, Stotts, Chesla, & Kroon, 2012) [62]; Journal of Cardiovascular Nursing	Glycemic control.	**Number of studies:** 12 RCTs; **Types of studies:** RCTs; **Total sample:** 1,495 participants.	Diabetes educational interventions (no drug intervention).	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) √ PSY (-) ☐ SMOKING √ SELF (-)	Nurses (36%), dieticians (36%), diabetes educators (5%), other professionals (9%) and nonprofessional staff (14%).	**Number of session:** 1 month or less; 1 to 3 months; and 12 months; **Total contact hours:** most studies did not describe, or from 1 session to more than 30 hours; **Duration:** from 1 session to 12 months, frequency: 1 session to 25 weekly or biweekly education.	**Strategies:** Teaching or counseling; home-based support; and visual aids. **Format:** group education or a combination of group education and individual counseling; or only individual counseling; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c level.**	Meta-analysis.
Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012) [76]; BMC Health Services Research	Clinical, lifestyle and psychosocial outcomes.	**Number of studies:** 21 studies (26 publications). **Types of studies:** RCTs; **Total sample:** 2,833 participants.	Group-based education.	Did not describe the content of the intervention.	Community workers; dietician; lay health advisors nurse and nutritionist.	**Number of session and Total contact hours:** 30 hours over 2.5 months, 52 hours over one year,and 36 hours or 96 hours over 6 months. **Duration:** Six months to two years.	**Strategies:** Face to face; **Format:** 5 to 8 participants group to 40 patients group. **Theoretical approach:** empowerment model and the discovery learning theory, the SCT and the social ecological theory, the self-efficacy and self-management theories and operant reinforcement theory.	Inpatient settings, post discharge, other	**↓ HbA1c,** **↑ Lifestyle outcomes,** **↑ Diabetes knowledge,** ↑ Self-management skills, ↑ Psychosocial outcomes, ↓ Mortality rate, ↓ BMI, ↓ Blood pressure; ↓ Lipid profile.	Meta-analysis using Review manager v5.
(Amaeshi,	Increasing	**Number of studies:**	Foot health	Food care.	Podiatrist,	**Number of session:**	**Strategies:** Face to face;	Unclear, did	**↓ LEA;**	Narrative

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2012) [32]; Podiatry Now	good foot health practices that will ultimately reduce LEA.	8 studies; **Types of studies:** RCT or clinical controlled trial (CCT); **Total sample:** Unclear.	education:		psychotogist or unclear.	Unclear; **Total contact hours:** between 15min and 14 hours; **Duration:** 3-30 months.	**Format:** In three of the studies, educational interventions were delivered to the participants in groups, while the other five provided individualized (one-to-one) foot-care education to the participants; **Theoretical approach:** Unclear.	not describe.	↑ Self-care.	synthesis.
Kai Lun Gan, Brammer, & Creedy, 2011) [57]; JBI Library of Systematic Reviews	Oral hypoglycaemic adherence.	**Number of studies:** Seven studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Educational interventions.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) √ PSY (-) ☐ SMOKING √ SELF (-)	Nurses; pharmacists; other skilled healthcare professionals.	**Number of session:** 1-12 or unclear; **Total contact hours:** 2.5 hours or unclear; **Duration:** 4-12 months.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↓ **HbA1c,** − **Medication adherence;** ↓ Blood glucose; − Tablet count; − Medication containers; − Diabetes complications; − Health service utilization.	Narrative summary form.
Burke et al., 2011) [38]; JBI Database of Systematic Reviews and Implementation Reports	HbAlc level,BP.	**Number of studies:** 11 RCTs and 4 quasi-experimental trials; **Types of studies:** RCTs and quasi-experimental trials; **Total sample:** 2,240 patients.	Group medical visits.	√ BEHA (-) √ DIET (-) ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Dndocrinologists ; DM nurse; family physician; nutritionist and rehab therapist.	**Number of session:** 1-4 or unclear; **Total contact hours:** 2-4 hours or unclear; **Duration:** One session to 2 years.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↓ **HbA1c;** − **Systolic and diastolic BP;** − LDL measurements.	Meta-analysis.
(Ramadas, Quek, Chan, & Oldenburg, 2011) [77];	HbAlc level.	**Number of studies:** 13 different studies; **Types of studies:** RCTs and quasi-experimental studies;	Web-based behavioural interventions.	√ BEHA (-) √ DIET (-) ☐ DR ☐ EXERCISE	Dietician; endocrinologist; physicians; researchers or research staff	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** ranged	**Strategies:** E-mail and SMS technologies that were commonly used together with the websites to reinforce the intervention, and Website, print material.	Inpatient settings, post discharge, other	− **Self-monitoring blood sugar,** − Weight-loss, − Dietary behaviour,	Not statistically combined and re-analyzed;

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International Journal of Medical Informatics		**Total sample:** Unclear.		√ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	members and study nurse.	between 12 and 52 weeks, with an average of 27.2 ± 18.3 weeks.	**Format:** Unclear; **Theoretical approach:** Wagner's Chronic Care Model; Self-efficacy theory/Social support theory; TTM; HBM; SCT.		− Physical activity.	
(Minet, Moller, Vach, Wagner, & Henriksen, 2010) [61]; Patient Education and Counseling	Glycaemic control.	**Number of studies:** Forty-seven studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Self-care management interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Case nurse manager; group facilitator; nurse educator; multidisciplinary team; physiologist; physician; peer counsellor; researcher; and pharmacist.	**Number of session:** 3-26; **Total contact hours:** Unclear; **Duration:** 4 weeks to 4 years.	**Strategies:** Face to face; home visit; phone calls; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c.**	Meta-analyses and meta-regression used Stata's meta command.
Hawthorne, Robles, Cannings-John, & Edwards, 2010) [54]; Diabetic Medicine	Effects of culturally appropriate health education	**Number of studies:** 10 trials; **Types of studies:** RCTs; **Total sample:** 1603 patients.	Culturally appropriate health education	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Exercise physiologists; dieticians; diabetes nurses; link workers, and podiatrists.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** one session to 12 months;	**Strategies:** Face to face; visual aids, leaflets and teaching materials; **Format:** group approach, one-to-one interviews and a mixed approach; **Theoretical approach:** SAT, Empowerment Behaviour Change Model, SCT, Management model and the Theory of Planned Behaviour.	Inpatient settings, post discharge, other	**−QoL;** **↓ HbA1c;** **− BP;** ↑ Knowledge; − BMI; ↓ Lipid levels, − Diabetic complications, − Mortality rates, hospital admissions, hypoglycaemia.	Meta - analysis using the Review Manager and narrative review.
(Fan & Sidani, 2009) [47]; Canadian	Knowledge, self-management	**Number of studies: 50 studies;** **Types of studies:** RCTs;	DSME intervention:	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE	Unclear, did not describe.	**Number of session:** 10 (range 1 to 28); **Total contact hours:** 17 contact hours (range 1 to	**Strategies:** Online/web-based (4%); video (2%); face-to-face (60%); phone contact (4%); Mixed (30%). **Format:** One-on-one (32%); Group	Inpatient settings, post discharge, other	**↑ Diabetes knowledge,** **↑ Self-management behaviours;**	Comprehensive Meta-Analysis (version

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Journal of Diabetes	behaviours and metabolic control.	**Total sample:** **Unclear.**		☐ GC ☐ MED √ PSY (-) ☐ SMOKING √ SELF (-)		52); ⩽ 10 (46%); 11-20 (21%); > 20 (33%); **Duration:** 22 weeks (range 1 to 48); ⩽ 8 weeks (26%); 9–24 weeks (37%); > 24 weeks (37%).	(40%); Mixed (28%). **Theoretical approach:** Unclear.		**↓ HbA1c,**	20).
(Duke, Colagiuri, & Colagiuri, 2009) [46]; The Cochrane Library	Metabolic control, diabetes knowledge and psychosocial outcomes.	**Number of studies:** Nine studies; **Types of studies:** RCTs; **Total sample:** 1,359 participants.	Individual patient education.	√ BEHA (-) ☐ DIET ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Diabetes educators and dieticians.	**Number of session:** 1-6; **Total contact hours:** 20 min – 7 hours; **Duration:** 4 weeks – 1 year.	**Strategies:** Face to face; telephone; **Format:** Individual; **Theoretical approach:** Unclear.	Inpatient settings	**− HbA1c;** **− Diabetes complications;** − Health service utilisation and health care costs; − Psychosocial outcomes; − Diabetes knowledge; patient self-care behaviours; − Physical measures; metabolic.	Meta-analysis.
(Alam, Sturt, Lall, & Winkley, 2009) [30]; Patient Education and Counseling	Glycaemic control and psychological status.	**Number of studies:** 35 trials; **Types of studies:** RCTs; **Total sample:** 1431 patients.	Psycho-educational Interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Generalists; psychological specialists; or did not report the specialist	**Number of session:** 1-16; **Total contact hours:** 20 min – 28 hours; **Duration:** about 13.7 (±11.06) weeks.	**Strategies:** Face to face; telephone calls; **Format:** group format; a single format and used a combination; **Theoretical approach:** TTM; motivational interviewing;	Inpatient settings, other	**↓ HbAlc;** **↓ Psychological distress.**	Meta-analysis.
Khunti, Camosso-	Knowledge and	**Number of studies:** nine studies;	Any educational	☐ BEHA √ DIET ☐	Unclear, did not describe.	**Number of session:** Unclear;	**Strategies:** Face to face; **Format:** Group and individual;	Unclear, did not describe.	**− Knowledge;** **− Psychological and**	Unclear.

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Stevanovic, Carey, Davies, & Stone, 2008) [58]; Diabetic Medicine	biomedical outcomes.	**Types of studies:** RCTs and RCT was followed by a before-and-after study; **Total sample:** 1004 patients.	intervention.	DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING ☐ SELF		**Total contact hours:** Unclear; **Duration:** 3- 12 months.	**Theoretical approach:** Unclear.		**biomedical outcome measures.**	
(Loveman, Frampton, & Clegg, 2008) [60]; Health Technology Assessment	Clinical effectiveness.	**Number of studies:** Twenty-one published trials; **Types of studies:** RCTs and CCTs; **Total sample:** Unclear.	Educational interventions.	√ BEHA (++) √ DIET (+++) ☐ DR √ EXERCISE (+++) √ GC (+++) ☐ MED ☐ PSY ☐ SMOKING √ SELF (+++)	Community workers; diabetes research technician; diabetes nurse, dieticians; educationalist; medical students; nurses; pharmacists; physician, or physician assistant.	**Number of session:** Two to four intensive education of 1.5 to 2 hours followed up with additional education at, 3 and 6 months; **Total contact hours and Duration:** about 150 mins over a 6-month or 61 to 52 hours over one year.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** cognitive-behavioural strategies; pedagogical principle.	Inpatient settings, post discharge, other	− **Diabetic control outcomes**; − Diabetic end-points; − QoL and cognitive measures.	Narrative review
(Wens et al., 2008) [78]; Diabetes Research and Clinical Practice	Improving adherence to medical treatment recommendations.	**Number of studies:** 8 studies; **Types of studies:** RCTs and controlling before and after studies. **Total sample:** 772 patients.	Interventions aimed at improving adherence to medical treatment.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Diabetes educator; nurse or did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** ~ 9 months or unclear.	**Strategies:** Face-to-face; telephone; **Format:** face-to-face; group based and telemedicine; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	− **Adherence;** − HbA1c; − Blood glucose.	Cochrane Review Manager software.

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(Hawthorne, Robles, Cannings-John, & Edwards, 2008) [53]; The Cochrane Library	HbAlc level, Knowledge and clinical outcomes.	**Number of studies:** A total of 11 trials; **Types of studies:** RCTs; **Total sample:** 1,603 patients.	Culturally appropriate (or adapted) health education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	Dieticians, diabetes nurses, exercise physiologists; link workers; podiatrists; psychologist and and non-professional link worker.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** one session to 12 months.	**Strategies:** Face-to-face; booklet; **Format:** Group intervention method; one to one interviews; mixture of the two methods; purely interactive patient-centred method; semi-structured didactic format and combination of the 2 approaches. **Theoretical approach:** SAT; Empowerment Behaviour Change Model; Behaviour Change Theory; SCT, Management Model and the Theory of Planned Behaviour.	Inpatient settings, post discharge, other	**↓ HbA1c** **↑ Knowledge scores** − Other outcome measures	Narrative presentation and meta-analysis.
(Nield et al., 2007) [63]; The Cochrane Library	Metablic control.	**Number of studies:** 36 articles (18 trials); **Types of studies:** RCTs; **Total sample:** 1,467 participants.	Dietary advice.	☐ BEHA √ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	exercise physiologist; dietitian; group facilitator; nutritionist; nurse educator; and physician.	**Number of session:** 1-12; **Total contact hours:** 20 min-22 hours; **Duration:** 11 weeks – 6months or unclear.	**Strategies:** Face-to-face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**− Weight;** **− Diabetic complications;** **− HbA1c;** − QoL; − Medication use; − Cardiovascular disease risk;	Meta-analysis.
(Zabaleta & Forbes, 2007) [79]; British Journal of Community Nursing	Clinical effectiveness.	**Number of studies:** 21 studies; **Types of studies:** Controlled trials; **Total sample:** Unclear.	Structured group diabetes education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Diabetes nurse educator; physician's assistant; and physicians;	**Number of session:** 4-6 or unclear; **Total contact hours:** 6-12 hours or unclear; **Duration:** 1-6 months or unclear.	**Strategies:** Face to face; **Format:** Group; **Theoretical approach:** Unclear.	Post discharge.	**−HbA1c.**	A tabulative synthesis.

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(Deakin, McShane, Cade, & Williams, 2005) [43]; The Cochrane Library	Clinical, lifestyle and psychosocial outcomes.	**Number of studies:** 14 publications, reporting 11 studies; **Types of studies:** RCTs, and CCTs; **Total sample:** 1,532 participants.	Group-based educational programmes.	Did not describe the content of the intervention.	Health professionals, lay health advisors.	**Number of session:** Unclear; **Total contact hours:** from 6 to 52 hours; **Duration:** 3 hours per year for 2 years and 3 or 4 hours per year for 4 years.	**Strategies:** Unclear; **Format:** Group; **Theoretical approach:** the Diabetes Treatment and Teaching Programme (DTTP); empowerment model; adult learning model, public health model, HBM and TTM.	Inpatient settings, post discharge	**↓ Metabolic control;** **↑ Diabetes knowledge;** ↑ QoL; ↑ Empowerment/self-efficacy.	Summarized statistically
(Vermeire et al., 2005) [80]; The Cochrane Library	Improving adherence to treatment recommendations.	**Number of studies:** 21 articles; **Types of studies:** RCTs; cross-over study; controlled trial; controlled before and after studies; **Total sample:** 4,135 patients.	Interventions that were aimed at improving the adherence to treatment recommendations.	☐ BEHA ☐ DIET ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Nurse, pharmacist and other healthcare professionals.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face to face; telephone; home visit; video; mailed educational materials; **Format:** Unclear. **Theoretical approach:** Unclear.	Inpatient settings, post discharge	**Direct indicators,** such as ↓ Blood glucose level; – Indirect indicators, such as pill counts; –Health outcomes.	A descriptive review and sub-group meta-analysis.
(Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003) [49]; Diabetes Educator	Body weight and glycaemic control.	**Number of studies:** Sixty-three RCTs; **Types of studies:** RCTs; **Total sample:** 2,720 patients.	Educational and behavioural component interventions.	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Nurse (39%); dietitian (26%); physician (17%); other or not specified (23%); other professional (13%); psychologist (9%); Exercise psychologist (9%); and health educator (4%).	**Number of session:** Unclear; **Total contact hours:** Unclear. **Duration:** 1 month to 19.2 months.	**Strategies:** Unclear; **Format:** Unclear; **Theoretical approach:** SAT, contracting model and patient empowerment.	Inpatient settings, post discharge	**– Glycaemic control;** **– Weight.**	Sufficient data were combined using meta-analysis.
(Norris, Lau, Smith,	Total GHb.	**Number of studies:** 31 studies	Self-management	√ BEHA (-) √ DIET (-)	Dietitian; lay health care	**Number of session:** 6 (1–36);	**Strategies:** Online/web-based; video ; face-to-face; phone contact;	Inpatient settings, post	**↓ Total GHb,**	Meta-analysis and

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Schmid, & Engelgau, 2002) [65]; Diabetes Care		**Types of studies:** RCTs. **Total sample:** 4,263 patients.	education.	☐DR ☐EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	worker; nurse; physician with team; self (e.g. computer assisted instruction); and team (nurse, dietitian, etc.).	**Total contact hours:** 9.2 (1–28) hours; **Duration:** 6 (1.0–27) months.	**Format: Group;** individual and mixed; **Theoretical approach:** Unclear	discharge, other		meta-regression.
(Norris, Engelgau, & Narayan, 2001) [64]; Diabetes Care	Clinical outcomes,Knowledge, Metablic control.	**Number of studies:** 72 studies (84 papers); **Types of studies:** RCTs; **Total sample:** Unclear.	Self-management training interventions.	√ BEHA (-) √ DIET (-) ☐ DR ☐EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	CHWs; nurse; or other healthcare professionals.	**Number of session:** 1-16; **Total contact hours:** ～22 hours; **Duration:** ～26 months.	**Strategies:** Online/web-based; video (2%); face-to-face; phone contact; **Format:** Group; individual and mixed; **Theoretical approach:** SAT; Fishbein and Ajzen HBM.	Inpatient settings, post discharge, other	**↑ Knowledge; ↑ Lifestyle behaviors; −Psychological and QoL outcomes; ↑ Glycemic control**; − Cardiovascular disease risk factors.	Outcomes are summarized in a qualitative fashion.

NOTE:

SMOKING= Smoking cessation; CVR= Cardiovascular risk factors; PSY =Psychosocial issues (depression, anxiety); DIET =Diet; EXERCISE= Exercise; MED= Medication; BEHA = Behavioral charge (including lifestyle modification); SELF = Self-management (including problems solving); GC= glycemic control; DR =Diabetes risks; CHD= Coronary heart disease; CAD = Coronary Artery Disease; CHW=Community Health Worker; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; LDL = Low-density Lipoprotein Cholesterol; SMS = Short Message Service; BCTs = Behavioral Change Techniques; LEA = Lower Extremity Amputation; PRIDE = Problem Identification, Researching one's routine, Identifying a management goal, Developing a plan to reach it, Expressing one's reactions and Establishing rewards for making progress; ASE = Attitude-social influence-efficacy; CVRF= Cardiovascular Risk Factors; SMS = Short Message System; PA = Physical Activity; EDU = Patient Education; GP= General Practice; RCTs =Randomized controlled trials; CCTS = controlled clinical trials; HRQoL = Health Related Quality of Life; QoL = Quality of Life; MI = Myocardial Infarction; CAD = Coronary Artery Disease; CABG= Coronary Artery Bypass Graft Surgery; T2DM = Type 2 Diabetes Mellitus; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; DSME = Diabetes Self-management Education; DSM = Diabetes Self-management; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model; SAT=Social Action Theory;

In the educational content: "+": minor focus; "++":moderate focus; "+++" major focus; "-" =unclear what the intensity of the education was for any topic;

In the outcomes: arrow up (" ↑ ") for improvement, arrow down (" ↓ ") for reduction; a dash ("−") for no change or inconclusive evidence.

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Table 4. Summary of evidence from quantitative research syntheses

Intervention	Number of systematic reviews/meta-analysis, Total participants	First author, Year	Primary Results/findings		Rating the evidence of effectiveness
Acute Coronary Syndrome Patients					
General health education	Six/161,997patients (Goulding et al., 2010 did not given the total sample size)	Ghisi et al., 2014 [50]	Knowledge	91% studies (+)	Some evidence
			Behavior	77%/84%/65% studies (+)	
			Psychosocial indicators	43% studies (+)	
		Brown et al., , 2013 [37]	Mortality		
			MI		
			Revascularizations		
			Hospitalizations		
			HRQoL		
			Withdrawals/drop outs		
			Healthcare utilization and costs		
		Brown et al., 2011 [70]	Total mortality		
			MI		
			CABG		
			Hospitalisations		
			HRQoL	63.6% studies (+)	
			Healthcare costs	40% studies (+)	
			Withdrawal/drop out		
		Goulding et al., 2010 [51]	Beliefs	30.08% studies (+)	
			Secondary outcomes		
			Smoking		
			Cholesterol level		

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		Fernandez et al., 2007 [48]	Multiple risk factor modification		
		Kotb, Hsieh, & Wells, 2014 [59]	All-cause hospitalization		
			All-cause mortality		
			Smoking cessation		
			Depression		
			Systolic blood pressure		
			Low-density lipoprotein		
			Anxiety		
Psychoeducational interventions	Six/ 37,883 patients	Barth et al., 2015 [69]	Abstinence by self-report or validated		Sufficient evidence
		Dickens et al., 2013 [45]	Depression		
		Aldcroft et al., 2011 [31]	Smoking cessation		
			Physical activity		
		Huttunen-Lenz et al.,2010 [56]	Prevalent smoking cessation		
			Continuous smoking cessation		
			Total mortality		
		Barth et al., 2008 [36]	Abstinence by self-report or validated		
			Smoking status		
		Barth et al., 2006 [35]	Abstinence		
			Smoking status		
Secondary prevention educational interventions	Three/25,154 patients	Devi et al., 2015 [44]	Mortality		
			Revascularisation		
			Total Cholesterol		
			HDL cholesterol		
			Triglycerides		
			HRQOL		
			All-cause mortality		

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(including Internet based secondary prevention)		Auer et al., 2008 [34]	Readmission rates		Some evidence
			Reinfarction rates		
			Smoking cessation rates		
		Clark et al., 2005 [41]	Mortality		
			MI		
			Quality of life	Most of the included studies (+)	
Type 2 Diabetes Mellitus Patients					
General health education	Five/2,319 patients (Choi et al., 2016; Loveman et al., 2008; Zabaleta et al., 2007 did not given the total sample size)	Choi et al., 2016 [40]	HbA1c		Some evidence
		Saffari et al., 2014 [74]	Glycemic control		
		Duke et al., 2009 [46]	HbA1c		
			BP		
			Knowledge, psychosocial outcomes and smoking habits	No Data	
			Diabetes complications or health service utilization and cost analysis	No Data	
		Loveman et al., 2008 [60]	Diabetic control outcomes	46.15% studies (+)	
			Weight	66.67% studies (+)	
			Cholesterol or triglycerides	40.00% studies (+)	
		Zabaleta et al., 2007 [79]	HbA1c	4.8% studies (+)	
		Creamer et al., 2016 [42]	HbA1c		
			HRQoL		
			AEs	No AEs	
		Ricci-Cabello et al., 2014 [73]	HbA1c		
			Diabetes knowledge	73.3% studies (+)	
			Behaviors	75% studies (+)	
			Clinical outcomes	Fasting blood glucose, HbA1c	

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				and BP improved in 71%, 59%, and 57% of the studies.	
Culturally appropriate health education	Eight/ 20,622 patients (Ricci-Cabello et al., 2014 and Gucciardi et al., 2013 did not given the total sample size)	Attridge et al., 2014 [33]	HbA1c		Some evidence
			Knowledge scores		
			Clinical outcomes		
			Other outcome measures	Showed neutral effects.	
		Gucciardi et al., 2013 [52]	HbA1c levels	Three of ten studies (+)	
			Anthropometrics	Three of eleven studies (+)	
			Physical activity	One of five studies (+)	
			Diet outcomes	Two of six studies (+)	
		Nam et al., 2012 [62]	HbA1c level		
		Hawthorne et al., 2010 [54]	HbA1c		
			Knowledge scores		
		Khunti et al., 2008 [58]	Knowledge levels	Only one study reporting a significant improvement	
			Biomedical outcomes	Only one study reporting a significant improvement.	
		Hawthorne et al., 2008 [53]	HbA1c		
			Knowledge scores		
			Other outcome measures		
		Huang et al., 2016 [55]	HbA1c		
			BMI		
			LDL-c and HDL-c		
		Chen et al., 2015 [39]	HbA1c		
			BMI		
			SBP		
			DBP		
			HDL-c		

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Lifestyle interventions + behavioral program	Six/10,440 patients (Huang et al., 2016; Pillay et al., 2015 and Ramadas et al., 2011 did not given the total sample size)	Terranova et al., 2015 [72]	HbA1c level		Some evidence
			Weight		
		Pillay et al., 2015 [71]	HbA1c levels		
			BMI		
		Ramadas et al., 2011 [77]	HbA1c	46.2% studies (+)	
		Gary et al., 2003 [49]	Fast blood sugar		
			Glychemoglobin		
			HbA1		
			HbA1c		
			Weight		
Self-management educational interventions	Nine/19,597 patients (Minet et al., 2010;Fan et al., 2009 and Norris et al., 2001 did not given the total sample size)	Pal et al., 2014 [67]	Cardiovascular Risk Factors		
			Cognitive Outcomes		
			Behavioral Outcomes	Only one study reporting a significant improvement.	
			AEs	No AEs	
		Vugt et al., 2013 [75]	Health behaviors	Seven of 13 studies (+)	
			Clinical outcomes measures	Nine studies (+)	
			Psychological outcomes	Nine studies (+)	
		Pal et al., 2013 [68]	HbA1c		
			Depression		
			Quality of life		
			Weight		
		Steinsbekk, et al., 2012 [76]	HbA1c		
			Main lifestyle outcomes		
			Main psychosocial outcomes		
		Minet et al., 2010 [61]	Glycaemic control		
			Diabetes knowledge		
			Overall self-management		

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			behaviours		
		Fan et al., 2009 [47]	Overall metabolic outcomes		
			Overall weighted mean effect sizes		Sufficient evidence
		Deakin et al., 2005 [43]	Metabolic control (HbA1c)		
			Fasting blood glucose levels		
			Weight		
			Diabetes knowledge		
			SBP		
			Diabetes medication		
		Norris et al.,, 2002 [65]	Total GHb		
		Norris et al., 2001 [64]	Knowledge		
			Self-monitoring of blood glucose		
			Self-reported dietary habits		
			Glycemic control		
Therapeutic education	One/Total sample: Unclear.	Odnoletkova et al., 2014 [66]	Cost-effectiveness	Overall high in studies on prediabetes and varied in studies on T2DM.	Insufficient evidence
Foot health education	One/ Total sample: Unclear.	Amaeshi, 2012 [32]	Diabetes complications		Some evidence
			Incidence of LEA		
Group medical visit	One/2,240 patients.	Burke et al., 2011 [38]	HbA1c		Some evidence
			BP and DBP		
			SBP		
			Cholesterol - LDL		
Psychoeducational intervention.	One/1.431 patients.	Alam et al., 2009 [30]	HbA1c		Some evidence
			Psychological status		
Interventions aimed at improving adherence to	Three/ 4,907 patients (Kai Lun Gan et al., 2011 did not	Kai Lun Gan et al., 2011 [57]	Oral hypoglycaemic adherence	Five of seven studies (+)	

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medical treatment recommendations	given the total sample size)	Wens et al., 2008 [78]	Adherence	General conclusions could not be drawn.	Some evidence
		Vermeire et al., 2005 [80]	HbA1c		
Dietary advice	One/1,467 patients	Nield et al., 2007 [63]	Glycaemic control (addition of exercise to dietary advice)		Insufficient evidence to determine
			Weight	Limited Data	
			Diabetic micro- and macrovascular diseases	Limited Data	

NOTE:

RCTs =Randomized controlled trials; HRQoL = Health Related Quality of Life; MI = Myocardial Infarction; CABG= Coronary Artery Bypass Graft Surgery; T2DM = Type 2 Diabetes Mellitus; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP = Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; LEA = Lower Extremity Amputation; Adverse Events = AEs.

（+）：Intervention Group is Significantly Better than Control Group; For example: “91% studies (+)” means 91% studies reported a significant better compared with control group;

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Table 5 Recommendations of health education programs for ACS and T2DM patients

		ACS patients	T2DM patients	Both ACS and T2DM
Theoretical approach		SCT, empowerment theories.	HBM; SCT.	HBM; SCT and empowerment theories.
Behavioral strategies		Goal setting	Goal setting	Goal setting
Educational content		Behavioral change (such as smoking cessation), cardiovascular risk factors, exercise, medication, and psychosocial issues.	Behavioral change, diet, exercise, glycemic control, medication, and self-management.	Behavioral change (such as smoking cessation), cardiovascular risk factors, diet, exercise, glycemic control, medication, psychosocial issues, and self-management.
Healthcare professionals to deliver		Nurse or multidisciplinary team	Multidisciplinary team; dietitian or nurse	Nurse or multidisciplinary team
Teaching approaches	Strategies	Face-to-face; telephone or mixed	Face to face, written materials; telephone or mixed	Face to face, written materials; telephone contact or mixed
	Format	Individual (One by one) or mixed	Individual (One by one) or mixed	Individual (One by one) or mixed
Delivery timing	Contact hours	More than 30 min per time per week	More than 30 min per time per week	More than 30 min per time per week
	Duration	At least 6 months	About 6 months	At least 6 months
Duration of follow up		At least 12 months	At least 12 months	At least 12 months
Settings		Inpatient and post-discharge settings	Hospital settings and primary care settings	Inpatient and post-discharge settings

Note: ACS = acute coronary syndrome; T2DM = type 2 diabetes mellitus; SCT=Social Cognitive Theory; HBM =Health Belief Model.

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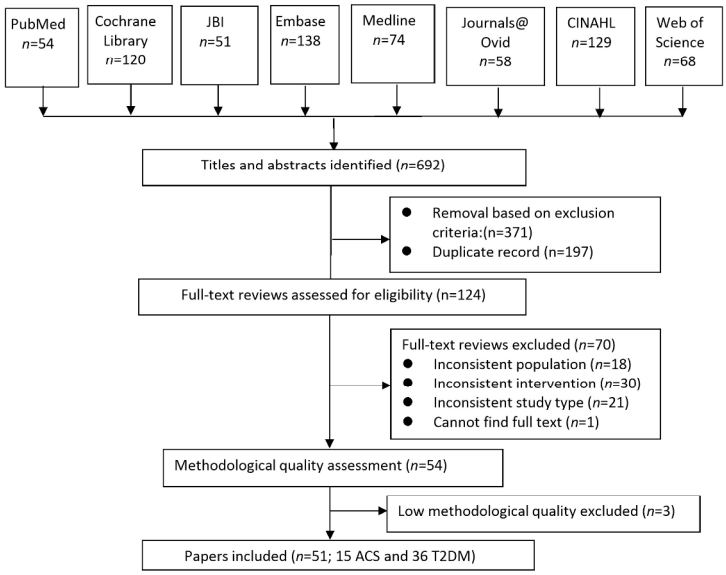

Fig. 1. Flow chart of the systematic reviews and meta-analyses selection process

Fig. 1. Flow chart of the systematic reviews and meta-analyses selection process

215x279mm (300 x 300 DPI)

Supplementary Annex 1. Searching Strategies

Items	Searching Strategy	Results
	PubMed	
#1	((((((((((Acute Coronary Syndrome[MeSH Terms]) OR Myocardial Infarction[MeSH Terms]) OR Angina, Unstable[MeSH Terms]) OR Coronary Artery Disease[MeSH Terms]) OR Coronary Artery Bypass[MeSH Terms]) OR Angina Pectoris[MeSH Terms]) OR "Myocardial Infarct*"[Title/Abstract]) OR "Unstable Angina*"[Title/Abstract]) OR "coronary heart diseas*"[Title/Abstract]) OR "Coronary Artery Disease*"[Title/Abstract]) OR "Unstable Angina Pectori*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	145310
#2	(((((Diabetes Mellitus, Type 2[MeSH Terms]) OR "Type 2 Diabetes Mellitus"[Title/Abstract]) OR "type 2 diabete*"[Title/Abstract]) OR "type ii diabet*"[Title/Abstract]) OR T2DM[Title/Abstract]) OR Adult-Onset Diabetes Mellitus[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	80218
#3	#1 OR #2	222103
#4	(((((((Health Education[MeSH Terms]) OR Patient Education as Topic[MeSH Terms]) OR Counseling[MeSH Terms]) OR Social Support[MeSH Terms]) OR "Community Health Education*"[Title/Abstract]) OR "Educational Activit*"[Title/Abstract]) OR "Education* intervention*"[Title/Abstract]) OR "Education* program*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	122323
#5	(((Meta-Analysis [Publication Type]) OR Meta-Analysis as Topic[MeSH Terms]) OR "Systematic Revie*"[Title/Abstract]) OR "Meta-analys*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	165265
#6	#3 AND #4 AND #5 Filters: Publication date from 2000/01/01 to 2016/04/31; English	**54**
	Cochrane Library	
#1	MeSH descriptor: [Acute Coronary Syndrome] explode all trees	1070
#2	MeSH descriptor: [Myocardial Infarction] explode all trees	9450
#3	MeSH descriptor: [Angina, Unstable] explode all trees	1015
#4	MeSH descriptor: [Coronary Artery Disease] explode all trees	3469

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#5	MeSH descriptor: [Coronary Artery Bypass] explode all trees	5321
#6	MeSH descriptor: [Angina Pectoris] explode all trees	4240
#7	"acute coronary syndrome":ti,ab,kw or Unstable Angina*:ti,ab,kw or Myocardial Infarct*:kw or coronary heart diseas*:ti,ab,kw or Coronary Artery Disease*:ti,ab,kw (Word variations have been searched)	29379
#8	#1 or #2 or #3 or #4 or #5 or #6 or #7	34062
#9	MeSH descriptor: [Diabetes Mellitus, Type 2] explode all trees	10474
#10	Type 2 Diabetes Mellitus:ti,ab,kw or type ii diabet*:ti,ab,kw or noninsulin dependent:ti,ab,kw or type 2 diabet*:ti,ab,kw or Adult-Onset Diabetes Mellitus:ti,ab,kw (Word variations have been searched)	20935
#11	#9 or #10	20937
#12	#8 or #11	53777
#13	MeSH descriptor: [Health Education] explode all trees	11291
#14	MeSH descriptor: [Patient Education as Topic] explode all trees	7507
#15	MeSH descriptor: [Counseling] explode all trees	4026
#16	MeSH descriptor: [Rehabilitation Nursing] explode all trees	55
#17	Education*:ti,ab,kw or Community Health Education:ti,ab,kw or Self-Management*:ti,ab,kw or Cardiac Rehabilitation:ti,ab,kw (Word variations have been searched)	40078
#18	#13 or #14 or #15 or #16 or #17	42943
#19	#12 and #18 Publication Year from 2000 to 2016, in Cochrane Reviews (Reviews only) and Other Reviews	120
#20	Cochrane reviews + other reviews	**49 + 71=120**
	Joanna Briggs Institute, Embase, MEDLINE	
#1	Acute Coronary Syndrome.m_titl.	16727
#2	Myocardial Infarction.m_titl.	151398

#3	Unstable Angina.m_titl.	6933
#4	Coronary Artery Disease.m_titl.	54621
#5	Coronary Artery Bypass.m_titl.	30449
#6	Angina Pectoris.m_titl.	17997
#7	Coronary Heart Disease.m_titl.	35397
#8	#1 or #2 or #3 or #4 or #5 or #6	305035
#9	Type 2 Diabetes Mellitus.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	64926
#10	"type 2 diabet*".m_titl.	102596
#11	"type ii diabet*".m_titl.	6139
#12	Adult-Onset Diabetes Mellitus.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	307
#13	#9 or #10 or #11 or #12	136982
#14	#8 or #13	439243
#15	Health Education.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	177285
#16	Patient Education.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	185631
#17	Counseling.m_titl.	23527
#18	Social Support.m_titl.	11535
#19	"Education*".m_titl.	247901
#20	#15 or #16 or #17 or #18 or #19	577203
#21	#14 and #20	6480
#22	Systematic Review.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	212014
#23	Meta-Analysis.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	262009
#24	#22 or #23	381113

#25	#21 and #24	288
#26	limit 25 to English and yr="2000 - 2016"	**263**
	Cumulative Index to Nursing and Allied Health Literature (CINAHL)	
#1	TI Acute Coronary Syndrome OR AB Acute Coronary Syndrome	4826
#2	TI Myocardial Infarction OR AB Myocardial Infarction	24578
#3	TI Unstable Angina OR AB Unstable Angina	1353
#4	TI Coronary Artery Disease OR AB Coronary Artery Disease	12930
#5	TI Coronary Heart Disease OR AB Coronary Heart Disease	12321
#6	#1 OR #2 OR #3 OR #4 OR #5	46436
#7	TI Type 2 Diabetes Mellitus OR AB Type 2 Diabetes Mellitus	8952
#8	TI type 2 diabet* OR AB type 2 diabet*	33085
#9	TI Adult-Onset Diabetes Mellitus OR AB Adult-Onset Diabetes Mellitus	23
#10	#7 OR #8 OR #9	33097
#11	#6 OR #10	77923
#12	TI Health Education OR AB Health Education	53415
#13	TI Patient Education OR AB Patient Education	37789
#14	TI Counseling OR AB Counseling	17673
#15	TI Social Support OR AB Social Support	30093
#16	TI Education* OR AB Education*	188291
#17	#12 OR #13 OR #14 OR #15 OR #16	227269
#18	#11 AND #17	4707
#19	TI Systematic Review OR AB Systematic Review	48830

#20	TI Meta-Analysis OR AB Meta-Analysis	28776
#21	#19 OR #20	64611
#22	S18 AND S21 Limiters - Published Date: 20000101-20160431; English Language	**129**
	Web of Science	
#1	TS=("Acute Coronary Syndrome*") OR TS=("Myocardial Infarct*") OR TS=("Unstable Angina") OR TS=("Coronary Artery Disease*") OR TS=("Coronary heart disease*") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	404699
#2	TS=("Type 2 Diabetes Mellitus") OR TS=("type 2 diabete*") OR TS=("Noninsulin-Dependent Diabete*") OR TS= ("Adult-Onset Diabetes Mellitus") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	103548
#3	#2 OR #1 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	495081
#4	TS=("Health Education") OR TS=("Patient Education") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	29830
#5	#4 AND #3 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	1290
#6	TS=("Systematic Review*") OR TS=("Meta-analysis*") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	149663
#7	(#6 AND #5) AND LANGUAGE: (English) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2016	**68**
	Journals@Ovid	
#1	Acute Coronary Syndrome.m_titl.	3021
#2	Myocardial Infarction.m_titl.	24269
#3	Unstable Angina.m_titl.	1038
#4	Coronary Artery Disease.m_titl.	10106
#5	Coronary Artery Bypass.m_titl.	6546
#6	Angina Pectoris.m_titl.	1480

#7	Coronary Heart Disease.m_titl.	6487
#8	#1 or #2 or #3 or #4 or #5 or #6	51548
#9	Type 2 Diabetes Mellitus. m_titl.	5097
#10	"type 2 diabet*".m_titl.	26434
#11	"type ii diabet*".m_titl.	980
#12	Adult-Onset Diabetes Mellitus. m_titl.	391
#13	#9 or #10 or #11 or #12	27795
#14	#8 or #13	78792
#15	Health Education. m_titl.	1135
#16	Patient Education. m_titl.	1556
#17	Counseling.m_titl.	5532
#18	Social Support.m_titl.	2667
#19	"Education*".m_titl.	50950
#20	#15 or #16 or #17 or #18 or #19	58969
#21	#14 and #20	510
#22	Systematic Review.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	117790
#23	Meta-Analysis.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	215069
#24	#22 or #23	282984
#25	#21 and #24	61
#26	limit 26 to yr="2000 - 2016"	**58**

Supplementary Annex 2.

Citation Matrix: Non-repeated trials (rows) included in the 15 systematic review and/or meta-analyses (column)--ACS.

Author-year (Trial reference)	Barth, Jacob, Daha, & Critchley, 2015	Devi et al., 2015	Ghisi, Abdallah, Grace, Thomas, & Oh, 2014	Kotb, Hsieh, & Wells, 2014	Brown, Clark, Dalal, Welch, & Taylor, 2013	Dickens et al., 2013	Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011	Brown, Clark, Dalal, Welch, & Taylor, 2011	Huttunen-Lenz, Song, & Poland, 2010	Goulding, Furze, & Birks, 2010	Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008	J. Barth, Critchley, & Bengel, 2008	Fernandez et al., 2007	J. Barth, Critchley, & Bengel, 2006	Clark, Hartling, Vandermeer, & McAlister, 2005
Allen JK. Coronary risk factor modification in women after coronary artery bypass surgery. Nursing Research 1996;45(5):260-5.	X											X			
Burt A, Thornley R, Illingworth D, White P, Shaw TR, Turner R. Stopping smoking after myocardial infarction. Lancet 1974;1(7852):304-6.	X											X		X	
Carlsson R, Lindberg G, Westin L, Israelsson B. Influence of coronary nursing managment follow up on lifestyle after acute myocardial infarction. Heart 1997;77(3):256-9.	X											X			
Ockene J, Kristeller JL, Goldberg R, Ockene I, Merriam P, Barrett S, et al. Smoking cessation and severity of disease: the Coronary Artery Smoking Intervention Study. Health Psychology 1992;11(2):119-26.	X											X		X	
DeBusk R, Miller NH, Superko R, Dennis CA, Thomas RJ, et al. A case-management system for coronary risk factor modification after acute myocardial infarction. Annals of Internal Medicine 1994;120(9):721-9.	X										X	X			X
Dornelas EA, Sampson RA, Gray J F, Waters D, Thompson PD. A randomized controlled trial of smoking cessation counseling after myocardial infarction. Preventive Medicine 2000;30(4):261-8.	X								X			X	X	X	
Hajek P, Taylor TZ, Mills P. Brief intervention during hospital admission to help patients to give up smoking after myocardial infarction and bypass surgery: randomised controlled trial. BMJ 2002;324:87-9.	X								X			X	X	X	
Heller RF, Knapp JC, Valenti LA, Dobson AJ. Secondary prevention after acute myocardial infarction. American Journal of Cardiology 1993;72(11):759-62.	X											X	X	X	
Moreno Ortigosa A, Ochoa Gomez FJ, Ramalle-Gomara E, Saralegui Reta I, Fernandez Esteban MV, Quintana Diaz M. Efficacy of an smoking cessationg intervention for patients with myocardial infarction [Eficacia de una intervencion para dejar de fumar en pacientes con infarto de miocardio]. Medicina Clinica 2000;114:209-10.	X											X		X	
Quist-Paulsen P, Gallefoss F. Randomised controlled trial of smoking cessation intervention after admission for coronary heart disease. BMJ 2003;327(7426):1254-7.	X								X			X		X	
Reid R, Pipe A, Higginson LK, D'Angelo MS, Cooke D, Dafoe W. Stepped care approach to smoking cessation in patients hospitalized for coronary artery disease. Journal	X											X		X	

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Rigotti NA, McKool KM, Shiffmann S. Predictors of smoking cessation after coronary artery bypass graft surgery. Annals of Internal Medicine 1994;120(4):287-93.	x								x			x		x	
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Van Elderen T, Maes S, Seegers G. Effects of a group health education program for coronary heart patients after the hospitalization phase. Tijdschrift voor Psychologie & Gezondheid 1991;19(3):129-44.	x											x			
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Devi R, Powell J, Singh S. A web-based program improves physical activity outcomes in a primary care angina population: randomized controlled trial. Journal of Medical Internet Research 2014;16(9):e186.		x													
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P.M. Smith, E. Burgess			x						x						

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Clark NM, Janz NK, Dodge JA, . Changes in functional health status of older women with heart disease: evaluation of a program based on self-regulation. J					x			x							

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	16	20	42	26	24	62	7	13	14	13	27	18	17	19	74

ACS = acute coronary syndrome;

% overlap 63/286= 22.0%

CA= Covered Area = (16+20+42+26+24+62+7+13+14+13+27+18+17+19+74)/ (15x286) = 392/4290=9.1%

CCA= Corrected Covered Area = (392-286)/ (4290-286) = 106/4004= 2.6% (slight)

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Supplementary Annex 3.

Citation Matrix: Non-repeated trials (rows) included in the 36 systematic review and/or meta-analyses (column)--T2DM.

Author-year (Trial reference)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K. Cai, S. Zhang, M. Lu, L. Shao The effects of intensive education for elderly patients with diabetes mellitus. Pract Geriatr, 18 (2004), pp. 313–315	x																																			
Y. Chen, W. Xue, S. Lin, S. Huang, D. Li. ntensive diabetes education in the role of diabetes control. J Sun Yat-sen Univ (Med Sci), 3S (2004), pp. 201–203	x																																			
L. Chen, M. Zhu. Clinical investigation of the effect of type 2 diabetes health education. Strait Pharm J, 21 (2009), pp. 217–218	x																																			
Y. Fang. Coordinated health education model in diabetes education. Today Nurse, 3 (2011), pp. 148–149	x																																			
B. Li, Y. Liu, J. Tian, J. Yuan. Impact of diabetes education for type 2 diabetes on glycated haemoglobin and health cost.Jiangsu J Prev Med, 23 (2012), pp. 55–56	x																																			
B.-h. Li, F.-h. Zhang, C. Zhang, M. Yang Effect of different education models on blood glucose in diabetic patients J Qilu Nurs, 19 (2013), pp. 26–27	x																																			
M. Li, T. Li, B.-y. Shi, C.-x. Gao Effect of motivational interviewing on the quality of life in type 2 diabetes patients with poor control of blood glucose Chin J Nurs, 49 (2014), pp. 6–10	x																																			
X. Li, Q. Zhou, F. Zou, L. Wu, H. Chen, Z. Liu Effectiveness of systematic self-management education on blood sugar level of patients in the community with type 2 diabetes J Central South Univ (Med Sci), 37 (2012), pp. 355–357	x																																			
Y. Li Evaluation of the standardized management effect of diabetes in community Chin Prim Health Care, 25 (2011), pp. 33–35	x																																			
Q. Liu, X. Pan, W. Feng, J. Kong Effectiveness of health education to the patients with diabetes mellitus J Nurs Sci, 20 (2005), pp. 54–55	x																																			
Z.-p. Liu, L.-l. Han, J.-r. Deng, X.-r. Liu, X.-r. Zhang, Q.-f. Li Effect of short-term intensified education on glucose	x																																			

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control of type 2 diabetic patients Chin J Nurs Educ, 4 (2007), pp. 249–251																																				
L.-m. Luo, K.-J. Yang, Z.-J. Zhang, Y.-H. Li, C.-H. Hu, X.-L. Feng Role of health education on diabetic community chronic disease management China Pharm, 24 (2013), pp. 3020–3022	x																																			
Y. Lu Observation on the effect of diabetes intensive education in type 2 diabetes mellitus patients Med Inform, 21 (2008), pp. 690–692	x																																			
X. Mei Analysis of compliance and effectiveness of community diabetes education program J Nanchang Univ (Med Sci), 50 (2010), pp. 83–84	x																																			
G. Pang The impact of intensive diabetes education on community patients J Med Theory Pract, 21 (2008), pp. 839–840	x																																			
Y. Qi, C. Chen, L. Yan Impact of cooking class on diabetic patients eating habits Chin J Nurs, 41 (2006), pp. 126–127	x																																			
B. Sun, B. Ban, H.-l. Sun, S. Zhang, S. Jie Effects of diabetes education and psychological intervention on comprehensive treatment of type 2 diabetes Chin J Clin Psychol, 13 (2005), pp. 483–485	x																						x													
M. Sun, X. Li, F. Wang, D. Zhu Study on the effect of diabetes education J Pract Diagn Ther, 19 (2005), pp. 422–423	x																																			
Z. Sun, M. Lv 90 cases of individualised type 2 diabetes education J Qilu Nurs, 14 (2008), pp. 106–107	x																																			
H. Wang, S. Hu Comparison of clinical applicability of individual intervention with intensive group education for diabetic patients People's Mil Surg, 53 (2009), pp. 234–235	x																																			
X. Wang, H. Zou, H. Jie, S. Shen, J. Zhang Effect of individualised diabetes education and care for aged patients with diabetes Chin J Clin Res, 26 (2013), pp. 90–91	x																																			
Y. Wei Effectiveness of intensive education for patients with diabetes mellitus Chin J Health Educ, 21 (2005), pp. 53–55	x																																			
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Effect observation of sample diet education on diet control of patients with diabetes J Nurs (China), 13 (2006), pp. 17–19																																						
Y. Wu, K. Wang, X. Yang The effect of diabetes self-management education curriculum for patients with diabetes Guide China Med, 11 (2013), pp. 395–397	x																																					
X.-L. Xiao, Q.-Q. Hu, Y.-P. Liu Effects of family involvement in health education for patients with type 2 diabetes Chin J Nurs, 47 (2012), pp. 313–316	x																																					
B. Xie, C.-p. Ju, Z.-l. Sun, J. Han, L. Liu Effect of education network for diabetes self-management on self-efficacy in patients with type 2 diabetes mellitus Chin Gen Pract, 15 (2012), pp. 3610–3616	x																																					
H. Xie, C. Cheng, D. Chen Intensive diabetes education for poorly controlled elderly diabetic patients in the community J Pract Med Tech, 14 (2007), pp. 3958–3959	x																																					
S. Xu Effect of continued outpatient health education on diabetes patients Mod Clin Nurs, 6 (2007), pp. 28–30	x																																					
L. Yan, C. Zhu, X. Tan “Diabetes conversation” map interactive education for diabetic patients Chin J Misdiagn, 11 (2011), pp. 6383–6384	x																																					
X. Yan, N. Li, H. Liu, H. Sha, P. Li Effect of “interactive groups” diabetes education model on diabetes patients in the village Nurs Pract Res, 9 (2012), pp. 13–14	x																																					
S. Yao, Y. Liu, R. Ji, G. Wang Effectiveness of diabetes education for patients with type 2 diabetes Hebei J Tradit Chin Med, 34 (2012), pp. 1723–1724	x																																					
W. Yu, Y.-l. Bi, J. Han, et al. Affect of the MUST education mode on compliance of patients with type 2 diabetes mellitus J Shandong Univ (Health Sci), 49 (2011), pp. 1–4	x																																					
Y. Zeng, A. Wang, M. Gong Clinical observation of communication management targeted at patients with type 2 diabetes J Pract Diabetol, 5 (2009), pp. 48–49	x																																					
F. Zhang, B. Xu Influence of diabetes education on patients lifestyle and metabolic indicators	x																																					

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Mod Med J China, 12 (2010), pp. 116–117																																	
J. Zhang, Y. Zhang, X. Huang "Diabetes conversation" map interactive education for type 2 diabetes patients Guide China Med, 9 (2011), pp. 330–331	x																																
L. Zhang Analysis on the therapeutic effects of diabetes education Tianjin J Tradit Chin Med, 26 (2009), pp. 22–23	x																																
X.-q. Zhang, L.-f. Fan, Y.-g. Zheng Effect of health education applied in promoting compliance of diet treatment of patients with diabetes mellitus Mod Nurs, 12 (2006), pp. 1082–1084	x																																
X. Zheng, H. Tang, Y. Huang Strengthen health education on observed efficacy in patients with type 2 diabetes Youjiang Med J, 33 (2005), pp. 349–350	x																																
C. Zhong, J. Li, X. Yang Effect of interactive diabetes education for patients with diabetes Jilin Med J, 27 (2006), pp. 1490–1491	x																																
A. Zhou, Y. Ying, X. Dai, et al. Application of text message to diabetic education J Nurs Sci, 27 (2012), pp. 17–19	x																																
M.-l. Gu, X.-g. Zhu, X.-f. Xu The study of comprehensive intervention for patients with type 2 diabetes in community of Shanghai Chin Gen Pract, 15 (2012), pp. 107–109	x																																
Z.-M. Huang Impact of intensive diabetes education targeted at patients with type 2 diabetes Shanghai J Prev Med, 21 (2009), pp. 323–324	x																																
C. Liu, W. Sun, J. Wang, J. Liu Effect of community management of type 2 diabetic patients Chin J Prev Control Chronic Dis, 20 (2012), pp. 624–625	x																																
J. Sun, Y. Wang, X. Chen, et al. An integrated intervention program to control diabetes in overweight Chinese women and men with type 2 diabetes Asia Pac J Clin Nutr, 17 (2008), pp. 514–524	x																																
X. Wang, X. Zhou, H. Zhen, J. Sun, C. Cui Impact of stratified intensive education for patients with diabetes J Med Theory Pract, 18 (2005), pp. 336–337	x																																
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B. Yang, C. Ma, X. Feng, et al. Effect of face-to-face education on metabolic improvement in Tibetan diabetic patients J Clin Rehabil Tissue Eng Res, 11 (2007), pp. 10467–10470	x																																				
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A. Lee, C.F. Siu, K.T. Leung, L.C. Lau, C.C. Chan, K.W. Kwok General practice and social service partnership for better clinical outcomes, patient self efficacy and lifestyle behaviours of diabetic care: randomised control trial of a chronic care model Postgrad Med J, 87 (2011), pp. 688–693	x				x																																
S.M. Chen, D. Creedy, H.S. Lin, J. Wollin Effects of motivational interviewing intervention on self-management, psychological and glycemic outcomes in type 2 diabetes: a randomized controlled trial Int J Nurs Stud, 49 (2012), pp. 637–644	x																																				
M.C. Huang, C.C. Hsu, H.S. Wang, S.J. Shin Prospective randomized controlled trial to evaluate effectiveness of registered dietitian-led diabetes management on glycemic and diet control in a primary care setting in Taiwan Diabetes Care, 33 (2010), pp. 233–239	x																																				
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1= Choi, Davidson, Walker, Lee, & Palermo, 2016; 2=Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016; 3=Huang et al., 2016; 4=Chen et al., 2015; 5=Pillay et al., 2015; 6= Terranova,

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Brakenridge, Lawler, Eakin, & Reeves, 2015; 7= Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014; 8= Odnoletkova et al., 2014; 9 = Pal et al., 2014; 10 = Ricci-Cabello et al., 2014; 11= Saffari, Ghanizadeh, & Koenig, 2014; 12=Gucciardi, Chan, Manuel, & Sidani, 2013; 13=Pal et al., 2013; 14=Vugt, Wit, Cleijne, & Snoek, 2013; 15= Amaeshi, 2012 ; 16= Nam, Janson, Stotts, Chesla, & Kroon, 2012 ; 17= Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012; 18= Burke et al., 2011; 19= Kai Lun Gan, Brammer, & Creedy, 2011; 20=Ramadas, Quek, Chan, & Oldenburg, 2011; 21=Hawthorne, Robles, Cannings-John, & Edwards, 2010; 22= Minet, Moller, Vach, Wagner, & Henriksen, 2010; 23=Alam, Sturt, Lall, & Winkley, 2009; 24= Duke, Colagiuri, & Colagiuri, 2009; 25= Fan & Sidani, 2009; 26=Hawthorne, Robles, Cannings-John, & Edwards, 2008 ; 27=Khunti, Camosso-Stefinovic, Carey, Davies, & Stone, 2008; 28=Loveman, Frampton, & Clegg, 2008 ; 29=Wens et al., 2008; 30 = Nield et al., 2007; 31=Zabaleta & Forbes, 2007; 32=Deakin, McShane, Cade, & Williams, 2005; 33=Vermeire et al., 2005; 34=Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003; 35=Norris, Lau, Smith, Schmid, & Engelgau, 2002; 36=Norris, Engelgau, & Narayan, 2001. T2DM = type 2 diabetes mellitus; NP = not applicable.

% overlap 177/532= 33.3%

CA= Covered Area =

(53+28+17+16+132+13+33+17+20+39+10+13+16+13+8+12+26+15+7+20+10+47+35+9+11+11+20+8+36+3+14+21+62+31+84)/(35x532) = 910/18620=4.8% (one review did not report the included studies list)

CCA= Corrected Covered Area = (910-532)/ (18620-532) = 378/18088= 2.1% (slight)

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Title page

Health Education for Patients with Acute Coronary Syndrome and Type 2 Diabetes Mellitus: An Umbrella Review of Systematic Reviews and Meta-Analyses

Xian-Liang Liu, RN, MScN

Ph.D. Candidate, Tenth People's Hospital of Tongji University, China;

Ph.D. Candidate, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Australia;

Lecturer, School of Nursing, Jinggangshan University, China.

Address: 1100 Nudgee Road, Banyo, Brisbane, QLD, Australia

Email: liu.xianliang@myacu.edu.au; 1988_liuxianliang@tongji.edu.cn

Yan Shi, RN, Ph.D., Professor, Executive Director of Nursing Department

Tenth People's Hospital and Tongji University, China

Address: 301, YanChang Road, Shanghai, China

E-mail: shlzk2002@163.com

Karen Willis, Ph.D., Professor, Associate Dean (Learning and Teaching)

Faculty of Health Sciences, Australian Catholic University, Australia

Address: 250 Victoria Parade, Melbourne, Australia

Email: Karen.Willis@acu.edu.au

Chiung-Jung (Jo) Wu, RN, DrHlthSc, FACN

Associate Professor, School of Nursing, Midwifery and Paramedicine, University of the Sunshine Coast;

Visiting Fellow, School of Nursing, Queensland University of Technology;

Honorary Research Fellow, Royal Brisbane and Women's Hospital;

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Honorary Research Fellow, Mater Medical Research Institute-University of Queensland (MMRI-UQ), Brisbane, Australia;

Postal Address: ML 57, PO Box 1149, Hervey Bay Q 4655, Australia.

Email: cwu@usc.edu.au; c3.wu@qut.edu.au

Maree Johnson, RN, Ph.D., Professor, Associate Dean (Research)

Faculty of Health Sciences, Australian Catholic University, Australia

Address: Tenison Woods House (8 -20 Napier Street), North Sydney, Australia

Email: Maree.Johnson@acu.edu.au

Affiliated with the Ingham Institute of Applied Medical Research, Liverpool. Sydney.

Corresponding author:

Xian-Liang Liu, RN, MScN,

Ph.D. Candidate, School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Australia; Ph.D. Candidate, Tenth People's Hospital of Tongji University, China; Lecturer, School of Nursing, Jinggangshan University, China.

Address: 1100 Nudgee Road, Banyo, Brisbane, QLD, Australia

Email: liu.xianliang@myacu.edu.au; 1988_liuxianliang@tongji.edu.cn

Tel: +61 497440830; +86 15921496130

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Abstract

Objectives: This umbrella review aimed to identify the current evidence on health education-related interventions for patients with acute coronary syndrome or type 2 diabetes mellitus; identify the educational content, delivery methods, intensity, duration and setting required. The purpose was to provide recommendations for educational interventions for high risk patients with both acute coronary syndrome and type 2 diabetes mellitus.

Design: Umbrella review of Systematic Reviews and Meta-Analyses.

Setting: Inpatient and post discharge settings.

Participants: Patients with ACS and T2DM.

Data sources: CINAHL, Cochrane Library, Joanna Briggs Institute, Journals@Ovid, EMBase, Medline, PubMed, and Web of Science databases from January 2000 through May 2016.

Outcomes measures: Clinical outcomes (such as HbA1C), behavioral outcomes (such as smoking), psychosocial outcomes (such as anxiety) and medical service use.

Results: Fifty-one eligible reviews (15 for ACS and 36 for T2DM) consisting of 1324 relevant studies involving 288,057 patients (15 papers did not provide the total sample); 30 (58.8%) reviews were rated as high quality. Nurses only and multidisciplinary teams were the most frequent professionals to provide education, and most educational interventions were delivered post-discharge. Face-to-face sessions were the most common delivery formats, and many education sessions were also delivered by telephone or via web contact. The frequency of educational sessions was weekly or monthly, and an average of 3.7 topics was covered per education session. Psychoeducational interventions were generally effective at reducing smoking and admissions for patients with ACS. Culturally appropriate health education, self-management educational interventions, group medical visits and psychoeducational interventions were

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generally effective for T2DM patients.

Conclusions: Results indicate that there is a body of current evidence about the efficacy of health education, its content, and delivery methods for patients with ACS or T2DM. These results provide recommendations about the content for, and approach to, health education intervention for these high risk patients.

KEY WORDS: Health Education; Acute Coronary Syndrome; Type 2 Diabetes Mellitus; Umbrella Review

Strengths and limitations of this review:

- This umbrella review is the first synthesis of systematic reviews or meta-analyses to consider health education-related interventions for patients with ACS or T2DM.
- These results provide recommendations about the content of a health education intervention for patients with ACS and T2DM.
- The diversity of the educational interventions seen in the reviews included in this umbrella review may reflect the uncertainty about the optimal strategy for providing health education to patients.
- This umbrella review found no reviews focused on patients with ACS and T2DM the intended target group; instead, all of the systematic reviews and meta-analyses focused on only one of these two diseases.

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Introduction

Acute coronary syndrome (ACS) is the leading cause of death worldwide. The risk of high mortality rates relating to ACS is markedly increased after an initial cardiac ischemic event.[1] Globally, 7.2 million (13%) deaths are caused by coronary artery disease (CAD),[2] and it is estimated that more than 780,000 persons will experience ACS each year in the United States. [3] Moreover, about 20–25% of patients with ACS reportedly also have diabetes mellitus (DM); predominantly type 2 diabetes mellitus [T2DM]). [4 5] Patients with ACS and DM have an increased risk of adverse outcomes such as death, recurrent myocardial infarction (MI), readmission, or heart failure during follow up. [6] Longer median delay times from symptom onset to hospital presentation, have been reported among patients with ACS and DM than patients with ACS alone. [7]

DM is now considered to confer a risk equivalent to that of CAD for patients for future MI and cardiovascular mortality. [8] Mortality was significantly higher among patients with ACS and DM than among patients with ACS only following either ST segment elevation myocardial infarction (STEMI) (8.5% [ACS and DM] versus 5.4% [ACS]) or unstable angina/non-STEMI (NSTEMI) (2.1% [ACS and DM] vs. 1.1% [ACS]).[9] ACS and T2DM are often associated with high-risk factors such as low levels of physical exercise, obesity, smoking, and unhealthy diet. [10] Some of these and other risk factors, specifically glycemia, high blood pressure (BP), lipidemia, and obesity, are frequently addressed by health education interventions. [10]

Health education interventions are comprehensive programs that healthcare providers deliver to patients aimed at improving patients' clinical outcomes through the increase and maintenance of health behaviours.[11] Along with education about, for example, medication taking, these programs seek to increase behaviors such as physical exercise and a healthy diet thus reducing

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patient morbidity or mortality. [11] Most diabetes education is provided through programs within outpatient services or physicians' practices. [12] Many recent education programs have been designed to meet national or international education standards [13-15] with diabetes education being individualized to consider patients' existing needs and health conditions. [16] Patients with T2DM have reported feelings of hopelessness and fatigue with low levels of self-efficacy, after experiencing an acute coronary episode. [17]

Although there are numerous systematic reviews of educational interventions relating to ACS, or T2DM, an umbrella review providing direction on educational interventions for high risk patients with both ACS and T2DM is not available, indicating a need to gather the current evidence and develop an optimal protocol for health education programs for patients with ACS and T2DM. This umbrella review will examine the best available evidence on health education-related interventions for patients with ACS or T2DM. We will synthesize these findings to provide direction for health education-related interventions for high risk patients with both ACS and T2DM.

An umbrella review is a new method to summarize and synthesize the evidence from multiple systematic reviews/meta-analyses into one accessible publication. [18] Our aim is to systematically gather, evaluate and organize the current evidence relating the health education interventions for patients with ACS or T2DM, and proffer recommendations for the scope of educational content and delivery methods that would be suitable for patients with ACS and T2DM.

Methods

Data Sources

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This umbrella review performed a literature search to identify systematic reviews and meta-analyses examining health education-related interventions for patients with ACS or T2DM. The search strategies are described in Appendix 1. This umbrella review searched eight databases for articles published from January 2000 to May 2016: CINAHL, Cochrane Library, Joanna Briggs Institute, Journals@Ovid, EMBase, Medline, PubMed, and Web of Science. The search was limited to English language only. The following broad MeSH terms were used: *acute coronary syndrome; angina, unstable; angina pectoris; coronary artery disease; coronary artery bypass; myocardial infarction; diabetes mellitus, type 2; counseling; health education; patient education as topic; meta-analysis [publication type];* and *meta-analysis* as a topic.

Inclusion Criteria

Participants

All participants were diagnosed with ACS or T2DM using valid, established diagnostic criteria. The diagnostic standards included those described by the American College of Cardiology or American Heart Association, [3] National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand, [19] World Health Organization, [20] or other associations.

Intervention Types

For this umbrella review, health education-related interventions refer to any planned activities or programs that include behavior modification, counseling, and teaching interventions. Results considered for this review included changes in clinical outcomes (including blood pressure levels, body weight, diabetes complications, HbA1C, lipid levels, mortality rate and physical activity levels), behavioral outcomes (such as diet, knowledge, self-management skills, self-efficacy, and smoking), and psychosocial outcomes (such as anxiety, depression, quality of life, and stress) and medical service use (such as medication use, health care utilization, and cost-

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effectiveness) for patients with ACS or T2DM. These activities or programs included any educational interventions delivered to patients with ACS or T2DM. The interventions are delivered in any format, including face-to-face, telephone and group-based or one-on-one, and the settings include community, hospital and home. The interventions were delivered by nurses (including diabetes nurse educators), physicians, community health care workers, dietitians, lay people, rehabilitation therapists, or multidisciplinary teams.

Study Types

Only systematic reviews and meta-analyses were included in this review.

Eligibility Assessment

The title and abstract of all of the retrieved articles were assessed independently by two reviewers (XL-L, YS) based on the inclusion criteria. All duplicate articles were identified within EndNote version X7 [21] and subsequently excluded. If the information from the titles and abstract was not clear, the full articles were retrieved. The decision to include an article was based on an appraisal of the full text of all retrieved articles. Any disagreements during this process were settled by discussion and, if necessary, consensus was sought with a third reviewer. We developed an assessment form in which specific reasons for exclusion were detailed.

Assessment of Methodological Quality

The methodological quality and risk of bias were assessed for each of the included publications using the Assessment of Multiple Systematic Reviews (AMSTAR),[22] independently by the same two reviewers (see Table 1). The AMSTAR is an 11-item tool, with each item provided a score of 1 (specific criterion is met) or 0 (specific criterion is not met, unclear, or not applicable). [22 23] An overall score for the review methodological quality is then calculated as the sum of the individual item scores: high quality, 8-11; medium quality, 4-7; or low quality, 0-3. [23] If the

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required data were not available in the article, the original authors were contacted for more information. The low quality reviews (AMSTAR scale: 0-3) were excluded in this umbrella review.

Data Extraction

Data were independently extracted by two reviewers using a predefined data extraction form. For missing or unclear information, the primary authors were contacted for clarification.

Statistical Presentation of Results from Reviews

All of the results were extracted for each included systematic review or meta-analysis, and the overall effect estimates are presented in a tabular form. The number of systematic reviews or meta-analyses that reported the outcome, total sample (from included publications), and information of health education interventions is also presented in the Tables (Table 2, 3). [24] A final 'summary of evidence' was developed to present the intervention, included study synthesis, and indication of the findings from the included papers (Table 4). [24] This umbrella review calculated the Corrected Covered Area (CCA) (Appendix 2, 3). The CCA statistic is a measure of overlap of trials (the repeated inclusion of the same trial in subsequent systematic reviews included in an umbrella systematic review). A detailed description of the calculation is provided by the authors who note slight CCA as 0-5%, moderate CCA as 6-10%, high CCA as 11-15% and very high CCA is more than 15%. [25] The lower the CCA the lower the likelihood of overlap of trials included in the umbrella review.

Synthesizing the Results and Rating the Evidence for Effectiveness

The statements of evidence were based on a rating scheme to gather and rate the evidence across the included publications.[26] The statements of evidence were based on the following rating

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scheme: *sufficient evidence*, sufficient data to support decisions about the effect of the health education-related interventions. [26] A rating of *sufficient evidence* in this review is obtained when systematic reviews or meta-analyses with a large number of included articles or participants produce a statistically significant result between the health education group and the control group. [26] *Some evidence*, is a less conclusive finding about the effects of the health education-related interventions[26] with statistically significant findings found in only a few included reviews or studies. *Insufficient evidence*, refers to not enough evidence to make decisions about the effects of the health education-related interventions, such as non-significant results between the health education group and the control group in the included systematic reviews or meta-analyses. [26] *Insufficient evidence to determine*, refers to not enough pooled data to be able to determine whether of the health education-related interventions are effective or not based on the included reviews. [26]

Results

Characteristics of Included reviews

The selection process and number of studies at each step was illustrated as presented in Figure 1. The database search yielded 692 publications, with removal of 197 duplicates and 371 articles that did not meet the inclusion criteria, 124 full-text articles were retrieved after applying the methodological quality rating (AMSTAR scale), and three studies [27-29] were removed due to low scores ≤3 on the AMSTAR scale. Fifty-one systematic reviews or meta-analyses [30-80] conducted between 2001 and 2016 and published in English were included (Figure 1; Tables 1 –3); 15 relating to ACS. The overlap of the trials included in the 15 reviews and meta-analyses related to ACS was slight (CCA = 2.6%). For the 36 systematic reviews relating to T2DM, the overlap of trials within these 35 reviews and meta-analyses (one review [47] did not report the included

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studies) was slight (CCA = 2.1%). None of the articles included patients with both ACS and T2DM. The umbrella review involved a total of 277,493 patients, including 225,034 patients with coronary heart disease or ACS (one article did not report the total sample) and 52,459 patients with T2DM (16 papers did not report the total sample). The average sample size of included articles was 8,161 (range, 536–68,556) participants, however, 63 studies related to ACS and 177 studies related to T2DM, were included in more than one systematic review or meta-analysis (see Appendix 2 and 3 and CCA statistics). The sample of these studies would therefore be included more than once. Of the included systematic reviews or meta-analyses, eleven were published in *The Cochrane Library*. Nine of the articles described meta-analyses, 29 articles described systematic reviews, and the remaining 13 articles were described as systematic reviews and meta-analyses or meta-regressions or narrative reviews.

Electronic database searches were conducted for all systematic reviews or meta-analyses, with an average of 6 databases searched (range, 2–16). The dates searched ranged widely, from inception of the database through December 2014. Most of the included reviews were randomized controlled trials (RCTs), and an average of 25.6 (range, 7–132) studies was included per systematic review or meta-analyses. Of the total, 818 unique (non-repeated) studies were included in all of the reviews or meta-analyses, 286 included patients with ACS, and 532 included patients with T2DM (Appendix 2, 3). The included reviews assessed the risk of bias using the Cochrane risk of bias tool (22 publications), JADA quality score (seven publications), Joanna Briggs quality assessment tool (two publications), PEDro scale (one publication), RCT Critical Appraisal Skills Programme (one publication), and the SIGN-50 checklist (one publication).

Methodological Quality of Included Systematic Reviews and Meta-Analyses

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The methodological quality of the included publications is presented in Table 1. Thirty (58.8%) publications were classified as high quality (scores 8–11), and 21 (41.2%) publications were classified as medium quality (scores 4–7). Twenty five (49%) reviews specifically provided an *a priori* design, while the use of such a design was unclear for 26 (51%) publications. The inclusion of other forms of literature (such as grey literature) was described in 18 (35%) reviews. Only 14 out of 51 (27%) reviews included a table of included and excluded studies. Only 2 (4%) reviews did not provide a characteristics table of the included papers. The scientific quality of the included papers was evaluated and documented in 47 (92%) reviews. The scientific quality of the included studies was used appropriately to formulate conclusions in 47 (92%) reviews. The methods to combine the results of the included studies were appropriate in 43 (86%) reviews. Publication bias was assessed in only 19 (37%) reviews. Finally, conflicts of interest were reported in 47 (92%) reviews.

Characteristics of Health Educational Interventions

The description of the health educational interventions followed the Workgroup for Intervention Development and Evaluation Research (WIDER) reporting guidelines for behavior change interventions. [81] The characteristics of the recipients, setting, delivery methods, intensity, duration, and educational content of health educational interventions for patients with ACS or T2DM are summarized in Tables 2 and 3. The delivery strategies for health education included face-to-face, internet-based, phone-based, videotape, written educational materials, or mixed. The format included one-on-one (individualized), group, or both. Face-to-face sessions were the most common delivery formats, and many education sessions were also delivered by telephone/web contact or individualized counseling. The number of sessions, total contact hours, and durations varied, and there was limited information about the intensity of health education

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for patients provided. The frequency of educational sessions was weekly or monthly, and an average of 3.7 topics was covered per education session. Nurses and multidisciplinary teams were the most frequent educators, and most education programs were delivered post-discharge.

Acute Coronary Syndrome

The educational content for patients with ACS covered cardiovascular risk factors in 8 reviews (53.33%), psychosocial issues in 8 reviews (53.33%), smoking cessation in 6 reviews (40.00%), exercise in 5 reviews (33.33%), behavioral change in 5 reviews (33.33%), diet in 4 reviews (26.67%), self-management in 3 reviews (20.00%), and medication in 1 review (6.67%). Two reviews only included smoking cessation and cardiovascular risk factors. The most common educational providers were nurses and a multidisciplinary team. Six studies [31 36 48 51 56 69] (6/15, 40%) described the theoretical approach that underpinned the education intervention.

Type 2 Diabetes Mellitus

The educational content for patients with T2DM included diet in 23 reviews (63.89%), behavioral change in 21 reviews (58.33%), self-management in 20 reviews (55.56%), exercise in 17 reviews (47.22%), glycemic regulation in 16 reviews (44.45%), medication in 13 reviews (36.11%), psychosocial issues in 9 reviews (25.00%), smoking cessation in 2 reviews (5.56%), cardiovascular risk factors in 2 reviews (5.56%), and DM risks in one review (2.78%). The most common providers were dieticians, nurses, and a multidisciplinary team. The number of sessions, total contact hours, and durations varied. Thirteen reviews [30 33 43 49 52-54 60 64 67 75-77] (13/36, 36.11%) described the theoretical approach that underpinned the education intervention.

Effect of Interventions

The outcomes of the included systematic reviews and meta-analyses were summarized in Table

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4.

Patients with Acute Coronary Syndrome

Three major types of health education-related interventions were used for patients with ACS: general health education (only included general health information), psychoeducational interventions, and secondary prevention educational interventions (including strategies to promote a healthy lifestyle, manage medications, and reduce cardiovascular complications) as well as internet-based interventions.

General Health Education

The findings are based on our synthesis of the findings from 6 systematic reviews. [37 48 50 51 59 70] Overall, there were mixed effects of general health education on behavioral change or clinical outcomes in patients with ACS. There was *some evidence* of a positive effect of general health education on knowledge, behavior, psychosocial indicators, beliefs, and risk factor modification, but no effects for key clinical outcomes, such as cholesterol level, hospitalization, mortality, MI, and revascularization. The results for health-related quality of life, healthcare utilization, and costs were mixed; several reviews reported a significant change, and other reviews reported no significant change for these outcomes. Only one review focused on telephone-based health education. There is *some evidence* that telephone-based health education during cardiac rehabilitation might improve all-cause hospitalization, anxiety, depression, smoking cessation, and systolic BP but there is no evidence for improvements in all-cause mortality and reductions in low-density lipoprotein cholesterol. [59]

Psychoeducational Interventions

Strategies for psychoeducational interventions have a specific focus on smoking cessation, and

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depression. The findings are based on synthesis of results from six publications. [31 35 36 45 56 69] There is *sufficient evidence* that psychoeducational programs are effective at decreasing smoking, achieving smoking abstinence, and reducing depression. One review reported no effect on smoking cessation [31] or total mortality [56].

Secondary Prevention Educational Interventions

The following statements are based on our synthesis of results from three papers. [34 41 44] There is *some evidence* that secondary prevention educational interventions reduce MI readmission rates and improve quality of life, but the intervention was ineffective in reducing revascularization, cholesterol levels, and improving smoking cessation rates. The results are mixed for mortality and re-infarction rates; two reviews [34 41] found positive effects on mortality, while one review [44] did not.

Patients with Type 2 Diabetes Mellitus

Ten types of health education-related interventions were used for patients with T2DM: culturally appropriate health education (tailored to the religious beliefs, culture, literacy, and linguistics of the geographical area), dietary advice, foot health education, group medical visits (a group education component taught by health professionals), general health education (only included general health information), improving the uptake and maintenance of medication regimes (e.g., promoting the use of oral hypoglycemic medications), lifestyle interventions (specific focus on dietary changes and increased physical activity, or stress management), psychoeducational interventions and self-management educational interventions (activities that promote or maintain the behaviors to manage T2DM often based on the National Standards for Diabetes Self-Management Education [13]), and therapeutic education (collaborative process needed to modify behavior and more effectively manage risk factors).

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Culturally Appropriate Health Education

Findings are based on our synthesis of results from 8 publications. [33 42 52-54 58 62 72] Overall, there was *some evidence* of the effects of culturally appropriate health education on clinical outcomes for T2DM. There was *sufficien*t evidence that culturally appropriate health education improves HbA1c reduction and knowledge scores. There is *some* evidence that physical activity and clinical outcomes (blood glucose, HbA1c, BP) were improved. There were no data relating to adverse events during the intervention and follow-up (such as hypoglycemic events and mortality), and there was insufficient evidence about improvements in quality of life.

General Health Education

The statements are based on our synthesis of results from five papers. [40 46 60 74 79] Overall, there were mixed effects of general health education programs on clinical outcomes for T2DM, including HbA1C, cholesterol level, and triglyceride level. There was *some evidence* of the effectiveness of general health education on the management of glycemia, weight reduction, and some diabetes management outcomes (HbA1C, diabetes complications). There were no data supporting the effectiveness of general health education on reduced health service utilization, diabetes complications, improved knowledge, psychosocial outcomes, or smoking habits.

Lifestyle Interventions

The following statements are based on our synthesis of results from 6 reviews. [39 49 55 71 72 77] Overall, there were mixed effects of the lifestyle interventions on cholesterol level, HbA1C level, and body weight. There is *some evidence* that lifestyle interventions or behavioral programs are effective for blood glucose and BP management, but they were ineffective for reductions in HbA1c scores [71 72].

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Uptake and maintenance of medication regimes

The statements are based on our synthesis of results from three publications. [57 78 80] There is *some evidence* of the effectiveness of increased uptake and maintenance of medication regimes for taking medications for HbA1C regulation including oral hypoglycemic agents.

Self-Management Educational Interventions

The statements are based on our synthesis of results from 9 reviews. [43 47 61 64 65 67 68 75 76] Overall, there was *sufficient evidence* of the effects of self-management education interventions on HbA1c level, knowledge, lifestyle outcomes, and main psychosocial outcomes. However, there was *insufficient* evidence of the benefits of this education intervention on depression, quality of life, and body weight.

Other Health Education-Related Interventions

Other health education-related interventions for patients with T2DM included therapeutic education, foot health education, group medical visits, psychoeducational interventions, and dietary advice. Statements for all of these interventions are based on our synthesis of results from one review.

There is *some evidence* that foot health education is effective in reducing the incidence of lower extremity amputation. [32] There is *some evidence* that group medical visits are effective for improving HbA1c and systolic BP management [38]. There is also *some evidence* that psychoeducational programs are effective for improving HbA1c regulation and psychological status. [30]

Finally, there is *insufficient evidence* that dietary advice improves glycemic and weight management or reduces micro- and macrovascular diseases. [63] There is also *insufficient*

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evidence for the cost-effectiveness of therapeutic education for patients with T2DM. [66]

Discussion

This umbrella review identified 51 systematic reviews or meta-analyses (15 for ACS and 36 for T2DM) that assessed the outcomes of various aspects (such as the duration, contact hours, educational content, delivery mode) of the delivery of health education-related interventions relevant to high risk patients with ACS and T2DM. Health education has become an integral part of the management for people with ACS and T2DM. The most appropriate focus of the education provided to ACS patients with T2DM remains largely undefined in the literature. For example, it remains unknown if the focus should be primarily on cardiovascular risk factors, blood glucose monitoring, or all educational components for patients with both conditions. [70 76] In addition, should cardiovascular risk factors be the focus during the acute inpatient stay with other educational needs such as the smoking cessation occurring within the primary care or outpatient settings. [31 69 70]

It remains challenging to determine the specific strategy or format that is the most effective delivery mode for patients with ACS or T2DM. There is very limited evidence to guide clinicians on the duration, contact hours, educational content, delivery mode, total length, and setting of health education programs for cardiac patients. [50] For patients with DM, one study reported that more successful programs were longer than 6 months (longer duration), consisted of greater than 10 contact sessions (high intensity), and were one-on-one sessions with individualized assessment. [82]

Use of Theoretical Orientation to Develop Educational Intervention

For patients with Acute Coronary Syndrome

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Use of theory when designing behavioral change interventions may also influence effectiveness.[75] Health education using a cognitive behavioral strategy is most consistently effective in changing maladaptive illness beliefs, [51] and studies using more than 2 behavioral change strategies reported significant differences between the intervention and control groups. [31] In one review, a significant change in smoking cessation was not observed in subgroup analyses between studies that did or did not report using a theory in intervention planning; [56] however, the authors did not suggest that using a theory in program planning should be disregarded but reported that examining actual theories or mechanisms underlying health education programs is required. [56] Owing to the considerable overlap between different theories and the detailed description of the theoretical approach in only approximately 40% of the included papers, it is difficult to determine the most effective theoretical approach, but many models can be used with success, such as the health belief model (HBM), social cognitive theory (SCT) and transtheoretical model (TTM). [56 67 69 75] Three reviews [31 41 44] noted that some included studies used behavioural strategies such as goal setting. These strategies were found to be beneficial for patients with coronary heart disease.

For patients with Type 2 Diabetes Mellitus

Although the theoretical approach underpinning the health education program was not always described, 13 of the 36 reviews (36.11%) related to T2DM reported the theoretical approach used in their included studies. The most common theories were SCT (including self-efficacy), empowerment theories (eg., Empowerment Behavior Change Model, Self-determination and Autonomy Motivation Theory, Middle-range Theory of Community Empowerment) and TTM. There is evidence that health education interventions based on a theoretical model are likely to be effective. [43] Vugt et al suggested that self-care education programs should be based on

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theories and that theory-based self-care interventions are more effective than non-theory-based programs. [75 83] Theories could help to specify the key target health behaviors and behavioral change techniques required to generate the desired outcomes. [75] The decision regarding the theory should be based on the aim of the program and factor for intervention. [77] Only one review reported that a theoretical approach underpinning the health education program is not necessary for better outcomes. [76] Fourteen reviews [30 33 40 46 52 57 60 63 64 67 68 73 75 77] reported that goal setting was conducted in the included studies. Goal setting by patients, health professionals or mutually-agreed goals were linked to improved patient outcomes.

Educational Content

For Patients with Acute Coronary Syndrome

Most reviews reported that the educational content of the interventions was comprehensive. The most common topics, of the average 3.7 topics per education session, were behavioral change, cardiovascular risk factors management, exercise, psychosocial issues, and smoking cessation. An underlying principle of health education for patients with ACS is that knowledge is necessary, but not enough to develop health behaviors and change risk factors. [31 50] Age, cognitive factors, environmental factors, and social and economic background are also important considerations. [50] While interventions using a behavioral program, telephone-based content, or self-care are effective for smoking cessation, there was insufficient evidence to support that any type of educational program was more efficacious than the others. [69] Psychoeducation, which is defined as multimodal, educationally based, self-management interventions,[31] led to enhanced physical activity levels within 6–12 months when added to cardiac rehabilitation (CR) and was more effective than an exercise program or health education alone. [31 56] Moreover, psychoeducational interventions were more effective for patients with ACS than other types of

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health education. [31 56]

For Patients with Type 2 Diabetes Mellitus

The educational content for patients with T2DM focused more on behavioral change, diet, exercise, glycemic regulation, medication, and self-management. Health education that was self-management was more effective for patients with T2DM. [40 47] In addition, based on the current evidence, the educational content should be culturally sensitive, especially for patients with T2DM; [33 42 54] culturally appropriate diabetes health education may have a greater impact on the management of glycemia and reduce diabetes complications. [77] The educational interventions for patients with T2DM focused primarily on HbA1C, lipid levels, quality of life, and body weight. HBM and SCT were the most common theories used in the included reviews.

Teaching Strategies and Outcomes

For Patients with Acute Coronary Syndrome

Most reviews reported that the education was provided using multiple teaching methods and in multiple settings. Nurses and multidisciplinary teams were the most frequent people providing education, and most education programs were delivered post-discharge. Although face-to-face sessions were the most common delivery format, many education sessions were also delivered by telephone or through individualized counseling. Telephone-based health education appeared to be effective for reducing hospitalizations, systolic BP, smoking rates, depression, and anxiety. [59] The educational interventions for patients with ACS focused primarily on clinical outcomes (hospitalization and mortality), modifiable risk factors (BP, low-density lipoprotein levels, and smoking cessation), and other psychological outcomes (anxiety and depression).

For Patients with Type 2 Diabetes Mellitus

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Mixed health education programs generally included group sessions combined with educator-facilitated individual sessions, covering basic knowledge and problem-solving skills. These programs produced greater benefits and larger effect sizes for blood glucose reduction and knowledge levels in patients with T2DM. [47] In contrast, individual education programs have been reported as more effective in achieving outcomes than group-based education. This may be because education programs might be more efficient at addressing personal needs, with greater participant engagement. [73] However, one systematic review reported that individual and group patient education, demonstrated similar outcomes among T2DM patients. [46]

Although face-to-face sessions were the most common delivery format, many education sessions were also delivered by telephone or individualized counseling. Face-to-face health education programs were most effective for enhancing blood glucose regulation and knowledge levels, while mixed delivery models (face-to-face, phone contact, online or web-based, or video) produced a moderate effect for knowledge levels. [47] Another review reported that face-to-face health education programs generated a greater benefit for metabolic management than those delivered using electronic communication technology. [73]

Nurses (including diabetes nurses educators), community workers, dieticians and multidisciplinary teams were the most frequent educators, and most of the education programs were delivered post-discharge. Some reviews indicated that health education programs delivered by a group of different educators, with some degree of education reinforcement at additional points of contact, may provide the best results. [60 76] However, based on two studies that reported HbA1C at 12 months, it is indicated that the outcomes in studies with only a diabetes nurse as the educator also tended to do better than the outcomes in studies with a multidisciplinary team , while the biggest effect was seen when a dietician was the only educator. [76] Health education

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programs delivered by one person may focus more on the patient's ability than the educational content or quality of the health education programs. [76] However, no clear conclusion can be drawn whether having one educator delivering the intervention is best due to few information. [60]

Delivery, Timing and Follow up

For Patients with Acute Coronary Syndrome

Most educational sessions were delivered weekly. Few reviews provided information regarding the duration of education interventions; when the duration was reported, it varied from 4 weeks to 48 months. These findings suggest that there is a significant gap in the evidence in relation to the duration, contact hours, educational content, optimal delivery mode, total length, and setting of health education programs for cardiac patients. [50] For patients with ACS, one systematic review that included 7 studies with a total of 536 participants reported that studies with education lasting at least 6 months resulted in the most significant changes in the primary outcomes (such as behavioral change, smoking cessation) [31] and that at least 12 months of follow-up is needed to evaluate the impact of telephone-based education. [59] Another review reported that the intensity of education programs is important for efficacy regarding smoking cessation: interventions with a very low intensity and brief interventions, do not have a significant effect, [69] and programs for smoking cessation among patients with coronary heart disease should last >1 month. [69] Most of the reviews were provided for patients with ACS in inpatient settings and then within post discharge settings, five reviews [31 36 45 48 59] did not explicitly state the settings in which the health education related interventions were provided.

For Patients with Type 2 Diabetes Mellitus

Education sessions were delivered weekly or monthly. Longer health education programs for T2DM (>6 months) produced larger effects for all primary outcomes (such as HbA1C). [47]

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Health education lasting >3 months resulted in the largest effect size compared with health education of a shorter duration (<3 months). [33] For HbA1C, the effect size at 6 months seemed to be significantly greater than at 3 and 12 months; in other words, the effect size peaked at 6 months. [62] In general, health education of a greater intensity (longer duration and more sessions) was more effective for blood glucose reduction and knowledge levels among patients with T2DM.[47 74] Compared with health education programs covering only one topic, programs that included multiple or mixed educational topics yielded consistently greater benefits in blood glucose reduction and knowledge levels. [47] In addition, health education programs combined with specific behavioral change strategies (such as self-care strategies) seemed more effective than other programs. [47] Health education related interventions were mainly delivered in hospital settings, primary care settings, diabetes centers or community based settings; although six reviews [32 39 55 58 67 72] did not explicitly state the delivery settings.

Recommendations about Health Education Interventions for Patients with ACS and T2DM

These results from included systematic reviews and meta-analyses help to provide recommendations about the content of a health education intervention for patients with ACS and T2DM, requiring further evaluation. Future development of educational programs for patients with ACS and T2DM by health care professionals should consider the needs of people with these diseases. [37 40 42 70] Based on the results and findings from this umbrella review, recommendations are made in Table 5. The acute life-threatening nature of ACS requires that increased emphasis should be placed on cardiovascular risk factors in any combined education program. Both ACS and T2DM have common lifestyle factors such as inactivity and high fat diet requiring modifications.

Overall Completeness and Applicability of Evidence

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This overview potentially provides an estimate with the lowest level of bias for the impact of health education-related interventions for patients with ACS or T2DM and could be regarded as an all-inclusive summary of the current evidence base for health education for these patients. While this umbrella review identified evidence for each of the types of health education, there was only a small number of reviews within some categories (such as psychoeducational intervention [30] and dietary advice [63]), and these studies were not very informative. This umbrella review also found no reviews that systematically analyzed varying doses of health education; therefore, could not examine the dose-response effects. There was insufficient information about the evaluated doses (total contact hours and duration of education) to enable comparison of the benefits of differences in the magnitude of the doses across the different research. This umbrella review found no reviews focused on patients with ACS and T2DM; instead, all of the systematic reviews and meta-analyses focused on only one of these diseases.

Quality of the Evidence

The methodological quality of the included systematic reviews and meta-analyses varied. All of the included reviews or meta-analyses were of moderate to high methodological quality, as assessed using AMSTAR. However, only 30 (58.8%) systematic reviews or meta-analyses were rated as high quality and only three (5.9%) systematic reviews or meta-analyses [43 53 69] adequately met all 11 AMSTAR criteria. This indicates that some of the reviews included in this umbrella review may have limitations in their design, conduct, and/or reporting that could have influenced the findings when considered both individually and collectively. [32 65]

The quality of the primary studies in the included systematic reviews or meta-analyses also varied. The main sources of bias were inadequate reporting of allocation concealment and randomization processes, as well as lack of outcome blinding. [33 42 69 70] This bias in the

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methodological quality led to lower quality assessments, which varied by results within each included review. Other reasons for lower methodological quality included heterogeneity in, or inconsistency of, the effect and imprecise findings. Heterogeneity between studies in this umbrella review was described in terms of the intervention, participant characteristics and length of follow-up. Heterogeneity was an important factor indicating the complexity of the health education interventions. [56] The variability in the approaches, tools or scales used to measure outcomes between the included studies are likely to introduce some heterogeneity. [30] The heterogeneity of the educational interventions seen in the reviews included in this umbrella review may reflect the uncertainty about the optimal strategy for providing health education to patients. [37] In addition, 240 studies were included more than once in the included reviews and meta-analyses. However, the overall overlap of studies among reviews and meta-analyses related ACS and T2DM was slight, CCA of 2.6% and 2.1%, respectively. [25]

This umbrella review is the first synthesis of systematic reviews or meta-analyses to take a broad perspective on health education-related interventions for patients with ACS or T2DM. Given that health education is complex, the biggest challenge for systematic reviews or meta-analyses of health education is accounting for the potential clinical heterogeneity in health education-related interventions (content and delivery approaches) and the population of patients who receive health education. To facilitate comparisons across systematic reviews of health education and the efficient future update of this umbrella review, future reviews or meta-analyses need high-quality research and to standardize their design and reporting, including the reporting of included study characteristics, assessment criteria for risk of bias, outcomes, and methods to synthesize evidence synthesis.

Conclusions

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For clinicians providing educational interventions to individuals with ACS and T2DM, the results from this review provide a contemporaneous perspective on current evidence on the effectiveness of health education (its content, and delivery methods) for this high risk patient group. The current evidence compiled by this umbrella review supports current international clinical guidelines, that theoretically-based education interventions lasting 6 months, delivered in multiple modes (face-to-face, phone contact, online or web-based, or video), and with individualized education delivered weekly, are more likely to generate positive outcomes. This review also supports health education- related interventions provided by health professionals, including nurses and multidisciplinary teams, delivering content including specific clinical factors for ACS and T2DM (BP, glycemic level, and medication), modifiable risk factors (unhealthy diet, inactivity, and smoking), and other psychological factors (anxiety and depression). These health education interventions could be delivered post-discharge, such as rehabilitation centers, primary care centers, and the community and should be at least 6 months in duration. The effectiveness of these programs was based on HbA1C levels, knowledge, psychosocial outcomes, readmission rates, and smoking status rather than clear evidence of reduced mortality, MI, or short and long-term complications. In addition, psychoeducational interventions were more effective for patients with ACS, and health education that was culturally appropriate or taught self-management was more effective for patients with T2DM. We also found that longer durations and high-intensity health education provided in an individualized format were more helpful for patients with ACS or T2DM.

The fact that none of the included reviews included patients with both ACS and T2DM indicates a clear need for further rigorous experimental studies with patients with both diseases. Future research that includes these aspects of education are likely determine the effectiveness of

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educational interventions focusing on cardiovascular and DM risk factors and complications within patients with ACS and T2DM.

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Table 1. Methodological quality assessment of included systematic reviews and meta-analyses

	Systematic Review/ Meta-analysis	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total score
Systematic reviews and meta-analysis involved ACS patients													
1	Barth, Jacob, Daha, & Critchley, 2015 [69]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
2	Devi et al., 2015 [44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
3	Ghisi, Abdallah, Grace, Thomas, & Oh, 2014 [50]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	7
4	Kotb, Hsieh, & Wells, 2014 [59]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
5	Brown, Clark, Dalal, Welch, & Taylor, 2013 [37]	Yes	No	Yes	CA	No	Yes	Yes	Yes	Yes	NA	Yes	7
6	Dickens et al., 2013 [45]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
7	Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011 [31]	CA	No	Yes	CA	NO	Yes	Yes	Yes	Yes	No	Yes	6
8	Brown, Clark, Dalal, Welch, & Taylor, 2011 [70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
9	Huttunen-Lenz, Song, & Poland, 2010 [56]	CA	No	Yes	CA	No	Yes	Yes	Yes	Yes	No	No	5
10	Goulding, Furze, & Birks, 2010 [51]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
11	Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008 [34]	CA	Yes	Yes	CA	No	No	Yes	No	Yes	Yes	No	5
12	J. Barth, Critchley, & Bengel, 2008 [36]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
13	Fernandez et al., 2007 [48]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	8
14	J. Barth, Critchley, & Bengel, 2006 [35]	CA	Yes	Yes	CA	No	Yes	CA	Yes	Yes	Yes	Yes	7

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15	Clark, Hartling, Vandermeer, & McAlister, 2005 [41]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Systematic reviews and meta-analysis involved T2DM patients													
16	Choi, Davidson, Walker, Lee, & Palermo, 2016 [40]	CA	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	8
17	Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016 [42]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
18	Huang et al., 2016 [55]	CA	CA	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	7
19	Chen et al., 2015 [39]	CA	CA	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	7
20	Pillay et al., 2015 [71]	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	9
21	Terranova, Brakenridge, Lawler, Eakin, & Reeves, 2015 [72]	CA	CA	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
22	Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014 [33]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10
23	Odnoletkova et al., 2014 [66]	Yes	CA	Yes	CA	No	No	Yes	Yes	Yes	Yes	No	6
24	Pal et al., 2014 [67]	CA	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
25	Ricci-Cabello et al., 2014 [73]	Yes	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	9
26	Saffari, Ghanizadeh, & Koenig, 2014 [74]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
27	Gucciardi, Chan, Manuel, & Sidani, 2013 [52]	CA	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	7
28	Pal et al., 2013 [68]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10
29	Vugt, Wit, Cleijne, & Snoek, 2013 [75]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	NA	No	Yes	6
30	Amaeshi, 2012 [32]	CA	CA	Yes	No	No	Yes	Yes	Yes	NA	No	No	4
31	Nam, Janson, Stotts, Chesla, &	CA	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8

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	Kroon, 2012 [62]												
32	Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012 [76]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	7
33	Burke et al., 2011 [38]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	10
34	Kai Lun Gan, Brammer, & Creedy, 2011 [57]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	No	Yes	8
35	Ramadas, Quek, Chan, & Oldenburg, 2011 [77]	CA	CA	Yes	No	No	Yes	Yes	Yes	NA	No	Yes	5
36	Hawthorne, Robles, Cannings-John, & Edwards, 2010 [54]	Yes	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	CA	Yes	8
37	Minet, Moller, Vach, Wagner, & Henriksen, 2010 [61]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	9
38	Alam, Sturt, Lall, & Winkley, 2009 [30]	Yes	Yes	No	CA	No	Yes	Yes	Yes	Yes	Yes	Yes	8
39	Duke, Colagiuri, & Colagiuri, 2009 [46]	Yes	CA	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	8
40	Fan & Sidani, 2009 [47]	Yes	No	Yes	CA	No	Yes	No	No	Yes	No	Yes	5
41	Hawthorne, Robles, Cannings-John, & Edwards, 2008 [53]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
42	Khunti, Camosso-Stefinovic, Carey, Davies, & Stone, 2008 [58]	CA	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	5
43	Loveman, Frampton, & Clegg, 2008 [60]	Yes	CA	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8
44	Wens et al., 2008 [78]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	Yes	NA	Yes	7
45	Nield et al., 2007 [63]	Yes	Yes	Yes	CA	Yes	Yes	Yes	Yes	Yes	No	Yes	9
46	Zabaleta & Forbes, 2007 [79]	CA	CA	Yes	CA	Yes	Yes	Yes	Yes	NA	No	No	5
47	Deakin, McShane, Cade, &	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11

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	Williams, 2005 [43]												
48	Vermeire et al., 2005 [80]	Yes	Yes	Yes	CA	Yes	Yes	Yes	Yes	Yes	No	Yes	9
49	Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003 [49]	CA	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	6
50	Norris, Lau, Smith, Schmid, & Engelgau, 2002 [65]	CA	No	Yes	No	No	Yes	Yes	Yes	CA	No	No	4
51	Norris, Engelgau, & Narayan, 2001 [64]	CA	Yes	Yes	CA	No	Yes	Yes	Yes	NA	No	No	5

Item 1:"Was an 'a priori' design provided?"; **Item 2**: "Was there duplicate study selection and data extraction?"; **Item 3**: "Was a comprehensive literature search performed?"; **Item 4**: "Was the status of publication (ie. grey literature) used as an inclusion criterion?"; **Item 5**: "Was a list of studies (included and excluded) provided?"; **Item 6**: "Were the characteristics of the included studies provided?"; **Item 7**: "Was the scientific quality of the included studies assessed and documented?"; **Item 8**: "Was the scientific quality of the included studies used appropriately in formulating conclusions?"; **Item 9**: "Were the methods used to combine the findings of studies appropriate?"; **Item 10**: "Was the likelihood of publication bias assessed?"; **Item 11**: "Was the conflict of interest stated?"

CA= Cannot Answer; NA= Not Application;

Source: *Shea, B. J., Grimshaw, J. M., Wells, G. A., Boers, M., Andersson, N., Hamel, C., ... & Bouter, L. M. (2007). Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Medical Research Methodology, 7(1), 1.*

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Table 2. Characteristics and interventions of included systematic reviews and meta-analysis involved ACS patients

(First author, Year); Journal	Primary objectives (To assess effect of interventions on….)	Studies details	Intervention					Outcomes (Primary outcomes were bold.) "–" : No change " ↑ " : Increase " ↓ " : decrease	Synthesis methods
			Educational Content		Provider	Number of session(s), delivery mode, time, setting			
(Devi et al., 2015) [44]; The Cochrane Library	Lifestyle changes and medicines management	**Number of studies**:11 completed trials (12 publications); **Types of studies:** RCTs; **Total sample:** 1,392 participants.	All Internet based interventions.	√ BEHA (-) √ CVR (-) √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY(-) √ SMOKING (-) ☐ SELF	Dietitians; exercise specialists; nurse practitioners; physiotherapist rehabilitation specialists, or did not describe.	**Number of session:** Weekly or monthly or unclear; **Total contact hours:** Unclear. **Duration:** From six weeks to one year.	**Strategies:** Internet- and mobile phone-based intervention, such as email access, private-messaging function on the website, one-to-one chat facility, a synchronised group chat, an online discussion forum, or telephone consultations; or video files; **Format:** one-on-one chat sessions; "ask an expert" group chat sessions; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**– Clinical outcomes;** **– Cardiovascular risk factors;** – Lifestyle changes; – Compliance with medication; – Healthcare utilization and costs; ↓ Adverse intervention effects.	Meta-analysis used Review Manager software.
(Barth, Jacob, Daha, & Critchley, 2015) [69]; The Cochrane Library	Smoking cessation	**Number of studies**:40 RCTs; **Types of studies:** RCTs; **Total sample:** 7,928 participants.	Psychosocial smoking cessation interventions	☐ BEHA ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY √ SMOKING ☐ SELF	Cardiologist; general practitioner physician or study nurse.	**Number of session**: Weekly or 2-3 times per week; **Total contact hours:** Unclear. **Duration:** From 8 weeks to one year.	**Strategies:** Face to face, telephone contact, written educational materials, videotape, booklet or unclear; **Format:** One by one counseling; telephone call; group meetings or unclear; **Theoretical approach:** TTM, SCT.	Inpatient settings, post discharge, other	**↑ Abstinence by self-report or validated.**	Meta-analysis used Review Manager software.
(Kotb, Hsieh, & Wells, 2014) [59]; PloS one	Patients' outcomes.	**Number of studies**: 26 studies; **Types of studies:** RCTs; **Total sample:** 4,081	Telephone-delivered post-discharge interventions.	☐ BEHA √ CVR ☐ DIET ☐ EXERCISE ☐ MED	Dietitians; exercise specialist; health educators; nurses and pharmacists.	**Number of session:** 3-6 sessions/telephone calls and was greater than 6 calls in five	**Strategies:** Telephone calls; **Format:** Unclear, did not describe the format; **Theoretical approach:** Unclear.	Unclear, did not describe the setting.	**↓ All-cause hospitalization;** **– All-cause mortality;** ↓ Depression;	Meta-analysis used Review Manager software.

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		participants.		☐ PSY ☐ SMOKING ☐ SELF		studies; or unclear; **Total contact hours:** 40 mins to 180 mins or unclear; **Duration:** 1.5 - 6 months or unclear.			– Anxiety; ↑ Smoking cessation, ↓ Systolic blood pressure; – LDL-c.	
(Ghisi, Abdallah, Grace, Thomas, & Oh, 2014)[50]; Patient Education and Counseling	knowledge, health behavior change, medication adherence, psychosocial well-being.	**Number of studies**: 42 articles; **Types of studies:** Thirty were experimental: 23 RCTs and 7 quasi-experimental; and 11 observational and 1 used a mixed-methods design. **Total sample:** 16,079 participants.	Any educational interventions.	√ BEHA (+) √ CVR (++) √ DIET (+++) √ EXERCISE (++) √ MED (++) √ PSY(++) √ SMOKING (+) ☐ SELF	Nurses (35.7%), a multidisciplinary team (31%), dietitians (14.3%), and a cardiologist (2.4%).	**Number of session:** 1-24 or unclear. **Total contact hours:** 5–10 min to 3 h as well as a full day of education. **Duration:** 1-24 month; from daily education to every 6 months.	**Strategies:** Did not describe the strategies; **Format:** Group (88.1%) education was delivered by lectures (40.5%), group discussions (40.5%), and question and answer periods (7.1%). Individual education (88.1%), including individual counseling (50%), follow-up telephone contacts (31%) and home visits (7.1%); **Theoretical approach:** Unclear.	Inpatient settings	**– Knowledge,** **– Behavior;** **– Psychosocial indicators.**	Narrative synthesis
(Brown, Clark, Dalal, Welch, & Taylor, 2013)[37]; European Journal of Preventive Cardiology	Mortality, morbidity, HRQoL and healthcare costs.	**Number of studies:** Twenty-four papers reporting on 13 RCTs; **Types of studies:** RCTs; **Total sample:** 68,556 participants.	Patient education.	☐ BEHA √ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	Nurses or other healthcare professionals.	**Number of session and Duration:** From a total of 2 visits to a 4-week residential stay reinforced with 11 months of nurse led follow-up. **Total contact hours:** Unclear.	**Strategies:** Face-to-face education sessions, telephone contact and interactive use of the Internet; **Format:** Group-based sessions, individualized education and four utilized a mixture of both sessions; **Theoretical approach:** Unclear.	Inpatient settings, other	**– Mortality,** **– Non-fatal MI,** **– Revascularizations,** **– Hospitalizations,** **– HRQoL,** – Withdrawals/drop outs; – Healthcare utilization and costs.	Meta-analysis used Review Manager software.
(Dickens et al., 2013)[45]; Psychosomatic Medicine	Depression and depressive symptoms.	**Number of studies:** Sixty-two independent studies. **Types of studies:** RCTs; **Total sample:** 17,397.	Psychological interventions.	√ BEHA (-) ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING	A single health professional or by a unidisciplinary team	**Number of session:** 14.4 (range, 1-156); **Total contact hours:** Varying from 10 to 240 minutes. **Duration:** Unclear.	**Strategies:** Face-to-face sessions, telephone contact or unclear; **Format:** Group or unclear; **Theoretical approach:** Unclear.	Unclear, did not describe.	**↓ Depression;** – Adverse cardiac outcomes; – Ongoing cardiac symptoms.	Univariate analyses using Comprehensive Meta-Analysis, multivariate

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				√ SELF (-)						Meta-regression using SPSS 15.0
(Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011) [20]; Journal of Cardiopulmonary Rehabilitation & Prevention	Health behavior change.	**Number of studies:** 7 trials. **Types of studies:** Six randomized controlled trials and a quasi-experimental trial. **Total sample:** 536 participants.	All psychoeducational or behavioral intervention.	☐ BEHA √ CVR (-) ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Appropriately trained health care workers.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 2-12 months.	**Strategies:** Did not describe the strategies; **Format:** Group setting, combination of group and one-on-one education and one-on-one format only; **Theoretical approach:** TTM, interactionist role theory, Bandura's self-efficacy theory, Gordon's relapse prevention model and a cognitive behavioral approach.	Unclear, did not describe.	**↓ Smoking rates; medication use; − Supplemental oxygen use; ↑ Physical activity;** ↑ Nutritional habits.	Meta-analysis and narrative presentation
(Brown, Clark, Dalal, Welch, & Taylor, 2011) [70]; The Cochrane Library	Mortality, morbidity, HRQofL and healthcare costs.	**Number of studies:** 24 papers reporting on 13 studies. **Types of studies:** RCTs; **Total sample:** 68,556 participants.	Patient education.	√ BEHA (-) √ CVR (-) ☐ DIET √ EXERCISE (-) √ MED ☐ PSY ☐ SMOKING ☐ SELF	Nurse or did not describe.	**Number of session and Duration:** two 2 visits to 4 week residential 11 months of nurse led folluw up **Total contact hours:** Unclear.	**Strategies:** face-to-face sessions, telephone contact and interactive use of the Internet; **Format:** Four studies involved group sessions, five involved individualized education and three utilized both session types, with one study comparing the two approaches; **Theoretical approach:** did not describe.	Post discharge, other	**− Total mortality; − Cardiovascular − mortality; − Non-cardiovascular mortality; − Total cardiovascular (CV) events; − Fatal and/or non-fatal MI;** − Other fatal and/or non-fatal CV events	Meta-analysis used Review Manager software.
(Goulding, Furze, & Birks, 2010) [51]; Journal of Advanced Nursing	Change maladaptive illness.	**Number of studies: 13 studies; Types of studies:** RCTs; **Total sample:** Unclear.	Interventions to change maladaptive illness beliefs	√ BEHA (-) ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED √ PSY (-) ☐ SMOKING	Cardiologist, nurse, psychologist or did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 4 days to two weeks or unclear.	**Strategies:** Face-to-face sessions, telephone contact and written self-administered; **Format:** Unclear; **Theoretical approach:** Common Sense Model, Leventhal's framework.	Inpatient settings, post discharge, other	**− Beliefs (or other illness cognition);** − QoL; − Behaviour; − Anxiety or depression; − Psychological	A descriptive data synthesis.

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				☐ SELF					wellbeing; − Modifiable risk factors; protective factors.	
(Huttunen-Lenz, Song, & Poland, 2010) [56]; British Journal of Health Psychology	Smoking cessation.	**Number of studies:** A total of 14 studies were included. **Types of studies:** RCTs; **Total sample:** 1,792 participants.	Psychoeducational cardiac rehabilitation intervention.	☐ BEHA ☐ CVR ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	Cardiologist, nurse psychologist, or did not describe.	**Number of session:** 4-20 or unclear. **Total contact hours:** 10-720 mins or unclear. **Duration:** 4-29 weeks or unclear.	**Strategies:** Face-to-face counselling, self-help materials; home visit, booklet, video and telephone contact. **Format:** individual or unclear. **Theoretical approach:** Social learning theory; ASE model; TTM; Behavioural multicomponent approach.	Inpatient settings, post discharge, other	**↑ Prevalent smoking cessation, ↑ Continuous smoking cessation,** − Mortality.	Subgroup meta-analysis was used software.
(Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008) [34]; Circulation	Multiple cardiovascular risk factors and all-cause mortality.	**Number of studies:** 27 articles reporting 26 studies. **Types of studies:** 16 clinical controlled trials and 10 before-after studies. **Total sample:** 2,467 patients in CCTs and 38, 581 patients in before-after studies.	In-Hospital Multidimensional Interventions of Secondary Prevention	☐ BEHA ☐ CVR √ DIET (-) √ EXERCISE (-) √ MED √ PSY (-) √ SMOKING (-) ☐ SELF	Cardiac nurses; physician, or did not describe.	**Number of session:**1-5 or unclear; **Total contact hours:** 30-240mins or unclear; **Duration:** 4 weeks – 12 months.	**Strategies:** Written material; audiotapes; presentations; face-to-face; **Format:** Group or unclear; **Theoretical approach:** Unclear.	Inpatient settings.	**↓ All-cause mortality; ↓ Readmission rates; − Reinfarction rates.**	Stata version 9.1.
(Barth, Critchley, & Bengel, 2008) [36] ; The Cochrane Library	Smoking cessation.	**Number of studies:** Forty trials; **Types of studies:** RCTs; **Total sample:** 7,682 patients.	Psychosocial intervention	√ BEHA (+++) √ CVR (++) ☐ DIET ☐ EXERCISE ☐ MED √ PSY (+) √ SMOKING (+++)	Cardiologist, nurse, physician or study nurse.	**Number of session:** 1-5 or unclear; **Total contact hours:** 15 mins - 9 hours. **Duration:** within 4 weeks or did not report on the duration.	**Strategies:** Face to face; information booklets, audio- or videotapes. **Format:** Group sessions or individual counselling; **Theoretical approach:** TTM.	Inpatient settings	**↑ Abstinence by self-report or validated.**	Meta-analysis used Review Manager software.

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				√ SELF(+++)						
(Fernandez et al., 2007) [48]; International Journal of Evidence-Based Healthcare	Risk factor modification.	**Number of studies:** Seventeen trials; **Types of studies:** randomised, quasi-RCTs and clustered trials; **Total sample:** 4,725 participants.	Brief structured intervention.	√ BEHA (-) √ CVR (-) ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Case manager; dieticians; health educator; nurses; psychologist; and research assistants.	**Number of session:** supportive counselling ranged from 1 to 7 calls for the duration of the study; **Total contact hours:** varied from 10 to 30 mins; **Duration:** Unclear.	**Strategies:** Written, visual, audio, telephone contact; **Format:** did not describe; **Theoretical approach:** theoretical behaviour change principles.	Unclear, did not describe.	**↓ Smoking;** **− Cholesterol level;** **− Physical activity;** **↑ Dietary habits;** **↓ Blood sugar levels;** **− BP levels;** **↓ BMI;** − Incidence of admission.	Cochrane statistical package Review Manager.
(J. Barth, Critchley, & Bengel, 2006) [35]; Annals of Behavioral Medicine	Smoking cessation.	**Number of studies:** Nineteen trials; **Types of studies:** RCTs; **Total sample:** 2,548 patients.	Psychosocial interventions.	√ BEHA (+++) √ CVR (++) ☐ DIET ☐ EXERCISE ☐ MED ☐ PSY ☐ SMOKING √ SELF (+++)	Unclear, did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face to face, telephone contact or unclear; **Format:** Unclear; **Theoretical approach:** Unclear.	Unclear, did not describe.	**↑ Abstinence;** **↓ Smoking status**.	Data analyses were carried out in Review Manager 4.2.
(Clark, Hartling, Vandermeer, & McAlister, 2005) [41]; Annals of Internal Medicine	Mortality, MI	**Number of studies:** 63 randomized trials; **Types of studies:** RCTs; **Total sample:** 21,295 patients.	Secondary prevention programs	☐ BEHA ☐ CVR √ DIET (-) √ EXERCISE (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Nurse, multidisciplinary team, or did not describe.	**Number of session:** 1-12 or unclear; **Total contact hours:** did not describe. **Duration:** 0.75-48 months.	**Strategies:** Face to face, telephone contact and home visit; **Format:** Group and individual or unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ Mortality,** **↓ MI,** − Hospitalization rates.	Performed analyses by using Review Manager 4.2 and Qualitative Data Synthesis

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SMOKING= Smoking cessation; CVR= Cardiovascular risk factors; PSY =Psychosocial issues (depression, anxiety); DIET =Diet; EXERCISE= Exercise; MED= Medication; BEHA = Behavioral charge (including lifestyle modification); SELF = Self-management (including problems solving); DR =Diabetes risks; CHD= Coronary heart disease; CAD = Coronary Artery Disease; CHW=Community Health Worker; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; LDL = Low-density Lipoprotein Cholesterol; SMS = Short Message Service; BCTs = Behavioral Change Techniques; LEA = Lower Extremity Amputation; PRIDE = Problem Identification, Researching one's routine, Identifying a management goal, Developing a plan to reach it, Expressing one's reactions and Establishing rewards for making progress; ASE = Attitude-social influence-efficacy; CVRF= Cardiovascular Risk Factors; SMS = Short Message System; PA = Physical Activity; EDU = Patient Education; GP= General Practice; RCTs =Randomized controlled trials; CCTS = controlled clinical trials; HRQoL = Health Related Quality of Life; QoL = Quality of Life; MI = Myocardial Infarction; CAD = Coronary Artery Disease; CABG= Coronary Artery Bypass Graft Surgery; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model; SAT=Social Action Theory;

In the educational content: “+”: minor focus; “++”:moderate focus; “+++” major focus; “-“ =unclear what the intensity of the education was for any topic;

In the outcomes: arrow up (“ ↑ ”) for improvement, arrow down (“ ↓ ”) for reduction; a dash (“−”) for no change or inconclusive evidence. Primary outcomes were bold.

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Table 3. Characteristics and interventions of included systematic reviews and meta-analysis involved T2DM patients

(First author, Year); Journal	Primary objectives (To assess effect of interventions on….)	Studies details	Intervention					Outcomes (Primary outcomes were bold.) "–" : No change " ↑ " : Increase " ↓ " : decrease	Synthesis methods
			Educational Content		Provider	Number of session(s), delivery mode, time, setting			
Choi, Davidson, Walker, Lee, & Palermo, 2016) [40]; Diabetes Research and Clinical Practice	Glycemic effect	**Number of studies:** 53 studies(five in English, 48 in Chinese); **Types of studies:** RCTs; **Total sample:** Unclear.	Diabetes education intervention.	☐ BEHA √ DIET (-) ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Unclear, did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 30–150 min or unclear.	**Strategies:** Face to face, written materials; telephone contact and home visit; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c (glycated haemoglobin).**	STATAversion 12 and Review Manager version 5.3
Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016) [42]; Diabetic Medicine	successful outcomes and to suggest directions for future research.	**Number of studies: 33; Types of studies:** RCTs; **Total sample:** 7,453 participants.	Culturally appropriate health education.	√ BEHA (-) √ DIET (-) √ DR (-) √ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	CHWs, clinical pharmacists dieticians, Nurses, podiatrists, physiotherapists, and psychologists.	**Number of session:** one to ten or unclear; **Total contact hours:** unclear; **Duration:** from a single session to 24 months.	**Strategies:** Face-to-face; Phone contact; **Format:** group sessions (10 studies), individual sessions (13) or a combination of both; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c,** **– HRQoL,** **– Adverse events,** – BP, – BMI, – Lipid levels, – diabetes complications, – Economic analyses, – Mortality and diabetes knowledge, – Empowerment, – Self-efficacy and satisfaction.	Meta-analysis using the Review Manager statistical program.

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(Huang et al., 2016) [55]; European Journal of Internal Medicine	Clinical markers of cardiovascular disease	**Number of studies:** 17 studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Lifestyle interventions.	☐ BEHA √ DIET (-) √ CVR (-) √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Nurse, Pharmacist or unclear.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** 6 month – 8 years.	**Strategies:** Unclear; **Format:** Individual; Group and Mixed. **Theoretical approach:** Unclear;	Unclear, did not describe.	**Cardiovascular risk factors** (such as, − BMI, ↓ HbA1c, − BP, ↓ The level of cholesterol.)	Review Manager 5.1.
(Chen et al., 2015) [39]; Metabolism-Clinical and Experimental	Clinical markers.	**Number of studies:** 16 studies; **Types of studies:** RCTs; **Total sample:** per study ranged from 23 to 2575;	Lifestyle intervention.	√ BEHA (-) ☐ DIET √ CVR (-) ☐ EXERCISE ☐ GC √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Unclear, did not describe.	**Number of session:** Monthly; **Total contact hours:** Unclear; **Duration:** < 6 months -8 years.	**Strategies:** Unclear; **Format:** Individual; Group and Mixed; **Theoretical approach:** Unclear.	Unclear, did not describe.	**Cardiovascular risk factors** including ↓ BMI, ↓ HbA1c, ↓ SBP, DBP, − HDL-c, and LDL-c.	All analyses were performed using Comprehensive Meta-Analysis statistical software.
(Terranova, Brakenridge, Lawler, Eakin, & Reeves, 2015) [72]; Diabetes, Obesity and Metabolism	Weight loss.	**Number of studies:** 10 individual studies (from 13 papers); **Types of studies:** RCTs; **Total sample:** ranging from 27 to 5145 participants.	Lifestyle-based-only intervention.	√ BEHA (-) √ DIET (-) ☐ DR (-) √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Dietician; diabetes educator; general physician; multidisciplinary team; or nutritionist; nurse.	**Number of session:** 1-42; **Total contact hours:** Unclear; **Duration:** ranged from 16 weeks to 9 years.	**Strategies and Format:** Face-to-face individual or group-based sessions, or a combination of those. One study delivered the intervention via the telephone **Theoretical approach:** Unclear.	Unclear, did not describe.	**↓ Weight change; − HbA1c.**	Meta-analyses - Review Manager and meta-regression analysis - stata version
(Pillay et al., 2015) [71]; Annals of	HbAlc level.	**Number of studies:** 132; **Types of studies:**	Behavioral Programs.	√ BEHA (-) √ DIET (-) ☐ DR	Trained individuals.	**Number of session:** Unclear; **Total contact hours:**	**Strategies:** Unclear; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge,	**− HbA1c; ↓ BMI.**	The analysis was conducted

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internal medicine		RCTs; **Total sample:** Unclear.		√ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)		range,17 to 40.5 hours; **Duration:** 4 or more weeks.		other	by using a Bayesian network model.
(Pal et al., 2014) [67]; Diabetes Care	Health status, cardiovascular risk factors, and QoL.	**Number of studies:** 20 papers describing 16 studies; **Types of studies:** RCTs; **Total sample:** 3,578 participants.	Computer-based self-management interventions.	☐ BEHA ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF	Unclear, did not describe.	**Number of session:** 1-8 ; **Total contact hours:** 10 mins - 6 hours; **Duration:** 8 weeks – 12 months;	**Strategies:** Online/web-based; Phone contact. **Format:** Individual; Group and Mixed. **Theoretical approach:** TTM, social ecological theory, SCT, and self-determination theory.	Unclear, did not describe.	**− HRQoL, ↓ HbA1c, − Death;** ↓ Cognitions, behaviors, − Social support, ↓ Cardiovascular risk factors, − Complications, − Emotional outcomes, − Hypoglycemia, − Adverse effects, − CE and ecfonomic data.	Meta-analysis using Review Manager software or narrative presentatio.
(Ricci-Cabello et al., 2014) [73]; BMC endocrine disorders	Knowledge, behaviors and clinical outcomes.	**Number of studies:** Thirty-seven studies; **Types of studies:** Almost two thirds of the studies were RCTs, 27% studies were Quasi-experimental design. **Total sample:** Unclear.	DSM educational programs.	☐ BEHA √ DIET(+++) ☐ DR √ EXERCISE (+++) √ GC(+++) √ MED(++) √ PSY(++) ☐ SMOKING ☐ SELF	Dietitian; Nurse; Psychologist; Physician; Research team or staff;	**Number of session:** 13.1; **Total contact hours:** 0.25-180 hours; **Duration:** 0.25-48 months.	**Strategies:** Face-to-face; Telecommunication; Both. **Format:** One on one; Group and Mixed. **Theoretical approach:** Unclear.	Post discharge, other	**− Diabetes knowledge; − Self-management; − Behaviors; − Clinical outcomes;** ↓ Glycated hemoglobin; − Cost-effectiveness analysis.	Meta-analyses and bivariate meta-regression were conducted with Stata, version 12.0.

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(Saffari, Ghanizadeh, & Koenig, 2014) [74]; Primary Care Diabetes	Glycemic control.	**Number of studies:** 10; **Types of studies:** RCTs; **Total sample:** 960 patients.	An educational intervention using SMS.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Unclear, did not describe.	**Number of session:** Weekly; or 2 messages daily or unclear; **Total contact hours:** Unclear. **Duration:** 3 months – 1 year	**Strategies:** SMS: sending and receiving data. Receive data through text-messaging by patients only. Used a website along with SMS; **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↑ **Glycemic control**.	Comprehensive Meta-analysis Software Version 2.0.
(Odnoletkova et al., 2014) [66]; Journal of Diabetes & Metabolism	Cost-effectiveness (CE).	**Number of studies:** Seventeen studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Therapeutic education.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	General physician; nutritionists or unclear.	**Number of session:** ~ 16; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face-to-face or unclear; **Format:** individual and group lessons; **Theoretical approach:** Unclear.	Inhospital or unclear.	− **CE.**	Incremental Cost-Effectiveness Ratio.
(Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014) [33]; The Cochrane Library	HbAIc level, Knowledge and clinical outcomes.	**Number of studies:** 33 trials; **Types of studies:** RCTs and quasi-RCTs; **Total sample:** 7453 participants.	'Culturally appropriate' health education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	CHWs; dieticians; exercise physiologists; lay workers; nurses; podiatrists; and psychologists;.	**Number of session:** one session to 24 months; **Total contact hours:** Unclear; **Duration:** The median duration of interventions was six months.	**Strategies:** **Format:** Group intervention method, one-to-one sessions and a mixture of the two methods. Or a purely interactive patient-centred method. **Theoretical approach:** empowerment theories; behaviour change theories, TTM of behaviour change and SCT.	Inpatient settings, post discharge, other	↓ **HbA1c;** − **HRQoL;** − **Adverse events;** − Mortality; − Complications; −Satisfaction; ↑ Empowerment; ↑ Self-efficacy; − Attitude; knowledge;	Meta-analyses used Review Manager software.

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									−BP; −BMI; ↓ Lipid levels; −Health economics.	
(Vugt, Wit, Cleijne, & Snoek, 2013) [75] ; Journal of Medical Internet Research	Health outcomes.	**Number of studies:** 13 studies; **Types of studies:** RCTs; **Total sample:** 3813 patients.	BCTs are being used in online self-management interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Health care professional.	**Number of session:** 6 weekly sessions or unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Online/web-based; **Format:** Unclear; **Theoretical approach:** self-efficacy theory, social support theory, TTM, SCT, social-ecological model, and cognitive behavioral therapy.	Post discharge	**− Health behavior change,** **− Psychological well-being;** − Clinical parameters.	Unclear.
(Gucciardi, Chan, Manuel, & Sidani, 2013) [52]; Patient Education and Counseling	HbAIc level,physical activity and diet outcomes.	**Number of studies:** Thirteen studies; **Types of studies:** RCTs and comparative studies; **Total sample:** Unclear.	DSME interventions.	☐ BEHA √ DIET (+++); ☐ DR √ EXERCISE (+++); ☐ GC √ MED (+); √ PSY (+) ☐ SMOKING √ SELF (++).	Dietitians (n = 7/13); Multidisciplinary Team (n = 7/13); Nurse (n = 5/13); Community Peer Worker (n = 3/13).	**Number of session:** Low Intensity: <10 education sessions (n = 7); High Intensity: ≥ 10 education sessions (n = 6); **Total contact hours:** Unclear; **Duration:** < 6 months (n = 7/13); ⩾6months (n = 6/13).	**Strategies:** Face-to-face(n = 13/13); Written Literature: (e.g., handbook) (n = 4/13);Telephone(n = 4/13);Audio-Visual(n = 1/13); **Format:** One-on-one: (n = 11/13);Group (n = 9/13); **Theoretical approach:** SAT; Empowerment Behavior Change Model; modification theories; Pharmaceutical Care Model; Behavior Change Theory; PATHWAYS Program; Symptom-Focused Management Model; Motivational interviewing.	Inpatient settings, post discharge	**− HbA1c levels,** − Anthropometrics, − Physical activity; − Diet outcomes.	Arecently described method.
(Pal et al., 2013) [68]; The Cochrane Library	Health status and HRQoL.	**Number of studies:** 16 studies; **Types of studies:** RCTs; **Total sample:** 3,578	Computer-based diabetes self-management intervention.	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-)	Nurse or other healthcare professionals.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** One session –	**Strategies:** Online/web-based; phone contact **Format:** Unclear; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**− HRQoL;** **− Death from any cause;** **↓ HbA1c;**	Formal meta-analyses and narrative

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		participants.		√ MED (-) √ PSY (-) ☐ SMOKING ☐ SELF		18 months.			− Cognitions; − Behaviours; −Social support; −Biological markers; − Complications.	synthesis.
(Nam, Janson, Stotts, Chesla, & Kroon, 2012) [62]; Journal of Cardiovascular Nursing	Glycemic control.	**Number of studies:** 12 RCTs; **Types of studies:** RCTs; **Total sample:** 1,495 participants.	Diabetes educational interventions (no drug intervention).	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) √ PSY (-) ☐ SMOKING √ SELF (-)	Nurses (36%), dieticians (36%), diabetes educators (5%), other professionals (9%) and nonprofessional staff (14%).	**Number of session:** 1 month or less; 1 to 3 months; and 12 months; **Total contact hours:** most studies did not describe, or from 1 session to more than 30 hours; **Duration:** from 1 session to 12 months, frequency: 1 session to 25 weekly or biweekly education.	**Strategies:** Teaching or counseling; home-based support; and visual aids. **Format:** group education or a combination of group education and individual counseling; or only individual counseling; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c level.**	Meta-analysis.
Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012) [76]; BMC Health Services Research	Clinical, lifestyle and psychosocial outcomes.	**Number of studies:** 21 studies (26 publications). **Types of studies:** RCTs; **Total sample:** 2,833 participants.	Group-based education.	Did not describe the content of the intervention.	Community workers; dietician; lay health advisors nurse and nutritionist.	**Number of session and Total contact hours:** 30 hours over 2.5 months, 52 hours over one year,and 36 hours or 96 hours over 6 months. **Duration:** Six months to two years.	**Strategies:** Face to face; **Format:** 5 to 8 participants group to 40 patients group. **Theoretical approach:** empowerment model and the discovery learning theory, the SCT and the social ecological theory, the self-efficacy and self-management theories and operant reinforcement theory.	Inpatient settings, post discharge, other	**↓ HbA1c,** **↑ Lifestyle outcomes,** **↑ Diabetes knowledge,** ↑ Self-management skills, ↑ Psychosocial outcomes, ↓ Mortality rate, ↓ BMI, ↓ Blood pressure; ↓ Lipid profile.	Meta-analysis using Review manager v5.
(Amaeshi,	Increasing	**Number of studies:**	Foot health	Food care.	Podiatrist,	**Number of session:**	**Strategies:** Face to face;	Unclear, did	**↓ LEA;**	Narrative

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2012) [32]; Podiatry Now	good foot health practices that will ultimately reduce LEA.	8 studies; **Types of studies:** RCT or clinical controlled trial (CCT); **Total sample:** Unclear.	education:		psychotogist or unclear.	Unclear; **Total contact hours:** between 15min and 14 hours; **Duration:** 3-30 months.	**Format:** In three of the studies, educational interventions were delivered to the participants in groups, while the other five provided individualized (one-to-one) foot-care education to the participants; **Theoretical approach:** Unclear.	not describe.	↑ Self-care.	synthesis.
(Kai Lun Gan, Brammer, & Creedy, 2011) [57]; JBI Library of Systematic Reviews	Oral hypoglycaemic adherence.	**Number of studies:** Seven studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Educational interventions.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) √ PSY (-) ☐ SMOKING √ SELF (-)	Nurses; pharmacists; other skilled healthcare professionals.	**Number of session:** 1-12 or unclear; **Total contact hours:** 2.5 hours or unclear; **Duration:** 4-12 months.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↓ **HbA1c,** − **Medication adherence;** ↓ Blood glucose; − Tablet count; − Medication containers; − Diabetes complications; − Health service utilization.	Narrative summary form.
(Burke et al., 2011) [38]; JBI Database of Systematic Reviews and Implementation Reports	HbAlc level,BP.	**Number of studies:** 11 RCTs and 4 quasi-experimental trials; **Types of studies:** RCTs and quasi-experimental trials; **Total sample:** 2,240 patients.	Group medical visits.	√ BEHA (-) √ DIET (-) ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Dndocrinologists; DM nurse; family physician; nutritionist and rehab therapist.	**Number of session:** 1-4 or unclear; **Total contact hours:** 2-4 hours or unclear; **Duration:** One session to 2 years.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	↓ **HbA1c;** − **Systolic and diastolic BP;** − LDL measurements.	Meta-analysis.
(Ramadas, Quek, Chan, & Oldenburg, 2011) [77];	HbAlc level.	**Number of studies:** 13 different studies; **Types of studies:** RCTs and quasi-experimental studies;	Web-based behavioural interventions.	√ BEHA (-) √ DIET (-) ☐ DR ☐ EXERCISE	Dietician; endocrinologist; physicians; researchers or research staff	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** ranged	**Strategies:** E-mail and SMS technologies that were commonly used together with the websites to reinforce the intervention, and Website, print material.	Inpatient settings, post discharge, other	− **Self-monitoring blood sugar,** − Weight-loss, − Dietary behaviour,	Not statistically combined and re-analyzed;

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International Journal of Medical Informatics		**Total sample:** Unclear.		√ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	members and study nurse.	between 12 and 52 weeks, with an average of 27.2 ± 18.3 weeks.	**Format:** Unclear; **Theoretical approach:** Wagner's Chronic Care Model; Self-efficacy theory/Social support theory; TTM; HBM; SCT.		− Physical activity.	
(Minet, Moller, Vach, Wagner, & Henriksen, 2010) [61]; Patient Education and Counseling	Glycaemic control.	**Number of studies:** Forty-seven studies; **Types of studies:** RCTs; **Total sample:** Unclear.	Self-care management interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Case nurse manager; group facilitator; nurse educator; multidisciplinary team; physiologist; physician; peer counsellor; researcher; and pharmacist.	**Number of session:** 3-26; **Total contact hours:** Unclear; **Duration:** 4 weeks to 4 years.	**Strategies:** Face to face; home visit; phone calls; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**↓ HbA1c.**	Meta-analyses and meta-regression used Stata's meta command.
Hawthorne, Robles, Cannings-John, & Edwards, 2010) [54]; Diabetic Medicine	Effects of culturally appropriate health education	**Number of studies:** 10 trials; **Types of studies:** RCTs; **Total sample:** 1603 patients.	Culturally appropriate health education	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	Exercise physiologists; dieticians; diabetes nurses; link workers, and podiatrists.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** one session to 12 months;	**Strategies:** Face to face; visual aids, leaflets and teaching materials; **Format:** group approach, one-to-one interviews and a mixed approach; **Theoretical approach:** SAT, Empowerment Behaviour Change Model, SCT, Management model and the Theory of Planned Behaviour.	Inpatient settings, post discharge, other	**−QoL;** **↓ HbA1c;** **− BP;** ↑ Knowledge; − BMI; ↓ Lipid levels, − Diabetic complications, − Mortality rates, hospital admissions, hypoglycaemia.	Meta - analysis using the Review Manager and narrative review.
(Fan & Sidani, 2009) [47]; Canadian	Knowledge, self-management	**Number of studies: 50 studies;** **Types of studies:** RCTs;	DSME intervention:	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE	Unclear, did not describe.	**Number of session:** 10 (range 1 to 28); **Total contact hours:** 17 contact hours (range 1 to	**Strategies:** Online/web-based (4%); video (2%); face-to-face (60%); phone contact (4%); Mixed (30%). **Format:** One-on-one (32%); Group	Inpatient settings, post discharge, other	**↑ Diabetes knowledge,** **↑ Self-management behaviours;**	Comprehensive Meta-Analysis (version

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Journal of Diabetes	behaviours and metabolic control.	**Total sample:** **Unclear.**		☐ GC ☐ MED √ PSY (-) ☐ SMOKING √ SELF (-)		52); ⩽ 10 (46%); 11-20 (21%); > 20 (33%); **Duration:** 22 weeks (range 1 to 48); ⩽ 8 weeks (26%); 9–24 weeks (37%); > 24 weeks (37%).	(40%); Mixed (28%). **Theoretical approach:** Unclear.		**↓ HbA1c,**	20).
(Duke, Colagiuri, & Colagiuri, 2009) [46]; The Cochrane Library	Metabolic control, diabetes knowledge and psychosocial outcomes.	**Number of studies:** Nine studies; **Types of studies:** RCTs; **Total sample:** 1,359 participants.	Individual patient education.	√ BEHA (-) ☐ DIET ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Diabetes educators and dieticians.	**Number of session:** 1-6; **Total contact hours:** 20 min – 7 hours; **Duration:** 4 weeks – 1 year.	**Strategies:** Face to face; telephone; **Format:** Individual; **Theoretical approach:** Unclear.	Inpatient settings	**– HbA1c;** **– Diabetes complications;** – Health service utilisation and health care costs; – Psychosocial outcomes; – Diabetes knowledge; patient self-care behaviours; – Physical measures; metabolic.	Meta-analysis.
(Alam, Sturt, Lall, & Winkley, 2009) [30]; Patient Education and Counseling	Glycaemic control and psychological status.	**Number of studies:** 35 trials; **Types of studies:** RCTs; **Total sample:** 1431 patients.	Psycho-educational Interventions.	√ BEHA (-) ☐ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Generalists; psychological specialists; or did not report the specialist	**Number of session:** 1-16; **Total contact hours:** 20 min – 28 hours; **Duration:** about 13.7 (±11.06) weeks.	**Strategies:** Face to face; telephone calls; **Format:** group format; a single format and used a combination; **Theoretical approach:** TTM; motivational interviewing;	Inpatient settings, other	**↓ HbAlc;** **↓ Psychological distress.**	Meta-analysis.
Khunti, Camosso-	Knowledge and	**Number of studies:** nine studies;	Any educational	☐ BEHA √ DIET ☐	Unclear, did not describe.	**Number of session:** Unclear;	**Strategies:** Face to face; **Format:** Group and individual;	Unclear, did not describe.	**– Knowledge;** **– Psychological and**	Unclear.

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Stevanovic, Carey, Davies, & Stone, 2008) [58]; Diabetic Medicine	biomedical outcomes.	**Types of studies:** RCTs and RCT was followed by a before-and-after study; **Total sample:** 1004 patients.	intervention.	DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING ☐ SELF		**Total contact hours:** Unclear; **Duration:** 3- 12 months.	**Theoretical approach:** Unclear.		**biomedical outcome measures.**	
(Loveman, Frampton, & Clegg, 2008) [60]; Health Technology Assessment	Clinical effectiveness.	**Number of studies:** Twenty-one published trials; **Types of studies:** RCTs and CCTs; **Total sample:** Unclear.	Educational interventions.	√ BEHA (++) √ DIET (+++) ☐ DR √ EXERCISE (+++) √ GC (+++) ☐ MED ☐ PSY ☐ SMOKING √ SELF (+++)	Community workers; diabetes research technician; diabetes nurse, dieticians; educationalist; medical students; nurses; pharmacists; physician, or physician assistant.	**Number of session:** Two to four intensive education of 1.5 to 2 hours followed up with additional education at, 3 and 6 months; **Total contact hours and Duration:** about 150 mins over a 6-month or 61 to 52 hours over one year.	**Strategies:** Face to face; **Format:** Group and individual; **Theoretical approach:** cognitive-behavioural strategies; pedagogical principle.	Inpatient settings, post discharge, other	− **Diabetic control outcomes**; − Diabetic end-points; − QoL and cognitive measures.	Narrative review
(Wens et al., 2008) [78]; Diabetes Research and Clinical Practice	Improving adherence to medical treatment recommendations.	**Number of studies:** 8 studies; **Types of studies:** RCTs and controlling before and after studies. **Total sample:** 772 patients.	Interventions aimed at improving adherence to medical treatment.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING √ SELF (-)	Diabetes educator; nurse or did not describe.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** ~ 9 months or unclear.	**Strategies:** Face-to-face; telephone; **Format:** face-to-face; group based and telemedicine; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	− **Adherence;** − HbA1c; − Blood glucose.	Cochrane Review Manager software.

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(Hawthorne, Robles, Cannings-John, & Edwards, 2008) [53]; The Cochrane Library	HbAlc level, Knowledge and clinical outcomes.	**Number of studies:** A total of 11 trials; **Types of studies:** RCTs; **Total sample:** 1,603 patients.	Culturally appropriate (or adapted) health education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED ☐ PSY √ SMOKING (-) ☐ SELF	Dieticians, diabetes nurses, exercise physiologists; link workers; podiatrists; psychologist and and non-professional link worker.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** one session to 12 months.	**Strategies:** Face-to-face; booklet; **Format:** Group intervention method; one to one interviews; mixture of the two methods; purely interactive patient-centred method; semi-structured didactic format and combination of the 2 approaches. **Theoretical approach:** SAT; Empowerment Behaviour Change Model; Behaviour Change Theory; SCT, Management Model and the Theory of Planned Behaviour.	Inpatient settings, post discharge, other	**↓ HbA1c** **↑ Knowledge scores** − Other outcome measures	Narrative presentation and meta-analysis.
(Nield et al., 2007) [63]; The Cochrane Library	Metablic control.	**Number of studies:** 36 articles (18 trials); **Types of studies:** RCTs; **Total sample:** 1,467 participants.	Dietary advice.	☐ BEHA √ DIET ☐ DR ☐ EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING ☐ SELF	exercise physiologist; dietitian; group facilitator; nutritionist; nurse educator; and physician.	**Number of session:** 1-12; **Total contact hours:** 20 min-22 hours; **Duration:** 11 weeks – 6months or unclear.	**Strategies:** Face-to-face; **Format:** Group and individual; **Theoretical approach:** Unclear.	Inpatient settings, post discharge, other	**− Weight;** **− Diabetic complications;** **− HbA1c;** − QoL; − Medication use; − Cardiovascular disease risk;	Meta-analysis.
(Zabaleta & Forbes, 2007) [79]; British Journal of Community Nursing	Clinical effectiveness.	**Number of studies:** 21 studies; **Types of studies:** Controlled trials; **Total sample:** Unclear.	Structured group diabetes education.	√ BEHA (-) √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) ☐ MED √ PSY (-) ☐ SMOKING ☐ SELF	Diabetes nurse educator; physician's assistant; and physicians;	**Number of session:** 4-6 or unclear; **Total contact hours:** 6-12 hours or unclear; **Duration:** 1-6 months or unclear.	**Strategies:** Face to face; **Format:** Group; **Theoretical approach:** Unclear.	Post discharge.	**−HbA1c.**	A tabulative synthesis.

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(Deakin; McShane, Cade, & Williams, 2005) [43]; The Cochrane Library	Clinical, lifestyle and psychosocial outcomes.	**Number of studies:** 14 publications, reporting 11 studies; **Types of studies:** RCTs, and CCTs; **Total sample:** 1,532 participants.	Group-based educational programmes.	Did not describe the content of the intervention.	Health professionals, lay health advisors.	**Number of session:** Unclear; **Total contact hours:** from 6 to 52 hours; **Duration:** 3 hours per year for 2 years and 3 or 4 hours per year for 4 years.	**Strategies:** Unclear; **Format:** Group; **Theoretical approach:** the Diabetes Treatment and Teaching Programme (DTTP); empowerment model; adult learning model, public health model, HBM and TTM.	Inpatient settings, post discharge	**↓ Metabolic control;** **↑ Diabetes knowledge;** ↑ QoL; ↑ Empowerment/self-efficacy.	Summarized statistically
(Vermeire et al., 2005) [80]; The Cochrane Library	Improving adherence to treatment recommendations.	**Number of studies:** 21 articles; **Types of studies:** RCTs; cross-over study; controlled trial; controlled before and after studies; **Total sample:** 4,135 patients.	Interventions that were aimed at improving the adherence to treatment recommendations.	☐ BEHA ☐ DIET ☐ DR ☐ EXERCISE √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Nurse, pharmacist and other healthcare professionals.	**Number of session:** Unclear; **Total contact hours:** Unclear; **Duration:** Unclear.	**Strategies:** Face to face; telephone; home visit; video; mailed educational materials; **Format:** Unclear. **Theoretical approach:** Unclear.	Inpatient settings, post discharge	**Direct indicators,** such as ↓ Blood glucose level; – Indirect indicators, such as pill counts; –Health outcomes.	A descriptive review and sub-group meta-analysis.
(Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003) [49]; Diabetes Educator	Body weight and glycaemic control.	**Number of studies:** Sixty-three RCTs; **Types of studies:** RCTs; **Total sample:** 2,720 patients.	Educational and behavioural component interventions.	☐ BEHA √ DIET (-) ☐ DR √ EXERCISE (-) √ GC (-) √ MED (-) ☐ PSY ☐ SMOKING ☐ SELF	Nurse (39%); dietitian (26%); physician (17%); other or not specified (23%); other professional (13%); psychologist (9%); Exercise psychologist (9%); and health educator (4%).	**Number of session:** Unclear; **Total contact hours:** Unclear. **Duration:** 1 month to 19.2 months.	**Strategies:** Unclear; **Format:** Unclear; **Theoretical approach:** SAT, contracting model and patient empowerment.	Inpatient settings, post discharge	**– Glycaemic control;** **– Weight.**	Sufficient data were combined using meta-analysis.
(Norris, Lau, Smith,	Total GHb.	**Number of studies:** 31 studies	Self-management	√ BEHA (-) √ DIET (-)	Dietitian; lay health care	**Number of session:** 6 (1–36);	**Strategies:** Online/web-based; video ; face-to-face; phone contact;	Inpatient settings, post	**↓ Total GHb,**	Meta-analysis and

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Schmid, & Engelgau, 2002) [65]; Diabetes Care		**Types of studies:** RCTs. **Total sample:** 4,263 patients.	education.	☐DR ☐EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	worker; nurse; physician with team; self (e.g. computer assisted instruction); and team (nurse, dietitian, etc.).	**Total contact hours:** 9.2 (1–28) hours; **Duration:** 6 (1.0–27) months.	**Format: Group;** individual and mixed; **Theoretical approach:** Unclear	discharge, other		meta regression.
(Norris, Engelgau, & Narayan, 2001) [64]; Diabetes Care	Clinical outcomes,Knowledge, Metablic control.	**Number of studies:** 72 studies (84 papers); **Types of studies:** RCTs; **Total sample:** Unclear.	Self-management training interventions.	√ BEHA (-) √ DIET (-) ☐ DR ☐EXERCISE ☐ GC ☐ MED ☐ PSY ☐ SMOKING √ SELF (-)	CHWs; nurse; or other healthcare professionals.	**Number of session:** 1-16; **Total contact hours:** ～22 hours; **Duration:** ～26 months.	**Strategies:** Online/web-based; video (2%); face-to-face; phone contact; **Format:** Group; individual and mixed; **Theoretical approach:** SAT; Fishbein and Ajzen HBM.	Inpatient settings, post discharge, other	**↑ Knowledge; ↑ Lifestyle behaviors; −Psychological and QoL outcomes; ↑ Glycemic control**; − Cardiovascular disease risk factors.	Outcomes are summarized in a qualitative fashion.

NOTE:

SMOKING= Smoking cessation; CVR= Cardiovascular risk factors; PSY =Psychosocial issues (depression, anxiety); DIET =Diet; EXERCISE= Exercise; MED= Medication; BEHA = Behavioral charge (including lifestyle modification); SELF = Self-management (including problems solving); GC= glycemic regulation; DR =Diabetes risks; CHD= Coronary heart disease; CAD = Coronary Artery Disease; CHW=Community Health Worker; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; LDL = Low-density Lipoprotein Cholesterol; SMS = Short Message Service; BCTs = Behavioral Change Techniques; LEA = Lower Extremity Amputation; PRIDE = Problem Identification, Researching one's routine, Identifying a management goal, Developing a plan to reach it, Expressing one's reactions and Establishing rewards for making progress; ASE = Attitude-social influence-efficacy; CVRF= Cardiovascular Risk Factors; SMS = Short Message System; PA = Physical Activity; EDU = Patient Education; GP= General Practice; RCTs =Randomized controlled trials; CCTS = controlled clinical trials; HRQoL = Health Related Quality of Life; QoL = Quality of Life; MI = Myocardial Infarction; CAD = Coronary Artery Disease; CABG= Coronary Artery Bypass Graft Surgery; T2DM = Type 2 Diabetes Mellitus; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP =Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; DSME = Diabetes Self-management Education; DSM = Diabetes Self-management; TTM= Transtheoretical Model; SCT=Social Cognitive Theory; HBM =Health Belief Model; SAT=Social Action Theory;

In the educational content: "+": minor focus; "++":moderate focus; "+++" major focus; "-" =unclear what the intensity of the education was for any topic;

In the outcomes: arrow up (" ↑ ") for improvement, arrow down (" ↓ ") for reduction; a dash ("−") for no change or inconclusive evidence.

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Table 4. Summary of evidence from quantitative research syntheses

Intervention	Number of systematic reviews/meta-analysis, Total participants	First author, Year	Primary Results/findings		Rating the evidence of effectiveness
Acute Coronary Syndrome Patients					
General health education	Six/161,997patients (Goulding et al., 2010 did not given the total sample size)	Ghisi et al., 2014 [50]	Knowledge	91% studies (+)	Some evidence
			Behavior	77%/84%/65% studies (+)	
			Psychosocial indicators	43% studies (+)	
		Brown et al., , 2013 [37]	Mortality		
			MI		
			Revascularizations		
			Hospitalizations		
			HRQoL		
			Withdrawals/drop outs		
			Healthcare utilization and costs		
		Brown et al., 2011 [70]	Total mortality		
			MI		
			CABG		
			Hospitalisations		
			HRQoL	63.6% studies (+)	
			Healthcare costs	40% studies (+)	
			Withdrawal/drop out		
		Goulding et al., 2010 [51]	Beliefs	30.08% studies (+)	
			Secondary outcomes		
			Smoking		
			Cholesterol level		

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		Fernandez et al., 2007 [48]	Multiple risk factor modification		
		Kotb, Hsieh, & Wells, 2014 [59]	All-cause hospitalization		
			All-cause mortality		
			Smoking cessation		
			Depression		
			Systolic blood pressure		
			Low-density lipoprotein		
			Anxiety		
Psychoeducational interventions	Six/ 37,883 patients	Barth et al., 2015 [69]	Abstinence by self-report or validated		Sufficient evidence
		Dickens et al., 2013 [45]	Depression		
		Aldcroft et al., 2011 [31]	Smoking cessation		
			Physical activity		
		Huttunen-Lenz et al.,2010 [56]	Prevalent smoking cessation		
			Continuous smoking cessation		
			Total mortality		
		Barth et al., 2008 [36]	Abstinence by self-report or validated		
			Smoking status		
		Barth et al., 2006 [35]	Abstinence		
			Smoking status		
Secondary prevention educational interventions	Three/25,154 patients	Devi et al., 2015 [44]	Mortality		
			Revascularisation		
			Total Cholesterol		
			HDL cholesterol		
			Triglycerides		
			HRQOL		
			All-cause mortality		

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(including Internet based secondary prevention)		Auer et al., 2008 [34]	Readmission rates		Some evidence
			Reinfarction rates		
			Smoking cessation rates		
		Clark et al., 2005 [41]	Mortality		
			MI		
			Quality of life	Most of the included studies (+)	
Type 2 Diabetes Mellitus Patients					
General health education	Five/2,319 patients (Choi et al., 2016; Loveman et al., 2008; Zabaleta et al., 2007 did not given the total sample size)	Choi et al., 2016 [40]	HbA1c		Some evidence
		Saffari et al., 2014 [74]	Glycemic control		
		Duke et al., 2009 [46]	HbA1c		
			BP		
			Knowledge, psychosocial outcomes and smoking habits	No Data	
			Diabetes complications or health service utilization and cost analysis	No Data	
		Loveman et al., 2008 [60]	Diabetic control outcomes	46.15% studies (+)	
			Weight	66.67% studies (+)	
			Cholesterol or triglycerides	40.00% studies (+)	
		Zabaleta et al., 2007 [79]	HbA1c	4.8% studies (+)	
		Creamer et al., 2016 [42]	HbA1c		
			HRQoL		
			AEs	No AEs	
		Ricci-Cabello et al., 2014 [73]	HbA1c		
			Diabetes knowledge	73.3% studies (+)	
			Behaviors	75% studies (+)	
			Clinical outcomes	Fasting blood glucose, HbA1c	

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				and BP improved in 71%, 59%, and 57% of the studies.	
Culturally appropriate health education	Eight/ 20,622 patients (Ricci-Cabello et al., 2014 and Gucciardi et al., 2013 did not given the total sample size)	Attridge et al., 2014 [33]	HbA1c		Some evidence
			Knowledge scores		
			Clinical outcomes		
			Other outcome measures	Showed neutral effects.	
		Gucciardi et al., 2013 [52]	HbA1c levels	Three of ten studies (+)	
			Anthropometrics	Three of eleven studies (+)	
			Physical activity	One of five studies (+)	
			Diet outcomes	Two of six studies (+)	
		Nam et al., 2012 [62]	HbA1c level		
		Hawthorne et al., 2010 [54]	HbA1c		
			Knowledge scores		
		Khunti et al., 2008 [58]	Knowledge levels	Only one study reporting a significant improvement	
			Biomedical outcomes	Only one study reporting a significant improvement.	
		Hawthorne et al., 2008 [53]	HbA1c		
			Knowledge scores		
			Other outcome measures		
		Huang et al., 2016 [55]	HbA1c		
			BMI		
			LDL-c and HDL-c		
		Chen et al., 2015 [39]	HbA1c		
			BMI		
			SBP		
			DBP		
			HDL-c		

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Lifestyle interventions + behavioral program	Six/10,440 patients (Huang et al., 2016; Pillay et al., 2015 and Ramadas et al., 2011 did not given the total sample size)	Terranova et al., 2015 [72]	HbA1c level		Some evidence
			Weight		
		Pillay et al., 2015 [71]	HbA1c levels		
			BMI		
		Ramadas et al., 2011 [77]	HbA1c	46.2% studies (+)	
		Gary et al., 2003 [49]	Fast blood sugar		
			Glychemoglobin		
			HbA1		
			HbA1c		
			Weight		
Self-management educational interventions	Nine/19,597 patients (Minet et al., 2010;Fan et al., 2009 and Norris et al., 2001 did not given the total sample size)	Pal et al., 2014 [67]	Cardiovascular Risk Factors		
			Cognitive Outcomes		
			Behavioral Outcomes	Only one study reporting a significant improvement.	
			AEs	No AEs	
		Vugt et al., 2013 [75]	Health behaviors	Seven of 13 studies (+)	
			Clinical outcomes measures	Nine studies (+)	
			Psychological outcomes	Nine studies (+)	
		Pal et al., 2013 [68]	HbA1c		
			Depression		
			Quality of life		
			Weight		
		Steinsbekk, et al., 2012 [76]	HbA1c		
			Main lifestyle outcomes		
			Main psychosocial outcomes		
		Minet et al., 2010 [61]	Glycaemic control		
			Diabetes knowledge		
			Overall self-management		

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			behaviours		
		Fan et al., 2009 [47]	Overall metabolic outcomes		
			Overall weighted mean effect sizes		Sufficient evidence
		Deakin et al., 2005 [43]	Metabolic control (HbA1c)		
			Fasting blood glucose levels		
			Weight		
			Diabetes knowledge		
			SBP		
			Diabetes medication		
		Norris et al.,, 2002 [65]	Total GHb		
		Norris et al., 2001 [64]	Knowledge		
			Self-monitoring of blood glucose		
			Self-reported dietary habits		
			Glycemic control		
Therapeutic education	One/Total sample: Unclear.	Odnoletkova et al., 2014 [66]	Cost-effectiveness	Overall high in studies on prediabetes and varied in studies on T2DM.	Insufficient evidence
Foot health education	One/ Total sample: Unclear.	Amaeshi, 2012 [32]	Diabetes complications		Some evidence
			Incidence of LEA		
Group medical visit	One/2,240 patients.	Burke et al., 2011 [38]	HbA1c		Some evidence
			BP and DBP		
			SBP		
			Cholesterol - LDL		
Psychoeducational intervention.	One/1.431 patients.	Alam et al., 2009 [30]	HbA1c		Some evidence
			Psychological status		
Interventions aimed at improving adherence to	Three/ 4,907 patients (Kai Lun Gan et al., 2011 did not	Kai Lun Gan et al., 2011 [57]	Oral hypoglycaemic adherence	Five of seven studies (+)	

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medical treatment recommendations	given the total sample size)	Wens et al., 2008 [78]	Adherence	General conclusions could not be drawn.	Some evidence
		Vermeire et al., 2005 [80]	HbA1c		
Dietary advice	One/1,467 patients	Nield et al., 2007 [63]	Glycaemic control (addition of exercise to dietary advice)		Insufficient evidence to determine
			Weight	Limited Data	
			Diabetic micro- and macrovascular diseases	Limited Data	

NOTE:

RCTs =Randomized controlled trials; HRQoL = Health Related Quality of Life; MI = Myocardial Infarction; CABG= Coronary Artery Bypass Graft Surgery; T2DM = Type 2 Diabetes Mellitus; BMI = Body Mass Index; HbA1c = Glycatedhemoglobin; BP = Blood Pressure; SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, HDL-c= High-density Lipoprotein Cholesterol; LDL-c = Low-density Lipoprotein Cholesterol; LEA = Lower Extremity Amputation; Adverse Events = AEs.

（+）：Intervention Group is Significantly Better than Control Group; For example: “91% studies (+)” means 91% studies reported a significant better compared with control group;

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Table 5 Recommendations of health education programs for ACS and T2DM patients

		ACS patients	T2DM patients	Both ACS and T2DM
Theoretical approach		SCT, empowerment theories.	HBM; SCT.	HBM; SCT and empowerment theories.
Behavioral strategies		Goal setting	Goal setting	Goal setting
Educational content		Behavioral change (such as smoking cessation), cardiovascular risk factors, exercise, medication, and psychosocial issues.	Behavioral change, diet, exercise, glycemic control, medication, and self-management.	Behavioral change (such as smoking cessation), cardiovascular risk factors, diet, exercise, glycemic control, medication, psychosocial issues, and self-management.
Healthcare professionals to deliver		Nurse or multidisciplinary team	Multidisciplinary team; dietitian or nurse	Nurse or multidisciplinary team
Teaching approaches	Strategies	Face-to-face; telephone or mixed	Face to face, written materials; telephone or mixed	Face to face, written materials; telephone contact or mixed
	Format	Individual (One by one) or mixed	Individual (One by one) or mixed	Individual (One by one) or mixed
Delivery timing	Contact hours	More than 30 min per time per week	More than 30 min per time per week	More than 30 min per time per week
	Duration	At least 6 months	About 6 months	At least 6 months
Duration of follow up		At least 12 months	At least 12 months	At least 12 months
Settings		Inpatient and post-discharge settings	Hospital settings and primary care settings	Inpatient and post-discharge settings

Note: ACS = acute coronary syndrome; T2DM = type 2 diabetes mellitus; SCT=Social Cognitive Theory; HBM =Health Belief Model.

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Fig. 1. Flow chart of the systematic reviews and meta-analyses selection process

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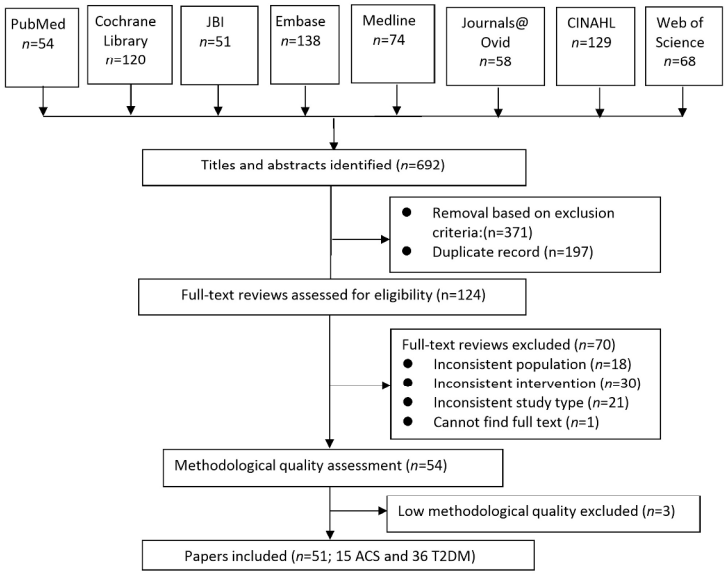

Fig. 1. Flow chart of the systematic reviews and meta-analyses selection process

Fig. 1. Flow chart of the systematic reviews and meta-analyses selection process

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Supplementary Annex 1. Searching Strategies

Items	Searching Strategy	Results
	PubMed	
#1	((((((((((Acute Coronary Syndrome[MeSH Terms]) OR Myocardial Infarction[MeSH Terms]) OR Angina, Unstable[MeSH Terms]) OR Coronary Artery Disease[MeSH Terms]) OR Coronary Artery Bypass[MeSH Terms]) OR Angina Pectoris[MeSH Terms]) OR "Myocardial Infarct*"[Title/Abstract]) OR "Unstable Angina*"[Title/Abstract]) OR "coronary heart diseas*"[Title/Abstract]) OR "Coronary Artery Disease*"[Title/Abstract]) OR "Unstable Angina Pectori*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	145310
#2	(((((Diabetes Mellitus, Type 2[MeSH Terms]) OR "Type 2 Diabetes Mellitus"[Title/Abstract]) OR "type 2 diabete*"[Title/Abstract]) OR "type ii diabet*"[Title/Abstract]) OR T2DM[Title/Abstract]) OR Adult-Onset Diabetes Mellitus[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	80218
#3	#1 OR #2	222103
#4	(((((((Health Education[MeSH Terms]) OR Patient Education as Topic[MeSH Terms]) OR Counseling[MeSH Terms]) OR Social Support[MeSH Terms]) OR "Community Health Education*"[Title/Abstract]) OR "Educational Activit*"[Title/Abstract]) OR "Education* intervention*"[Title/Abstract]) OR "Education* program*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	122323
#5	(((Meta-Analysis [Publication Type]) OR Meta-Analysis as Topic[MeSH Terms]) OR "Systematic Revie*"[Title/Abstract]) OR "Meta-analys*"[Title/Abstract] Filters: Publication date from 2000/01/01 to 2016/04/31; English	165265
#6	#3 AND #4 AND #5 Filters: Publication date from 2000/01/01 to 2016/04/31; English	**54**
	Cochrane Library	
#1	MeSH descriptor: [Acute Coronary Syndrome] explode all trees	1070
#2	MeSH descriptor: [Myocardial Infarction] explode all trees	9450
#3	MeSH descriptor: [Angina, Unstable] explode all trees	1015
#4	MeSH descriptor: [Coronary Artery Disease] explode all trees	3469

#5	MeSH descriptor: [Coronary Artery Bypass] explode all trees	5321
#6	MeSH descriptor: [Angina Pectoris] explode all trees	4240
#7	"acute coronary syndrome":ti,ab,kw or Unstable Angina*:ti,ab,kw or Myocardial Infarct*:kw or coronary heart diseas*:ti,ab,kw or Coronary Artery Disease*:ti,ab,kw (Word variations have been searched)	29379
#8	#1 or #2 or #3 or #4 or #5 or #6 or #7	34062
#9	MeSH descriptor: [Diabetes Mellitus, Type 2] explode all trees	10474
#10	Type 2 Diabetes Mellitus:ti,ab,kw or type ii diabet*:ti,ab,kw or noninsulin dependent:ti,ab,kw or type 2 diabet*:ti,ab,kw or Adult-Onset Diabetes Mellitus:ti,ab,kw (Word variations have been searched)	20935
#11	#9 or #10	20937
#12	#8 or #11	53777
#13	MeSH descriptor: [Health Education] explode all trees	11291
#14	MeSH descriptor: [Patient Education as Topic] explode all trees	7507
#15	MeSH descriptor: [Counseling] explode all trees	4026
#16	MeSH descriptor: [Rehabilitation Nursing] explode all trees	55
#17	Education*:ti,ab,kw or Community Health Education:ti,ab,kw or Self-Management*:ti,ab,kw or Cardiac Rehabilitation:ti,ab,kw (Word variations have been searched)	40078
#18	#13 or #14 or #15 or #16 or #17	42943
#19	#12 and #18 Publication Year from 2000 to 2016, in Cochrane Reviews (Reviews only) and Other Reviews	120
#20	Cochrane reviews + other reviews	**49 + 71=120**
	Joanna Briggs Institute, Embase, MEDLINE	
#1	Acute Coronary Syndrome.m_titl.	16727
#2	Myocardial Infarction.m_titl.	151398

#3	Unstable Angina.m_titl.	6933
#4	Coronary Artery Disease.m_titl.	54621
#5	Coronary Artery Bypass.m_titl.	30449
#6	Angina Pectoris.m_titl.	17997
#7	Coronary Heart Disease.m_titl.	35397
#8	#1 or #2 or #3 or #4 or #5 or #6	305035
#9	Type 2 Diabetes Mellitus.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	64926
#10	"type 2 diabet*".m_titl.	102596
#11	"type ii diabet*".m_titl.	6139
#12	Adult-Onset Diabetes Mellitus.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	307
#13	#9 or #10 or #11 or #12	136982
#14	#8 or #13	439243
#15	Health Education.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	177285
#16	Patient Education.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	185631
#17	Counseling.m_titl.	23527
#18	Social Support.m_titl.	11535
#19	"Education*".m_titl.	247901
#20	#15 or #16 or #17 or #18 or #19	577203
#21	#14 and #20	6480
#22	Systematic Review.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	212014
#23	Meta-Analysis.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	262009
#24	#22 or #23	381113

#25	#21 and #24	288
#26	limit 25 to English and yr="2000 - 2016"	**263**
	Cumulative Index to Nursing and Allied Health Literature (CINAHL)	
#1	TI Acute Coronary Syndrome OR AB Acute Coronary Syndrome	4826
#2	TI Myocardial Infarction OR AB Myocardial Infarction	24578
#3	TI Unstable Angina OR AB Unstable Angina	1353
#4	TI Coronary Artery Disease OR AB Coronary Artery Disease	12930
#5	TI Coronary Heart Disease OR AB Coronary Heart Disease	12321
#6	#1 OR #2 OR #3 OR #4 OR #5	46436
#7	TI Type 2 Diabetes Mellitus OR AB Type 2 Diabetes Mellitus	8952
#8	TI type 2 diabet* OR AB type 2 diabet*	33085
#9	TI Adult-Onset Diabetes Mellitus OR AB Adult-Onset Diabetes Mellitus	23
#10	#7 OR #8 OR #9	33097
#11	#6 OR #10	77923
#12	TI Health Education OR AB Health Education	53415
#13	TI Patient Education OR AB Patient Education	37789
#14	TI Counseling OR AB Counseling	17673
#15	TI Social Support OR AB Social Support	30093
#16	TI Education* OR AB Education*	188291
#17	#12 OR #13 OR #14 OR #15 OR #16	227269
#18	#11 AND #17	4707
#19	TI Systematic Review OR AB Systematic Review	48830

#20	TI Meta-Analysis OR AB Meta-Analysis	28776
#21	#19 OR #20	64611
#22	S18 AND S21 Limiters - Published Date: 20000101-20160431; English Language	**129**
	Web of Science	
#1	TS=("Acute Coronary Syndrome*") OR TS=("Myocardial Infarct*") OR TS=("Unstable Angina") OR TS=("Coronary Artery Disease*") OR TS=("Coronary heart disease*") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	404699
#2	TS=("Type 2 Diabetes Mellitus") OR TS=("type 2 diabete*") OR TS=("Noninsulin-Dependent Diabete*") OR TS= ("Adult-Onset Diabetes Mellitus") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	103548
#3	#2 OR #1 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	495081
#4	TS=("Health Education") OR TS=("Patient Education") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	29830
#5	#4 AND #3 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	1290
#6	TS=("Systematic Review*") OR TS=("Meta-analysis*") Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years	149663
#7	(#6 AND #5) AND LANGUAGE: (English) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=2000-2016	**68**
	Journals@Ovid	
#1	Acute Coronary Syndrome.m_titl.	3021
#2	Myocardial Infarction.m_titl.	24269
#3	Unstable Angina.m_titl.	1038
#4	Coronary Artery Disease.m_titl.	10106
#5	Coronary Artery Bypass.m_titl.	6546
#6	Angina Pectoris.m_titl.	1480

#7	Coronary Heart Disease.m_titl.	6487
#8	#1 or #2 or #3 or #4 or #5 or #6	51548
#9	Type 2 Diabetes Mellitus. m_titl.	5097
#10	"type 2 diabet*".m_titl.	26434
#11	"type ii diabet*".m_titl.	980
#12	Adult-Onset Diabetes Mellitus. m_titl.	391
#13	#9 or #10 or #11 or #12	27795
#14	#8 or #13	78792
#15	Health Education. m_titl.	1135
#16	Patient Education. m_titl.	1556
#17	Counseling.m_titl.	5532
#18	Social Support.m_titl.	2667
#19	"Education*".m_titl.	50950
#20	#15 or #16 or #17 or #18 or #19	58969
#21	#14 and #20	510
#22	Systematic Review.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	117790
#23	Meta-Analysis.mp. [mp=ti, ab, ot, nm, hw, kf, px, rx, ui, an, tx, sh, ct, sa, tn, dm, mf, dv, kw]	215069
#24	#22 or #23	282984
#25	#21 and #24	61
#26	limit 26 to yr="2000 - 2016"	**58**

Supplementary Annex 2.

Citation Matrix: Non-repeated trials (rows) included in the 15 systematic review and/or meta-analyses (column)--ACS.

Author-year (Trial reference)	Barth, Jacob, Daha, & Critchley, 2015	Devi et al., 2015	Ghisi, Abdallah, Grace, Thomas, & Oh, 2014	Kotb, Hsieh, & Wells, 2014	Brown, Clark, Dalal, Welch, & Taylor, 2013	Dickens et al., 2013	Aldcroft, Taylor, Blackstock, & O'Halloran P, 2011	Brown, Clark, Dalal, Welch, & Taylor, 2011	Huttunen-Lenz, Song, & Poland, 2010	Goulding, Furze, & Birks, 2010	Auer, Gaume, Rodondi, Cornuz, & Ghali, 2008	J. Barth, Critchley, & Bengel, 2008	Fernandez et al., 2007	J. Barth, Critchley, & Bengel, 2006	Clark, Hartling, Vandermeer, & McAlister, 2005
Allen JK. Coronary risk factor modification in women after coronary artery bypass surgery. Nursing Research 1996;45(5):260-5.	X											X			
Burt A, Thornley R, Illingworth D, White P, Shaw TR, Turner R. Stopping smoking after myocardial infarction. Lancet 1974;1(7852):304-6.	X											X		X	
Carlsson R, Lindberg G, Westin L, Israelsson B. Influence of coronary nursing managment follow up on lifestyle after acute myocardial infarction. Heart 1997;77(3):256-9.	X											X			
Ockene J, Kristeller JL, Goldberg R, Ockene I, Merriam P, Barrett S, et al. Smoking cessation and severity of disease: the Coronary Artery Smoking Intervention Study. Health Psychology 1992;11(2):119-26.	X											X		X	
DeBusk R, Miller NH, Superko R, Dennis CA, Thomas RJ, et al. A case-management system for coronary risk factor modification after acute myocardial infarction. Annals of Internal Medicine 1994;120(9):721-9.	X										X	X			X
Dornelas EA, Sampson RA, Gray J F, Waters D, Thompson PD. A randomized controlled trial of smoking cessation counseling after myocardial infarction. Preventive Medicine 2000;30(4):261-8.	X								X			X	X	X	
Hajek P, Taylor TZ, Mills P. Brief intervention during hospital admission to help patients to give up smoking after myocardial infarction and bypass surgery: randomised controlled trial. BMJ 2002;324:87-9.	X								X			X	X	X	
Heller RF, Knapp JC, Valenti LA, Dobson AJ. Secondary prevention after acute myocardial infarction. American Journal of Cardiology 1993;72(11):759-62.	X											X	X	X	
Moreno Ortigosa A, Ochoa Gomez FJ, Ramalle-Gomara E, Saralegui Reta I, Fernandez Esteban MV, Quintana Diaz M. Efficacy of an smoking cessationg intervention for patients with myocardial infarction [Eficacia de una intervencion para dejar de fumar en pacientes con infarto de miocardio]. Medicina Clinica 2000;114:209-10.	X											X		X	
Quist-Paulsen P, Gallefoss F. Randomised controlled trial of smoking cessation intervention after admission for coronary heart disease. BMJ 2003;327(7426):1254-7.	X								X			X		X	
Reid R, Pipe A, Higginson LK, D'Angelo MS, Cooke D, Dafoe W. Stepped care approach to smoking cessation in patients hospitalized for coronary artery disease. Journal	X											X		X	

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of Cardiopulmonary Rehabilitation 2003;23(3):176-82.															
Rigotti NA, McKool KM, Shiffmann S. Predictors of smoking cessation after coronary artery bypass graft surgery. Annals of Internal Medicine 1994;120(4):287-93.	x								x			x		x	
Sivarajan ES, Newton KM, Almes MJ, Kempf TM, Mansfield LW, Bruce RA. Limited effects of outpatient teaching and counseling after myocardial infarction: a controlled study. Heart & Lung 1983;12(1):65-73.	x													x	
Taylor CB, Houston-Miller N, Killen JD, DeBusk RF. Smoking cessation after acute myocardial infarction: effects of a nurse-managed intervention. Annals of Internal Medicine 1990;113(2):118-23.	x								x				x	x	
Van Elderen T, Maes S, Seegers G. Effects of a group health education program for coronary heart patients after the hospitalization phase. Tijdschrift voor Psychologie & Gezondheid 1991;19(3):129-44.	x											x			
van Elderen-van Kemenade T, Maes S, van den Broek Y. Effects of a health education programme with telephone follow-up during cardiac rehabilitation. British Journal of Clinical Psychology 1994;33(Pt 3):367-78.	x		x	x							x	x		x	
Antypas K, Wangberg SC. An Internet- and mobile-based tailored intervention to enhance maintenance of physical activity after cardiac rehabilitation: short-term results of a randomized controlled trial. Journal of Medical Internet Research 2014;16(3):e77.		x													
Devi R, Powell J, Singh S. A web-based program improves physical activity outcomes in a primary care angina population: randomized controlled trial. Journal of Medical Internet Research 2014;16(9):e186.		x													
Frederix I, Van Driessche N, Hansen D, Berger J, Bonne K, Alders T, et al. Increasing the medium-term clinical benefits of hospital-based cardiac rehabilitation by physical activity telemonitoring in coronary artery disease patients. European Journal of Preventive Cardiology 2015;22(2):150-8.		x													
Lear SA, Singer J, Banner-Lukaris D, Horvat D, Park JE, Bates J, et al. Randomized trial of a virtual cardiac rehabilitation program delivered at a distance via the internet. Circulation: Cardiovascular Quality and Outcomes 2014;7(6):952-9.		x													
Lindsay S, Bellaby P, Smith S, Baker R. Enabling healthy choices: is ICT the highway to health improvement?. Health (London, England: 1997) 2008;12(3):313-31.		x													
Maddison R, Pfaeffli L, Whittaker R, Stewart R, Kerr A, Jiang Y, et al. A mobile phone intervention increases physical activity in people with cardiovascular disease: Results from the HEART randomized controlled trial. European Journal of Preventive Cardiology 2014 May 9 [Epub ahead of print].		x													
Reid RD, Morrin LI, Beaton LJ, Papadakis S, Kocourek J, McDonnell L, et al. Randomized trial of an internet-based computer-tailored expert system for physical activity in patients with heart disease. European Journal of Preventive Cardiology 2012;19(6):1357-64.		x													

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Southard BH, Southard DR, Nuckolls J. Clinical trial of an Internet-based case management system for secondary prevention of heart disease. Journal of Cardiopulmonary Rehabilitation and Prevention 2003;23(5):341-8.		x			x	x		x					x		
Varnfield M, Karunanithi M, Lee CK, Honeyman E, Arnold D, Ding H, et al. Smartphone-based home care model improved use of cardiac rehabilitation in postmyocardial infarction patients: results from a randomised controlled trial. Heart 2014;100(22):1770-9.		x													
Vernooij JW, Kaasjager HA, van der Graaf Y, Wierdsma J, Grandjean HM, Hovens MM, et al. Internet based vascular risk factor management for patients with clinically manifest vascular disease: randomised controlled trial. BMJ (Clinical research ed.) 2012;344:e3750.		x													
Zutz A, Ignaszewski A, Bates J, Lear SA. Utilization of the Internet to deliver cardiac rehabilitation at a distance: a pilot study. Telemedicine Journal and e-Health 2007;13(3):323-30.		x													
Dale L, Whittaker R, Jiang Y, Stewart R, Rolleston A, Maddison R. Improving coronary heart disease self-management using mobile technologies (Text4Heart): a randomised controlled trial protocol. Trials 2014;15:71.		x													
ISRCTN29243064. Effectiveness of a comprehensive telerehabilitation program for the heart. http://www.controlled-trials.com/ISRCTN29243064 (accessed January 2015).		x													
NCT02228603. How to enhance physical activity after cardiac rehabilitation? A randomised controlled study comparing two follow-up training exercise programs. https://clinicaltrials.gov/show/NCT02228603 (accessed January 2015).		x													
NCT02350192. Effectiveness of an e-health educational intervention for cardiovascular disease adults in improving total exercise and outcomes. https://clinicaltrials.gov/ct2/show/NCT02350192 (accessed January 2015).		x													
Redfern J, Usherwood T, Harris MF, Rodgers A, Hayman N, Panaretto K, et al. A randomised controlled trial of a consumer-focused e-health strategy for cardiovascular risk management in primary care: the Consumer Navigation of Electronic Cardiovascular Tools (CONNECT) study protocol. BMJ Open 2014; Vol. 4, issue 2. [DOI: 10.1136/bmjopen-2013-004523]		x													
Reinwand D, Kuhlmann T, Wienert J, Vries HD, Lippke S. Designing a theory- and evidence-based tailored eHealth rehabilitation aftercare program in Germany and the Netherlands: study protocol. BMC Public Health 2013;13:1081.		x													
Shah B, Adams M, Peterson E, Powers B, Oddone E, Royal K, et al. Secondary Prevention Risk Interventions Via Telemedicine and Tailored Patient Education (SPRITE): A randomized trial to improve postmyocardial infarction management. Circulation: Cardiovascular Quality and Outcomes 2011;4(2):235-42.		x													

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T. Buckley, S. McKinley, R. Gallagher, K. Dracup, D.K. Moser, L.M. Aitken The effect of education and counselling on knowledge, attitudes and beliefs about responses to acute myocardial infarction symptoms Eur J Cardiovasc Nurs, 6 (2007), pp. 105–111			x							x					
J.J. Carlson, G.J. Norman, D.L. Feltz, B.A. Franklin, J.A. Johnson, S.K. Locke Self-efficacy, psychosocial factors, and exercise behavior in traditional versus modified cardiac rehabilitation J Cardpulm Rehabil, 21 (2001), pp. 363–373			x												
S.S. Chan, D.Y. Leung, D.C. Wong, C.P. Lau, V.T. Wong, T.H. Lam A randomized controlled trial of stage-matched intervention for smoking cessation in cardiac-outpatients Addiction, 107 (2012), pp. 829–837			x												
K.M. Cordasco, S.M. Asch, D.S. Bell, J.J. Guterman, S. Gross-Schulman, L. Ramer, et al. A low-literacy medication education tool for safety-net hospital patients Am J Prev Med, 37 (2009), pp. S209–S216			x												
M.H. Eckman, R. Wise, A.C. Leonard, E. Dixon, C. Burrows, F. Khan, et al. Impact of health literacy on outcomes and effectiveness of an educational intervention in patients with chronic diseases Patient Educ Couns, 87 (2012), pp. 143–151			x												
P. Giannuzzi, P.L. Temporelli, R. Marchioli, A.P. Maggioni, G. Balestroni, V. Ceci, et al. Global secondary prevention strategies to limit event recurrence after myocardial infarction: results of the GOSPEL study, a multicenter, randomized controlled trial from the Italian Cardiac Rehabilitation Network Arch Intern Med, 168 (2008), pp. 2194–2204			x												
K.B. Heidal, N.M. Lewis, S.M. Evans, L. Boeckner Nutrition education intervention increases total n − 3 fatty acid intakes in heart patients living in the Midwest Nutr Res, 27 (2007), pp. 33–37			x												
L. Horlick, R. Cameron, W. Firor, U. Bhalerao, R. Baltzan The effects of education and group discussion in the post myocardial infarction patient J Psychosom Res, 28 (1984), pp. 485–492			x												
H.S. Jeong, J.S. Chae, J.S. Moon, Y.S. Yoo An individualized teaching program for atherosclerotic risk factor reduction in patients with myocardial infarction Yonsei Med J, 43 (2002), pp. 93–100			x												
X. Jiang, J.W. Sit, T.K. Wong A nurse-led cardiac rehabilitation programme improves health behaviours and cardiac physiological risk			x												

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	16	20	42	26	24	62	7	13	14	13	27	18	17	19	74

ACS = acute coronary syndrome;

% overlap 63/286= 22.0%

CA= Covered Area = (16+20+42+26+24+62+7+13+14+13+27+18+17+19+74)/ (15x286) = 392/4290=9.1%

CCA= Corrected Covered Area = (392-286)/ (4290-286) = 106/4004= 2.6% (slight)

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Supplementary Annex 3.

Citation Matrix: Non-repeated trials (rows) included in the 36 systematic review and/or meta-analyses (column)--T2DM.

Author-year (Trial reference)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K. Cai, S. Zhang, M. Lu, L. Shao The effects of intensive education for elderly patients with diabetes mellitus. Pract Geriatr, 18 (2004), pp. 313–315	x																																			
Y. Chen, W. Xue, S. Lin, S. Huang, D. Li. ntensive diabetes education in the role of diabetes control. J Sun Yat-sen Univ (Med Sci), 3S (2004), pp. 201–203	x																																			
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B. Li, Y. Liu, J. Tian, J. Yuan. Impact of diabetes education for type 2 diabetes on glycated haemoglobin and health cost.Jiangsu J Prev Med, 23 (2012), pp. 55–56	x																																			
B.-h. Li, F.-h. Zhang, C. Zhang, M. Yang Effect of different education models on blood glucose in diabetic patients J Qilu Nurs, 19 (2013), pp. 26–27	x																																			
M. Li, T. Li, B.-y. Shi, C.-x. Gao Effect of motivational interviewing on the quality of life in type 2 diabetes patients with poor control of blood glucose Chin J Nurs, 49 (2014), pp. 6–10	x																																			
X. Li, Q. Zhou, F. Zou, L. Wu, H. Chen, Z. Liu Effectiveness of systematic self-management education on blood sugar level of patients in the community with type 2 diabetes J Central South Univ (Med Sci), 37 (2012), pp. 355–357	x																																			
Y. Li Evaluation of the standardized management effect of diabetes in community Chin Prim Health Care, 25 (2011), pp. 33–35	x																																			
Q. Liu, X. Pan, W. Feng, J. Kong Effectiveness of health education to the patients with diabetes mellitus J Nurs Sci, 20 (2005), pp. 54–55	x																																			
Z.-p. Liu, L.-l. Han, J.-r. Deng, X.-r. Liu, X.-r. Zhang, Q.-f. Li Effect of short-term intensified education on glucose	x																																			

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control of type 2 diabetic patients Chin J Nurs Educ, 4 (2007), pp. 249–251																																				
L.-m. Luo, K.-J. Yang, Z.-J. Zhang, Y.-H. Li, C.-H. Hu, X.-L. Feng Role of health education on diabetic community chronic disease management China Pharm, 24 (2013), pp. 3020–3022	x																																			
Y. Lu Observation on the effect of diabetes intensive education in type 2 diabetes mellitus patients Med Inform, 21 (2008), pp. 690–692	x																																			
X. Mei Analysis of compliance and effectiveness of community diabetes education program J Nanchang Univ (Med Sci), 50 (2010), pp. 83–84	x																																			
G. Pang The impact of intensive diabetes education on community patients J Med Theory Pract, 21 (2008), pp. 839–840	x																																			
Y. Qi, C. Chen, L. Yan Impact of cooking class on diabetic patients eating habits Chin J Nurs, 41 (2006), pp. 126–127	x																																			
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1= Choi, Davidson, Walker, Lee, & Palermo, 2016; 2=Creamer, Attridge, Ramsden, Cannings-John, & Hawthorne, 2016; 3=Huang et al., 2016; 4=Chen et al., 2015; 5=Pillay et al., 2015; 6= Terranova,

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Brakenridge, Lawler, Eakin, & Reeves, 2015; 7= Attridge, Creamer, Ramsden, Cannings-John, & Hawthorne, 2014; 8= Odnoletkova et al., 2014; 9 = Pal et al., 2014; 10 = Ricci-Cabello et al., 2014; 11= Saffari, Ghanizadeh, & Koenig, 2014; 12=Gucciardi, Chan, Manuel, & Sidani, 2013; 13=Pal et al., 2013; 14=Vugt, Wit, Cleijne, & Snoek, 2013; 15= Amaeshi, 2012 ; 16= Nam, Janson, Stotts, Chesla, & Kroon, 2012 ; 17= Steinsbekk, Rygg, Lisulo, Rise, & Fretheim, 2012; 18= Burke et al., 2011; 19= Kai Lun Gan, Brammer, & Creedy, 2011; 20=Ramadas, Quek, Chan, & Oldenburg, 2011; 21=Hawthorne, Robles, Cannings-John, & Edwards, 2010; 22= Minet, Moller, Vach, Wagner, & Henriksen, 2010; 23=Alam, Sturt, Lall, & Winkley, 2009; 24= Duke, Colagiuri, & Colagiuri, 2009; 25= Fan & Sidani, 2009; 26=Hawthorne, Robles, Cannings-John, & Edwards, 2008 ; 27=Khunti, Camosso-Stefinovic, Carey, Davies, & Stone, 2008; 28=Loveman, Frampton, & Clegg, 2008 ; 29=Wens et al., 2008; 30 = Nield et al., 2007; 31=Zabaleta & Forbes, 2007; 32=Deakin, McShane, Cade, & Williams, 2005; 33=Vermeire et al., 2005; 34=Gary, Genkinger, Guallar, Peyrot, & Brancati, 2003; 35=Norris, Lau, Smith, Schmid, & Engelgau, 2002; 36=Norris, Engelgau, & Narayan, 2001. T2DM = type 2 diabetes mellitus; NP = not applicable.

% overlap 177/532= 33.3%

CA= Covered Area =

(53+28+17+16+132+13+33+17+20+39+10+13+16+13+8+12+26+15+7+20+10+47+35+9+11+11+20+8+36+3+14+21+62+31+84)/(35x532) = 910/18620=4.8% (one review did not report the included studies list)

CCA= Corrected Covered Area = (910-532)/ (18620-532) = 378/18088= 2.1% (slight)

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