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Implementation and Outcomes of Lay Health Worker-led Self-management Interventions for Long-Term Conditions and Prevention: A Systematic Review

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Manuscript ID	HEB-17-0575.R1
Manuscript Type:	Review
Research Methods:	
Topics:	Lay Health Workers < GENERAL TERMS, Long-term Conditions, Self-management, Behavior Change Technique, Intervention Components
Abstract:	<p>The aim of this study was to systematically review lay health worker (LHW) -led self-management interventions for adults with long-term conditions (LTCs) to see how the interventions have been implemented and to compose a synthesis of their findings taking into consideration the intervention components that have been applied.</p> <p>We conducted systematic searches for articles published between January 2010 and December 2015 in five databases: Cochrane, MEDLINE, CINAHL, PsycINFO and Web of Science. Forty original studies were found that met the inclusion criteria that were self-management with diabetes (n=29), cardiovascular diseases (n=8), and those at risk of cardiovascular diseases (n=3), consisting of 22 randomized controlled trials and 18 other trials, with durations of one day to 24 months. The findings showed that the training of LHWs and the implementation of interventions varied widely. A synthesis of the implementation methods covers the background of the LHWs and the interventions as well as the components applied in each. Eight interventions had effects on physical activity and eight on nutrition behavior. The review also includes preliminary findings on intervention components effective in improving physical activity and nutrition behavior, including self-monitoring as a behavior change technique and group meetings as an intervention format. The same components and behavior change techniques were applied in effective and non-effective interventions.</p> <p>The review found that LHW-led interventions have potential in promoting self-management in LTC. In the future, a qualified and evidence-based structure for LHW-led interventions is suggested in order to improve the systematization of interventions and their effects.</p> <p>Keywords: lay health worker, long-term condition, self-management, intervention component, behavior change technique, systematic review</p>

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**Implementation and Outcomes of Lay Health Worker–Led Self-Management
Interventions for Long-Term Conditions and Prevention: A Systematic Review**

3 March 2019: revised version

A manuscript for Health Education & Behavior

Abstract

The aim of this study was to systematically review lay health worker (LHW)-led self-management interventions for adults with long-term conditions (LTCs) to see how the interventions have been implemented and to compose a synthesis of research findings, taking into consideration the intervention components that have been applied.

We conducted systematic searches for articles published between January 2010 and December 2015 in five databases: Cochrane, MEDLINE, CINAHL, PsycINFO and Web of Science. Forty original studies were found that met the inclusion criteria: self-management with diabetes ($n = 29$), cardiovascular diseases ($n = 8$), and those at risk of cardiovascular diseases ($n = 3$). These consisted of 22 randomized controlled trials and 18 other trials, with durations of one day to 24 months. The findings showed that the training of LHWs and the implementation of interventions varied widely. A synthesis of the implementation methods covers the background of the LHWs and the interventions as well as the components applied in each. Eight interventions had effects on physical activity and eight on nutrition behavior. The review also includes preliminary findings on intervention components effective in improving physical activity and nutrition behavior, including self-monitoring as a behavior change technique and group meetings as an intervention format. The same components and behavior change techniques were applied in effective and non-effective interventions.

The review found that LHW-led interventions have potential in promoting self-management in LTC. In the future, a qualified and evidence-based structure for LHW-led interventions is suggested in order to improve the systematization of interventions and their effects.

Keywords: lay health worker, long-term condition, self-management, intervention component, behavior change technique, systematic review

Introduction

Non-communicable diseases (NCD) are long-term conditions (LTC) that require ongoing self-management over a period of years as individuals learn to manage their health challenges (Eaton, Roberts, & Turner, 2015; Taylor et al., 2014; Nolte & McKee, 2008). The self-management of LTCs has been defined as a daily and flexible process where an individual, as a responsible actor, is able to perform individual goal-driven activities (Lorig & Holman, 2003; Ausili, Masotto, Dall'Ora, Salvini, & Di Mauro, 2014), such as adopting information, drug and symptom management, and adjustment to psychological consequences such as emotions and stress (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002).

Acquiring and applying individual skills related to self-management components demands effort from patients, peers, and health professionals (Kaptein, Fischer, & Scharloo, 2014; Kawi, 2012). People's beliefs that they can cope in their everyday activities and meet the challenges of self-management have been labelled as self-efficacy (Bandura, 1977; Vervekina, Shi, Fuentes-Caceres & Scanlon, 2014). Self-management interventions provide support to modify one's decisions and behavior for a healthier lifestyle. Interventions usually include a variety of observable and replicable behavior change techniques (BCT), such as goal setting, action planning, and self-monitoring (Michie et al., 2013; Duff et al., 2017).

The self-management of LTC has been supported by peers (Tang, Funnell, Gillard, Nwankwo, & Heisler, 2011; Dale, Williams, & Bowyer 2012; CADTH, 2013), who are usually people with the same diagnosis or health condition as the people they assist (Lorig & Holman, 2003; Carr et al., 2011; van Ginneken et al., 2013). Lay health workers (LHW) as LTC self-management supporters are especially able to share values, socioeconomic status or cultural background and, in some cases, also the experience of LTC (South, Meah, Bagnall & Jones, 2013; Hunt, Grant, & Appel, 2011; Islam et al., 2015).

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LHWs act as peer supporters, educators, role models, and community capacity builders (South et al., 2013). LHWs have been shown to improve equity in health care services by reaching underserved people with a poorer health status (Walker & Jan, 2005; Shah & Patel, 2013). There has been a wide variety of LHW training in terms of duration and methods (O’Brien, Squires, Bixby, & Larson, 2009; South et al., 2013).

The effectiveness of LTC self-management interventions has been measured through individuals’ knowledge, psychological state, behavior, and clinical outcomes (Dube, Van de Broucke, Housiaux, Dhoore, & Rendall-Mkosi, 2015). Lay-led self-management programs for those with chronic conditions may improve short-term self-management outcomes, such as physical activity (PA) and self-efficacy (Foster, Taylor, Eldridge, Ramsay, & Griffiths, 2009). Previous systematic reviews of LHW interventions for diabetes found that (a) LHWs’ roles in individuals’ self-management counseling were diverse in their ways to support, educate, advocate, and facilitate, and (b) interventions were partially effective in improving HbA1C levels and health behavior outcomes (Hunt et al., 2011; Little, Wang, Castro, Jimenez, & Rosal, 2014). Carr et al. (2011) investigated connections between the implementation of interventions and their outcomes, but found no firm relationships between them.

However, in this study we systematically reviewed previous LHW-led self-management interventions for adults with LTCs in terms of the implementation of interventions. The first objective was to investigate those characteristics of LHWs and their training that have been reported within the context of self-management. The second objective was to investigate the implementation of interventions. The third objective was to investigate what kind of relationships, if any, there are between intervention components and nutrition behavior (NB) and PA outcomes.

Methods

Search strategies and selection criteria

The present review was conducted according to standard systematic review methodology (CRD, 2009) and reported according to the PRISMA Statement (Liberati et al., 2009). A systematic search for articles, reported full text in English (due to limited facilities and resources for translation) and published between 2010 and 2015, was undertaken in five databases between December 2015 and January 2016: Cochrane, MEDLINE, CINAHL, PsycINFO, and Web of Science. Search terms included Community Health Worker* OR Lay health* OR Lay supporter* OR Lay tutor* OR Advisor* OR counsellor* OR counselor* OR peer OR peer counsellor* OR peer counselor* OR peer-advisor* OR peer-coach* OR peer-counsellor* OR peer-counselor* OR peer-educator* OR peer-led* OR health trainer* AND Self-Management OR Self care. Both MeSH and free-text terms were used. The full search strategy is available from the authors on request.

One of the authors extracted the following data independently and discussed it with the other researchers who were involved with study selection. Disagreements between reviewers were resolved by consensus. The following inclusion criteria were applied: adults as recipients; non-communicable and somatic diseases or their prevention; LHW-led self-management intervention; organized by primary health care, community health center or corresponding organization; RCTs and quantitative trials. The exclusion criteria were the following: studies that reported outcomes of LHWs' own self-management; intervention was led by non-trained peer supporter; family interventions; cancer, HIV, asthma or mental health self-management interventions; review papers; study protocols; and papers presenting baseline results only (Figure 1).

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All of the included studies deal with self-management of diabetes and cardiovascular diseases. Both diseases, as long-term somatic and non-communicable conditions, can largely be prevented or treated by allied self-management activities covering certain daily behavioral and psychological actions taken by individuals. NB and PA are key self-management activities when dealing with type 2 diabetes and cardiovascular diseases on a daily basis (WHO, 2013; Donaldson & Rutter, 2017). In addition, there is a vital need for research with a scope that combines self-management and prevention in both diabetes and cardiovascular diseases. The quality of the included studies was assessed using the 14-item checklist from the Manual for Quality Scoring of Quantitative Studies with a range of 0–28 points (MQSQ; Kmet, Lee, & Cook, 2004). The quality evaluation was conducted by the first author, and the decisions have also been discussed with two other authors.

Analysis

The analysis of the first and second objectives concerned the contents of LHWs, their training and LHW-led self-management interventions. The interventions’ components were classified according to their formats (e.g., group, individual, telephone, home visit), elements (e.g., lectures, PA classes; Davidson et al., 2003), and BCTs (Michie et al., 2013). The data were analyzed using content analysis (Schreier, 2012) by identifying the units of meaning, condensing them and finally creating subcategories. Based on similar subcategories, eight main categories were composed: (1) characteristics of LHWs, (2) training of LHWs, (3) intervention delivery by LHWs, (4) theoretical background and guidelines of the interventions, (5) principles of implementation, (6) intervention formats and elements, (7) behavior change techniques, and (8) intervention management and mediators. (Table 1.)

For the third objective of the review, self-management was investigated as a behavioral outcome of NB and PA in 13 original studies that measured them. The analysis was conducted by identifying the components and clinical measurements and their links to NB and PA. The data within these analyses was relatively narrow, however, it was eventually grouped according to their improvements in NB and PA and those groups were compared. This review describes and identifies the intervention features that indicate participants' behavior changes within the original studies.

All of the following aspects in the fields of NB and PA and clinical measurements were manually coded and categorized in Microsoft Excel: the reported intervention formats and elements, such as delivery in group or individual sessions, telephone or online contact, and education lectures (Davisdon et al., 2003); behavior change techniques (applied by Michie et al., 2013); intervention length and frequency; significantly improved and not improved self-management outcomes in terms of PA and NB; and clinical measurements.

This semi-qualitative metric was developed in the current study to extract and investigate the links between intervention components and PA and NB. Additionally, there were a large variety of measurements used to assess PA, NB, blood lipids, and blood pressure as self-management outcomes, which were difficult to bring together. Therefore, all of the tests that investigated similar items were classified as items of self-management (Table 2) in order to allow the data to be analyzed and for the results to be explained based on the study topic. All of the results are based on the published study results, and no original study data or intervention material have been examined.

Results

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Included studies

The included studies ($n = 40$) originated from seven countries, most of them from the United States ($n = 31$). Twenty-nine studies examined self-management in diabetes, eight in cardiovascular diseases, and three in a risk of cardiovascular diseases. The included studies consisted of 22 randomized controlled trials and 18 other trials. The methodological quality of the studies ranged from 9 to 25 points, with a total possible MQSQ sum of 28 points (9–12 points, 5 studies; 13–20 points, 23 studies; 21–25 points, 12 studies; see Table 3). Points were typically subtracted due to an absence of randomization or blinding, or due to a lack of reporting about them. No original studies were excluded, since the focus of the review was on qualitative description of LHWs and interventions. Additionally, MQSQ does not set any score limits for the appropriate level of study quality.

The durations of the self-management interventions varied from one day to 24 months. The number of baseline recipients in all the included studies was 10,065 (female 55%) and follow-up 7,970, with a total attrition rate of 21%. The studies varied largely in their reporting. For example, in some papers the background, training, and duties of LHWs as well as intervention details were clearly presented, and in others they were not. Due to the high number of studies included in the current review, the original studies will be cited according to the numbers referred to in Table 3.

Characteristics of LHWs and their training

The individual skills and characteristics often included having the similar health condition or experience of it as the participants had^(8,10,12,16,20,21,32,38). LHWs came from the same community as the recipients did^(6,8,26), and some of them also had a professional

background^(24,26). Many of the studies were located in minority communities, therefore LHWs were often bilingual, combining, for example, Spanish and English^(11,25,27,30,31).

Training educators were revealed to be health professionals^(7,14), specialists^(1,28), or university researchers^(25,29). **Training content** consisted of using community resources, navigating health care services, and organizational issues.^(5,8,9,12,16,18,20,22,29) (See Figure 2.) Additionally LHWs' training also included themes of supporting effective self-management techniques, such as motivational, self-monitoring and measuring^(2,4,5,7,8,9,11,12,15,16,17,18,20,21,22,23,25,28,29,33,34,37,40), alongside clinical protocols^(8,11,16,25,34,35), medication^(9,20,34) and self-care routines^(9,16). The training **elements** varied from, for example, classroom activities^(8,28,38,40) to home visits⁽⁹⁾. The LHWs were also trained in research practices^(2,5,8,12,16,25,28,38), protecting human subjects^(5,18,25), and cultural awareness^(5,18).

The number of LHWs within one intervention varied from 1⁽¹⁴⁾ to 41⁽¹⁶⁾. LHWs had **multiple roles and duties related to intervention components**. Between the education sessions, LHWs contacted participants to provide support or to answer their questions^(1,7,17,25,35,39). They were also available for recipients' phone calls.⁽¹⁾ In a few interventions LHWs worked as equal members of health care teams^(5,11,12,24,27,29,30,33,34,40).

LHWs also collected research data^(1,25,31), contributed to intervention evaluations⁽²⁵⁾, and acted as a team leader for a group of LHWs.^(4,26,39) Some studies reported **supervision provided to LHWs** by program coordinators^(3,4,5,8,9,20,37), nurse care managers^(2,3,28), health care teams of community centers^(5,37), and university professionals⁽³⁷⁾. In some cases, LHWs were provided with a written manual to ensure consistency of delivery.^(37,38,40) They consulted with health professionals on any serious symptoms or for measurements of recipients.^(11,12,27,32)

Intervention delivery of LHW-led interventions

Nearly half of the 40 studies reported no **theoretical background** for the intervention or program^(3,4,6,9,10,12,13,16,18-20,24,26,27,34-36,39), but some did (Table 4). In eight studies the theoretical background was presented as a combination of two theories^(5,8,11,23,25,33,38,40). The framework of an intervention's content or its components was often based on **national guidelines and recommendations** on diabetes^(1,2,5,11,12,14,15,26,27,32,35), hypertension^(8,29), or cardiovascular diseases^(30,39).

Meetings usually **took place** in community centers and churches, often held at a convenient location to the recipients^(1,2,4,22,23,25-27,31). **The length** of sessions, when reported, ranged from 30 to 90 minutes.^(26,27,29,37) **Group sizes** varied from two^(24,38) to twenty-five⁽³²⁾ participants. In a few interventions the interaction frequency was based on the needs of peers and recipients.^(2,21)

LHWs delivered educational activities for individuals or groups, including making action plans, motivating, problem solving, and self-management guidance with support given either face to face by telephone^(2,4,5,7,9,10,15,17,22,24,25,27,28,29,33,34,39,40), or online⁽³²⁾. Home visits were also conducted^(11,17). Some of the LHWs assessed goals⁽³⁹⁾, provided confidant information⁽²⁹⁾, or helped patients to understand their long-term conditions and self-management^(2,9,25). All together, the studies reported thirty-five separate **health behavior change techniques** being applied (Table 5).

Recruitment of potential individuals to participate in interventions was conducted at hospitals, health centers, community centers or churches^(6,7,8,12,15,34,35), or via the media, websites or seminars^(15,22,32). To ensure **fidelity of program delivery**, classes were

monitored^(16,22) or audio recorded⁽¹²⁾, checklists were completed⁽²¹⁾ or activity reports were submitted⁽²²⁾. Interventions acted as **bridges to local health and social services** by encouraging participants to continue with their health care services^(3,5,6,14,16,17,18,19,21,22,28,31,37,38,39). **Attrition prevention** was performed by implementing make-up sessions⁽³¹⁾, providing cash incentives, stipends or gift cards^(14,19,20,37,39), and making telephone support calls to recipients who did not attend the sessions⁽¹⁸⁾.

PA and NB outcomes in the LHW-led interventions

Statistically significant improvements (minimum of $p < .05$) in all self-management outcomes, including psychological, behavioral, and clinical outcomes, were reported in many studies. Because our review concentrated on behavior, the outcomes of PA and NB as self-management activities, and their links to clinical outcomes, are presented. Ten studies measured both PA and NB, and three studies measured only PA (see Table 6). Measurements of the studies were mostly pre- and posttest, with only two studies having follow-ups^(32,37).

Out of ten studies that investigated both PA and NB, six reported both improved PA and NB^(7,23,25,29-31), two reported improved NB^(21,37), one reported improved PA⁽¹⁷⁾, and one found no improvements⁽¹⁵⁾. NB- and PA-effective interventions were organized into groups, and four of ~~them~~ these had additional individual activities.^(7,23,25,31) Their length varied from two-and-a-half months⁽²⁵⁾ to 12 months⁽³⁰⁾. Four of them provided activities weekly, and five had education lectures. Their number of identified BCTs were eight⁽²⁹⁾ or nine^(7,25,30). Three of the NB- and PA-effective interventions also improved clinical measurements such as HbA1C^(7,23,25), blood pressure^(23,25,29), blood lipids^(23,29,30), and weight loss^(7,23,29), and one⁽³¹⁾ found no clinical improvements. (Table 7)

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The current review also aimed to identify PA- and NB-effective interventions separately to get more accurate results concerning behavior change in LHW-led self-management interventions. In PA-effective interventions^(7,17,23,25,29–32) the number of applied BCTs varied from three to fifteen. In some of the interventions, group meetings were combined with individual face-to-face meetings, at recipients’ homes, or via telephone. In PA-ineffective interventions^(15,21,26,33,37) the intervention components were mainly similar to effective PA interventions, with two of them providing only individual meetings. The number of BCTs ranged from two to nine. Regarding the high number of applied BCTs, certain remarks appeared in terms of PA as a form of self-management activity. Self-monitoring, enhancing social support, hands-on activities, and self-efficacy support were mainly linked to improvements, whereas goal setting was linked to both improvements and no improvements. Increased PA was often related to positive effects on clinical measurements, but not in all cases.

In NB-effective interventions^(7,21,23,25,29–31,37) the number of BCTs was from three to nine, with some variations in techniques, theoretical backgrounds, and durations. In those studies, it was more likely that self-monitoring, goal setting, and motivation were used as BCTs. For example, information providing had been used in four studies where NB improved but also in both studies where no improvement was found. When measured alongside NB, many studies also found positive effects on clinical measurements. Nevertheless, despite the improved NB, blood pressure was more likely to increase than decrease.

Discussion

The current review found that LHW-led self-management interventions have potential in promoting self-management in LTC. The implementation of interventions varied widely.

Only about one third of the studies investigated NB and PA as indicators of behavior change, however, some of those that did had found positive outcomes.

The findings show that LHWs were often themselves trained LTC patients, who were personally interested in acting as LHWs. This study restates the previous descriptions of LHWs (Hunt et al., 2011; South, Kinsella & Meah, 2012; South et al., 2013), who are considered to be trained peer workers, as having similar cultural, ethnic or health backgrounds to their clients. LHWs' roles were identified as educators, supporters, opinion leaders, organizers, and acting as bridges between communities, professionals, and clients. Interventions typically encompassed empowerment, social support, and tailoring-oriented principles, and they varied widely in length, frequency, and components. For example, group sessions, education lectures, and individual appointments were common formats, whereas self-monitoring, goal setting, information providing, action plans, and social support were frequently applied BCTs. Similar formats and BCTs were often applied in effective as well as in non-effective interventions.

The implementation of and reporting on both LHW training and LHW-led interventions diverged, as has been shown in previous studies (Hunt et al., 2011; Shah et al., 2013). A number of interventions lacked a theoretical background, or at least did not report one (Hunt et al., 2011; Dale et al., 2012), which is a common issue in evidence-based health promotion. Implementation quality was assured in many interventions by providing continuous supervision during the intervention process (Hunt et al., 2011). That can be considered as a way to empower LHWs to be self-management tutors, and also assist them in cooperating with each other. As a non-professional workforce, they may benefit from organizational support for their work.

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Interventions often followed national recommendations or guidelines for particular LTCs, as well the program for chronic disease self-management (Lorig et al., 2013). However, the current review highlights self-management as a person’s own activities and emotions for taking care of a LTC by, for example, setting and modifying goals, solving problems, relying on peer support, and action planning (also Richardson et al., 2014). It seems that part of the interventions emphasized lecturing and giving advice, while many interventions consisted of behavioral and emotional elements that supported self-management (also Kawi, 2012; Lorig, Ritter, Ory & Whitelaw, 2013; Kaptein, et al., 2014). Effective self-management support should correspond to recipients’ unique needs as well as assist individuals in strengthening their motivation and skills in coping in daily life with an LTC (Newbould, Taylor, & Bury, 2006). However, participants who lack knowledge and others with low self-efficacy may fail to benefit from similar activities and support in improving their self-management. These demands have been responded to in many interventions by tailoring intervention activities according to individual participants’ requirements.

This review had similar findings to previous work, in that LHW-led self-management interventions can be effective in HbA1c (Hunt et al., 2011; Dale et al 2012; Little et al., 2014), and in a few interventions in PA, NB, blood pressure, and blood lipids (Hunt et al., 2011; Dale et al., 2012). Even though the same components and BCTs led to both significant and non-significant outcomes, some preliminary but not robust links were observed. Group meetings and enhancing social support seemed to be particularly effective in improving PA. This reflects earlier findings (Greaney et al., 2017) and also highlights the need for social activities and for sharing motivation and feelings with LHWs and other recipients when improving one’s PA. Furthermore, self-monitoring and hands-on activities and exercises as self-management actions were more likely linked to both improved PA and NB. Regarding the findings of generally applied BCTs in PA interventions (Duff et al., 2017), goal setting

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3 did not appear as an effective BCT at this time. However, in terms of behavior change
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5 interventions, only about one third of the studies measured NB and/or PA as an outcome of
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7 behavior change. In considerations of behavior changes among long-term patients, measuring
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9 their health behavior may provide beneficial knowledge on how patients manage with self-
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11 management in the context of their daily lives. Both research and clinical practice would
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13 benefit from this information.
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21 Thus, a particular intervention component does not consistently lead to improvements.
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23 Firstly, identifying and understanding (Johnston et al., 2017) formats and BCTs and, second,
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25 applying them in self-management interventions are demanding processes, especially
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27 deciding how to maintain techniques based on recipients' unique needs, such as motivation or
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29 making action plans. When the training periods of LHWs last from days to months, it may
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31 have been challenging to learn the further ethos of the BCTs that were applied. In a portion of
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33 the interventions it remained unclear how the LHWs were trained in BCTs. Furthermore,
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35 based on the results of this study, it is possible that other intervention components, such as
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37 intensity (Palmas et al., 2015), duration, and overall personal interaction between LHWs and
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39 participants may play a role in effective interventions.
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45 Nevertheless, as this review suggests, LHWs may have particular potential in self-
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47 management interventions among cultural and lingual minorities due to their reciprocal
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49 ability to share culture and experiences. They may have the potential to increase vulnerable
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51 individuals' involvement in services but also to promote self-management and health
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3 *Limitations and strengths*
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6 The collected data enabled specific examinations of LHW-led self-management
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8 interventions, yet the current study has its limitations. The study protocols differed,
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10 combining RCT and trials with a variety of study participants. Due to the high variability and
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12 high numbers of different BCTs and self-management outcomes reported within the data, the
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14 evidence for making links between techniques and outcomes is limited. However, only the
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16 most prominent themes are presented in this paper. The heterogeneity across interventions
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18 and outcomes may also lead to limitations in identifying the intervention components
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20 (Abraham et al., 2015; Johnston et al 2017) and determining the results of this review, which
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22 itself contains reviews by Carr et al. (2011) and Little et al. (2014). The recipients of the
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24 original studies often represented cultural or linguistic minorities or low-income groups, so
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26 the results may not be transferable to other groups. In addition, there may be a risk of
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28 language bias because the included studies had to be reported only in English (CRD, 2009).
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30 Nevertheless, to our knowledge, the major studies regarding the topic have been conducted in
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32 an international context and reported in English.
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39 This study has three primary strengths. First, it sets out a systematic synthesis of the
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41 characteristics and training of LHWs, the implementation and components of LHW-led
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43 interventions, and BCTs. The synthesis could serve as a framework for future research and
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45 clinical practice considering LHW-led self-management interventions. Second, it contains a
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47 number of original studies that provide robust data on LHW-led self-management
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49 interventions among people with diabetes and cardiovascular disease. Third, it presents
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51 preliminary links between intervention components and outcomes in the field of LHW-led
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53 self-management interventions. To our knowledge, there is currently only scant evidence of
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55 such a link.
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Implications for Policy and Practice

LHW interventions, as a mode of health services for multiple groups of people, have the potential to improve self-management for those with diabetes, cardiovascular diseases and chronic conditions as well as assist in prevention. LHW-led services in self-management support may reach people who are vulnerable or underserved. However, to improve self-management in LTC, systematic training in adopting and applying formats and BCTs should be provided to LHW candidates. In the future, an evidence-based standard for LHW training and interventions may be formulated for the field of LHW self-management interventions and their investigation. Such a standard, however, requires further research on its implementation.

Another suggestion for further research on self-management outcomes of LHW interventions would be to examine whether interaction frequency, meeting minutes, or group size have effects on self-management and, if so, what are the mechanisms that make them effective. A further line of study could determine how different combinations of intervention formats and BCTs interact.

Additionally, promoting recipients' self-regulation strategies or improving their psychological flexibility as stages of health behavior change may offer new ways to achieve goals in LHW interventions. In summary, the results of this review suggest that LHW-led self-management interventions for diabetes and cardiovascular diseases have been implemented in multiple ways, and these interventions have seemed to improve, at least partially, behavioral and clinical self-management outcomes.

References

- Abraham, C., Wood, C., Johnston, M., Francis, J., Hardeman, W., Richardson, M. & Michie, S. (2015). Reliability of identification of behavior change techniques in intervention descriptions. *Annals of Behavioral Medicine*, 49, 885-900.
- Ausili, D., Masotto, M., Dall'Ora, C., Salvini, L., & Di Mauro, S. (2014). A literature review on self-care of chronic illness: definition, assessment and related outcomes. *Professioni Infermieristiche*, 67(3), 180–189.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215.
- Barlow, J., Wright, C., Sheasby, J., Turner, A., & Hainsworth, J. (2008). Self-management approaches for people with chronic conditions: A review. *Patient Education and Counseling*, 48, 177–187.
- CADTH, Canadian Agency for Drugs and Technologies in Health (2013). *Peer support for diabetes, heart disease and HIV/AIDS: A review of the clinical effectiveness, cost-effectiveness, and guidelines. Rapid response report: Summary with critical appraisal*. Retrieved from <https://www.cadth.ca/sites/default/files/pdf/htis/dec-2013/RC0494%20Peer%20support%20for%20chronic%20disease%20Final.pdf>
- Carr, S.M., Lhussier, M., Forster, N., Geddes, L., Deane, K., Pennington, M., ...Hildreth, A. (2011). An evidence synthesis of qualitative and quantitative research on component intervention techniques, effectiveness, cost- effectiveness, equity

and acceptability of different versions of health-related lifestyle advisor role in improving health. *Health Technology Assessment*, 15(9).

CRD. (2009). Systematic Reviews. CRD's guidance for undertaking reviews in health care. *Centre for Reviews and Dissemination*. UK: York Publishing Services.

Dale, J.R., Williams, S.M., & Bowyer, V. (2012). What is the effect of peer support on diabetes outcomes in adults? A systematic review. *Diabetic Medicine*, 29, 1361–1377.

Davidson, K.W., Goldstein, M., Kaplan, R.M., Kaufmann, P.G., Knatterud, G.L., Orleans, T.C., ... Whitlock, E.P. (2003). Evidence-based behavioral medicine: What is it and how do we achieve it? *Annals of Behavioral Medicine*, 26, 161. doi:10.1207/S15324796ABM2603_01

Donaldson, L. & Rutter, P. (2017). Healthier, fairer, safer: The global health journey, 2007–2017. Geneva: World Health Organization. License: CC BY-NC- SA 3.0 IGO.

Dube, L., Van de Broucke, S., Housiaux, M., Dhoore, W., & Rendall-Mkosi, K. (2015). Type 2 diabetes self-management education programs in high and low mortality developing countries: A systematic review. *The Diabetes Educator*, 41(1), 69–85.

Duff, O.M., Walsh, D.M.J., Furlong, B.A., O'Connor, N.E., Moran, K.A., & Woods, C.B. (2017). Behavior change techniques in physical activity eHealth interventions for people with cardiovascular disease: Systematic review. *Journal of Medical Internet Research*, 19(8), e281.

Eaton, S., Roberts, S., & Turner, B. (2015). Delivering person centred care in long term conditions. *BMJ*, 350, h181. doi: 10.1136/bmj.h181

- Foster, G., Taylor, S.J.C., Eldridge, S., Ramsay, J., & Griffiths, C.J. (2009). Self-management education programmes by lay leaders for people with chronic conditions. *Cochrane Database of Systematic Reviews*, 4.
- van Ginneken, N., Tharyan, P., Lewin, S., Rao, GN., Meera, S.M., Pian, J., Chandrashekar, S., & Patel, V. (2013). Non-specialist health worker interventions for the care of mental, neurological and substance-abuse disorders in low and middle-income countries. *Cochrane Database of Systematic Reviews*, 11. Art. No.: CD009149. doi: 10.1002/14651858.CD009149.pub2
- Greaney, M.L., Puleo, E., Sprunck-Harrild, K., Haines, J., Houghton, S.C. & Emmons, K.M. (2017). Social support for changing multiple behaviors: Factors associated with seeking and the impact of offered support. *Health Education & Behavior*, 1-9. doi: 10.1177/1090198117712333
- Hunt, C.W., Grant, J.S., & Appel, S.J. (2011). An integrative review of community health advisors in type 2 diabetes. *Journal of Community Health*, 36, 883–893.
- Islam, N., Zanolwiak, J., Riley, L., Nadkarni, S., Kwon, S., & Trinh-Shevrin, C. (2015). Characteristics of Asian American, Native Hawaiian and Pacific Islander community health worker programs: A systematic review. *Journal of Health Care for the Poor and Underserved*, 26, 238–268.
- Johnston, M., Johnston, D., Wood, C., Hardeman, W., Francis, J. & Michie, S. (2017). Communication of behavior change interventions: Can they be recognized from written descriptions? *Psychology & Health*, doi: 10.1080/08870446.2017.1385784

- Kaptein, A.A., Fischer, M.J., & Scharloo, M. (2014). Self-management in patients with COPD: theoretical context, content, outcomes, and integration into clinical care. *International Journal of COPD*, 9, 907–917.
- Kawi, J. (2012). Self-management support in chronic illness care: A concept analysis. *Research and Theory for Nursing Practice*, 26(2), 108–125.
- Kmet, L.M., Lee, R.C., & Cook, L.S. (2004). Standard quality assessment criteria for evaluating primary research papers from a variety of fields. HTA Initiative #13. *Alberta Heritage Foundation for Medical Research*. Retrieved from <http://www.biomedcentral.com/content/supplementary/1471-2393-14-52-s2.pdf>
- Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P.A., ... Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Med*, 6(7): e1000100. doi:10.1371/journal.pmed.1000100
- Little, T.V., Wang, M.L., Castro, E.M., Jimenez, J., & Rosal, M.C. (2014). Community health worker interventions for Latinos with type 2 diabetes: A systematic review of randomized controlled trials. *Current Diabetes Reports*, 14(12), 558.
- Lorig, K.R., & Holman, H.R. (2003). Self-management education: History, definition, outcomes, and mechanisms. *Annals of Behavioral Medicine*, 26(1), 1–7.
- Lorig, K., Ritter, P. L., Ory, M. G., & Whitelaw, N. (2013). Effectiveness of a generic chronic disease self-management program for people with type 2 diabetes: A translation study. *The Diabetes Educator*, 39(5), 655–663.

- 1
2
3 Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., ... Wood,
4
5 C.E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically
6
7 clustered techniques: Building an international consensus for the reporting of
8
9 behavior change interventions. *Annals of Behavioral Medicine*, 46, 81.
10
11 doi:10.1007/s12160-013-9486-6
12
13
14
15 Newbould, J., Taylor, D., & Bury M. (2006). Lay-led self-management in chronic illness: a
16
17 review of the evidence. *Chronic Illness*, 2, 249–261.
18
19
20
21 Nolte, E., & McKee, M. (2008). Caring for people with chronic conditions: an introduction.
22
23 In E. Nolte & M. McKee (Eds.) *Caring for people with chronic conditions*.
24
25 McGraw-Hill Education; Open University Press.
26
27
28
29 O'Brien, M.J., Squires, A.P., Bixby, R.A., & Larson, S.C. (2009). Role development of
30
31 community health workers: An examination of Selection and Training
32
33 Processes in the Intervention Literature. *American Journal of Preventive*
34
35 *Medicine*, 37 (6S1).
36
37
38
39 Palmas, W., March, D., Darakjy, S., Findley, S. E., Teresi, J., Carrasquillo, O., & Luchsinger,
40
41 J. A. (2015). Community health worker interventions to improve glycemic
42
43 control in people with diabetes: A systematic review and meta-analysis. *Journal*
44
45 *of General Internal Medicine*, 30(7), 1004–1012.
46
47
48
49 Richardson, J., Loyola-Sanchez, A., Sinclair, S., Harris, J., Letts, L., MacIntyre, N. J.,
50
51 ...Ginis, K. M. (2014). Self-management interventions for chronic disease: a
52
53 systematic scoping review. *Clinical Rehabilitation*, 28(11), 1067–1077.
54
55
56
57 Schreier, M. (2012). *Qualitative content analysis in practice*. London: SAGE Publications.
58
59
60

- Shah, M., Kaselitz, E., & Heisler, M. (2013). The role of community health workers in diabetes: Update on current literature. *Current Diabetes Reports*, 13, 163–171.
- Shah, D., & Patel, V. (2014). Utilisation of Hispanic community workers and case managers to increase adherence to diabetes treatment in Hispanic populations. *Journal of Diabetes Nursing*, 18(10), 396–404.
- South, J., Kinsella, K., & Meah, A. (2012). Lay perspectives on lay health worker roles, boundaries and participation within three UK community-based health promotion projects. *Health Education & Research*, 27(4), 656–670.
- South, J., Meah, A., Bagnall, A-M., & Jones, R. (2013). Dimensions of lay health worker programmes: results of a scoping study and production of a descriptive framework. *Global Health Promotion*, 20(1), 5–12.
- Tang, T.S., Funnell, M.M., Gillard, M., Nwankwo, R., & Heisler, M. (2011). Training peers to provide ongoing diabetes self-management support (DSMS): Results from a pilot study. *Patient Education and Counseling*, 85, 160–168.
- Taylor, S., Pinnock, H., Epiphaniou, E., Pearce, G., Parke, H., Schwappach, A., ... Sheikh, A. (2014). A rapid synthesis of the evidence on interventions supporting self-management for people with long-term conditions: PRISMS – Practical systematic Review of Self-Management Support for long-term conditions. *Health Services and Delivery Research*, 2(53). National Institute for Health Research. doi:10.3310/hsdr02530
- Vervekina, N., Shi, Y., Fuentes-Caceres, V.A., & Scanlon, P.A. (2014). Attrition in chronic disease self-management programs and self-efficacy at enrollment. *Health Education & Behavior*, 41(6), 590-8.

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59
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Walker, D.G., & Jan, S. (2005). How do we determine whether community health workers are cost-effective? Some core methodological issues. *Journal of Community Health*, 30(3), 221–229.

WHO (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*. Geneva: World Health Organization. Retrieved from http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf

For Peer Review

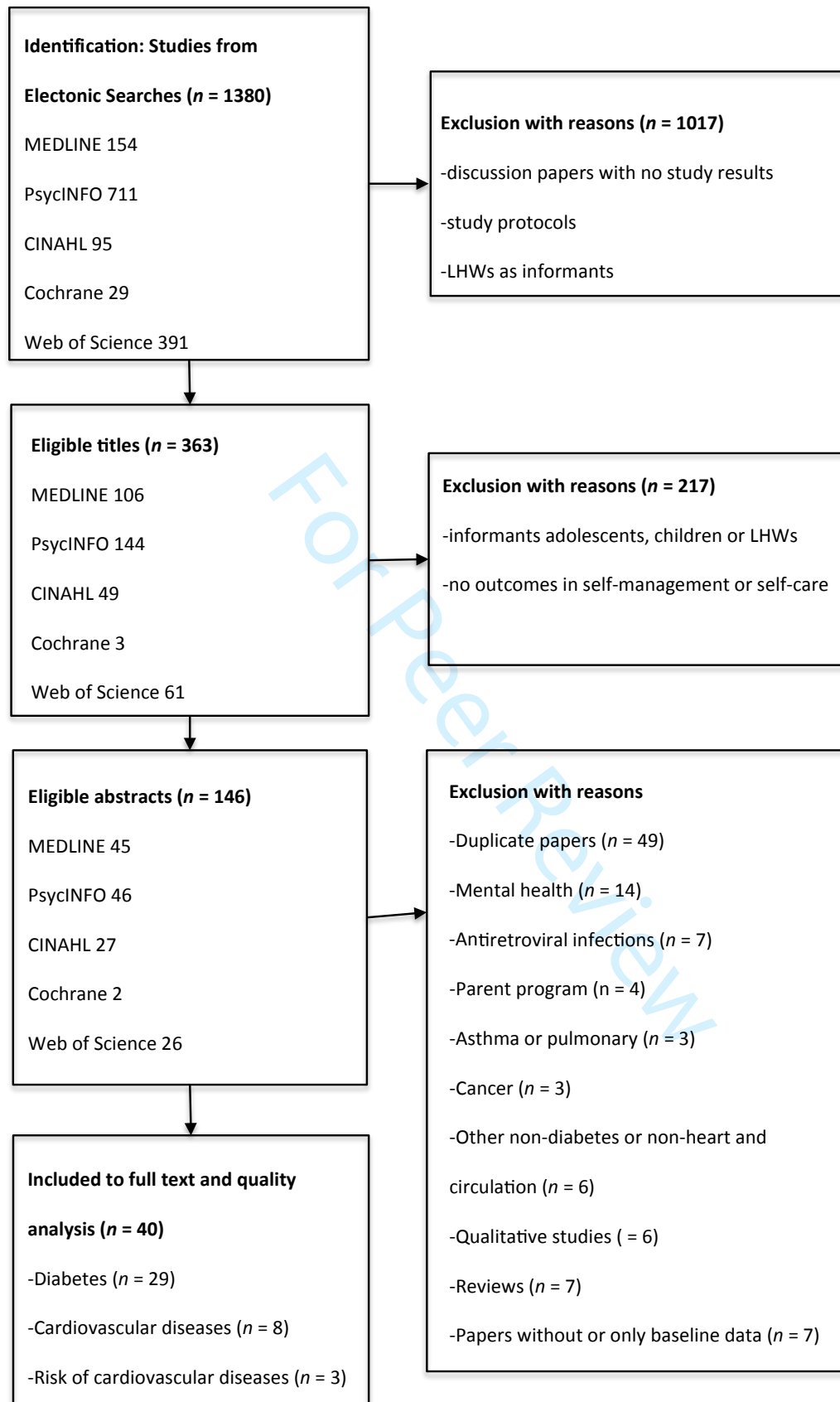


Figure 1. Flowchart of the searches.

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Table 1. Example of the content analysis phase concerning LHW characteristics

Examples of the original expressions	Condensed expression	Subcategory	Main category
[The facilitators were six lay people with experience of heart disease, either personally -- or as carers of people with heart disease. 3.10]	The facilitators were six lay people with experience of heart disease self-management	Background and experience	Characteristics of LHWs
[The CHWs had an average of 6 years' experience leading DSME at CHASS. 18.22]	The CHWs had an average of six years' experience in leading diabetes self-management programs		
[--co-delivered by -- a patient (lay) tutor who had experience in these services 40.11.1]	Patient lay tutor had experience of services related to self-management support		
[-- an organization devoted to the education of people with diabetes and health care team members, on the basis of their excellent diabetes control, self-motivation, communication and support skills and interest. 4.21]	On the basis of their excellent diabetes control, self-motivation, communication and support skills and interest.	Eligibility criteria	
[simply interest of being a diabetes educator 24.9]	Simply one's own interest of being a diabetes educator		

[someone with diabetes or with a family member or friend with diabetes 24.8]	Having diabetes her/himself or a family member who has		
[16 hours training by the project manager or principal investor. 1.14]	Training provided by the project manager or principal investor	Training educators	LHWs' training
[The trainings were delivered by an interdisciplinary team of academics and practitioners with expertise in clinical medicine, health inequities, Latino health, diabetes self-management, diabetes medications, nutrition, exercise, cross-cultural counseling, and mental health. 11.27]	The culturally sensitive training delivered by an interdisciplinary team of academics and practitioners		
[CHWs trained by research staff from the University of Illinois at Chicago (UIC) 25.2.1]	CHWs trained by research staff from the University		
[to teaching blood pressure and glucose readings 1.18]	Training prepared CHWs in teaching blood pressure and glucose readings	Training purposes	
[building and reinforcing the participants' knowledge on diabetes, 23.22]	Building and reinforcing the participants' knowledge on diabetes		
[We trained community volunteers to be "Health	To train community volunteers to be health coaches		

Coaches” for our project -- 29.34]

Table 2. Examples of self-management outcomes transferred to self-management items

Item of self-management	An example of original self-management measurement
Physical activity (PA)	Summary of Diabetes Self-Care Activities measure ^{(7)*} Moderate levels of physical activity 30 min per day at least 5 days per week ⁽¹⁷⁾ Physical Activity Scale for Elderly ⁽²¹⁾ Survey of Diabetes Self-Care Activities: Exercise ⁽²³⁾ Minutes of daily physical activity ⁽²⁵⁾ Questionnaire on physical activity ⁽³⁷⁾

Nutrition behavior (NB)	Number of days to follow a diet ⁽⁷⁾
	Amount of daily servings of vegetable and fruits ⁽¹⁷⁾
	Survey of Diabetes Self-Care Activities: Nutrition ⁽²³⁾
	Following a healthy eating plan, eating fruits/vegetables ^(25,30)
	Self-reported eating behavior ⁽²⁹⁾
	Questionnaire on nutrition ^(31,37)
Blood lipids	HDL ^(23,30,35) LDL ^(17,30)
	Total cholesterol ^(23,30) Triglycerides ⁽³⁰⁾
Blood pressure	Systolic ^(23,25,29)
	Diastolic ⁽²³⁾
*References in Table 3.	

Table 3. Studies included in the analysis

Num	Original Paper	Purpose of LHW	Field	Method	Main outcome,	Setting	Follow-up,	Format (briefly)	Months of	Quality
ber		intervention			analysis		N =		duration +	assessment
									follow-up	score
1	Daniels, E., Powe, B., Metoyer, T., McCray, G., Baltrus, P., & Rust, G. (2012). Increasing knowledge of cardiovascular risk factors among African Americans by use of community health workers: The ABCD community intervention pilot project. <i>Journal of the National Medical Association, 104</i> (3-4), 179–185. USA	To increase knowledge of cardiovascular risk among African- Americans	CVD	RCT	Knowledge of CVD, health literacy, Depression, HBA1C, BP, cholesterol, BMI, waist circumference <i>t</i> tests	Church	25	Group meeting Telephone counselling	1.5	17
2	DePue, J., Dunsiger, S., Seiden A., Blume, J., Rosen, R., Goldstein, M., Nu'usolia, O., Tuitele, J., & McGarvey, S. (2013). Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial. <i>Diabetes Care, 36</i> (7), 1947–1953.	To support diabetes self-management among American Samoans	T2DM	RCT	HBA1C, BP, BMI, waist circumference, dietary intake Wilcoxon, <i>t</i> test, mixed effects	CHC	243	Group meetings Individual meetings	12	22

	American Samoa, USA				longitudinal regression model					
3	Furze, G., Cox, H., Morton, V., Chuang, L- H., Lewin, R.J.P., Nelson, P., Carty, R., Norris, H., Patel, N., & Elton, P. (2012). Randomized controlled trial of a lay- facilitated angina management programme. <i>Journal of Advanced Nursing</i> , 68(10), 2267–2279. England	To assess the effectiveness of a angina management program	CVD (Angina manage- ment)	RCT	Angina frequency (1-week angina diary) Negative binomial, linear and logistic regression	Home- based	124	Individual interview Home visits Telephone calls	3	20
4	Gagliardino, J.J., Arrechea, V., Assad, D., Gagliardino, G.G., González, L., Lucero, S., Rizzuti, L., Zufriategui, Z., & Clark, C Jr. (2013). Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals. <i>Diabetes/Metabolism Research & Reviews</i> , 29(2), 152–160. Argentina	To compare standard care and the care and ongoing support of trained peers for people with T2DM	CVD (Hyper- tension)	RCT	HBA1C, BMI, BP, cholesterol, attitudes regarding diabetes and their care Chi-square test, <i>t</i> test	Health education center	198	Peer support group Face-to-face visits Telephone communication	1.5	15

5	Hargraves, J.L., Ferguson, W.J., Lemay, C.A., & Pernice, J. (2012). Community health workers assisting patients with diabetes in self-management. <i>Journal of Ambulatory Care Management</i> , 35(1), 15–26. Massachusetts, USA	To integrate community health workers into work with diabetes type 2 patients and support diabetes self-management	T2DM	RCT	HBA1C, cholesterol, BP, self-management	CHC	1,415	LHW in health care teams	13	9
6	Kronish, I.M., Goldfinger, J.Z., Negron, R., Fei, K.Z., Tuhim, S., Arniella, G., & Horowitz, C.R. (2014). Effect of peer education on stroke prevention: The Prevent Recurrence of All Inner-City Strokes Through Education (PRAISE) randomized controlled trial. <i>Stroke</i> , 45(11), 3330–3336. New York City, USA	To determine the effect of peer education on secondary stroke prevention	CVD (Stroke)	RCT	BP, cholesterol, use of antithrombotic medications, control of the stroke risk factors <i>t</i> test for continuous variables, χ^2 analysis for categorical variables, mixed models	Primary health care	510	Group meetings	1.5 + 6	20
7	Lynch, E.B., Liebman, R., Ventrelle, J., Avery, E., & Richardson, D. (2014). A self-	To determine the effectiveness of	T2DM, CVD	RCT	Medical history, clinical variables,	Communit y setting	55	Group sessions	6	19

		management intervention for African Americans with comorbid diabetes and hypertension: A pilot randomized controlled trial. <i>Preventing Chronic Disease</i> , 11, 130349. Chicago, USA	comorbid diabetes and hypertension self-management intervention for African Americans	(hypertens ion)	BMI, medications, dietary intake, PA, health literacy, nutrition knowledge and quality of life	Telephone calls				
					<i>t</i> tests, χ^2 tests, Fisher's exact test, continuous variables, Wilcoxon rank-sum test					
8	Martin, M.Y., Kim, Y.I., Kratt, P., Litaker, M.S., Kohler, C.L., Schoenberger, Y.M., Clarke, S.J., Prayor-Patterson, H., Tseng, T.S., Pisu, M., & Williams, O.D. (2011). Medication adherence among rural, low-income hypertensive adults: a randomized trial of a multimedia community-based intervention. <i>American Journal of Health Promotion</i> , 25(6), 372–378. Alabama, USA	To examine the effectiveness of community-based multimedia intervention in medication adherence among hypertensive patients	CVD (hypertens ion)	RCT	Pill count Means, standard deviations, frequencies. χ^2 analysis, general linear model	Online, CHC	338	Online program	6 + 6	16
						Home visits		Telephone calls		

9	McDermott, R.A., Schmidt, B., Preece, C., Owens, V., Taylor, S., Li, M., & Esterman, A. (2015). Community health workers improve diabetes care in remote Australian Indigenous communities: results of a pragmatic cluster randomized controlled trial. <i>BMC Health Services Research</i> , 15, 68. Australia (north)	To test the effectiveness of a community-based approach to intervention for indigenous adults with poorly controlled T2DM in Australian indigenous communities	T2DM	RCT	HBA1C t tests, Wilcoxon rank sum tests, chi-square test, generalized estimating equations regression models	Primary health care	191	LHW in health care team	18	20
10	Moskowitz, D., Thom, D.H., Hessler, D., Ghorob, A., & Bodenheimer, T. (2013). Peer coaching to improve diabetes self-management: Which patients benefit most? <i>Journal of General Internal Medicine</i> , 28(7), 938–942. San Francisco, USA	To examine the effect of peer health coaching on HbA1C modified by diabetes control characteristics	T2DM	RCT	HbA1C t tests, Fischer's exact test	Public health care	299	NR	6	18
11	Perez-Escamilla, R., Damio, G., Chhabra, J., Fernandez, M.L., Segura-Perez, S., Vega-Lopez, S., Kollannor-Samuel, G., Calle, M., Shebl, F.M., & D'Agostino, D. (2015). Impact of a Community Health Workers-Led Structured Program on Blood	To evaluate home-based culturally appropriate CHW-integrated T2DM counselling among Latino adults	T2DM	RCT	HbA1c, BG and lipid profile χ^2 test for categorical variables and independent samples ANOVA	Primary health care	148	Home visits	12 + 6	22

	Glucose Control Among Latinos With Type 2 Diabetes: The DIALBEST Trial. <i>Diabetes Care</i> , 38(2), 197–205. Connecticut, USA					for continuous variables, a linear mixed effects				
12	Philis-Tsimikas, A., Fortmann, A., Lleva-Ocana, L., Walker, C., & Gallo, L.C. (2011). Peer-Led Diabetes Education Programs in High-Risk Mexican Americans Improve Glycemic Control Compared With Standard Approaches A Project Dulce Promotora Randomized Trial. <i>Diabetes Care</i> , 34(9), 1926–1931. San Diego, USA	To evaluate the effect of a culturally sensitive diabetes self-management program among Mexican-American with T2DM	T2DM	RCT	HbA1C	CHC	156	Learning class	10 + 4	15
					Multilevel models, within-group analysis			Support group		
								Telephone calls		
13	Prezio, E.A., Pagan, J.A., Shuval, K., & Culica, D. (2014). The Community Diabetes Education (CoDE) program: cost-effectiveness and health outcomes. <i>American Journal of Preventive Medicine</i> , 47(6), 771–779. USA	To examine the long term cost effectiveness and improvements in diabetes-related complications	T2DM	RCT	HBA1c	NR	10 000'	NR	NR	15
					Archimedes model					
14	Prezio, E.A., Cheng, D., Balasubramanian, B.A., Shuval, K., Kendzor, D.E., & Culica, D. (2013). Community Diabetes Education	To determine the impact of a culturally tailored diabetes education	T2DM	RCT	HbA1C	CHC	156	LHW	12	23
					<i>t</i> test to continuous			appointments along with usual		

	(CoDE) for uninsured Mexican Americans:	program for uninsured			variables and			care		
	a randomized controlled trial of a culturally	Mexican-American with			Pearson χ^2 for					
	tailored diabetes education and	DM			categorical					
	management program led by a community				variables, linear					
	health worker. <i>Diabetes Research &</i>				mixed-models					
	<i>Clinical Practice</i> , 100(1), 19–28. Texas,									
	USA									
15	Rothschild, S.K., Martin, M.A., Swider,	To assess whether	T2DM	RCT	DM empowerment,	Communit	121	Telephone calls	24	25
	S.M., Tumialan Lynas, C.M., Janssen, I.,	community health			DM self-care	y setting		Home visits		
	Avery, E.F., & Powell, L.H. (2014).	workers could improve			Activities (also PA,					
	Mexican American trial of community	glycemic control among			nutrition),					
	health workers: a randomized controlled	Mexican-Americans			depression, stress					
	trial of a community health worker	with diabetes			scale, anxiety					
	intervention for Mexican Americans with				<i>t</i> test, Wilcoxon					
	type 2 diabetes mellitus. <i>American Journal</i>				rank sum test,					
	<i>of Public Health</i> , 104(8), 1540–1548.				mixed effect linear					
	Chicago, USA				model analysis.					
16	Safford, M.M., Andreae, S., Cherrington,	To test the effectiveness	T2DM	RCT	HbA1c, systolic BP,	Communit	270	Meetings	10 + 5	23
	A.L., Martin, M.Y., Halanych, J., Lewis,	of peer coaches plus			LDL-C, BMI, and	y setting		Telephone calls		
	M., Patel, A., Johnson, E., Clark, D.,	brief diabetes education								

	Gamboa, C., & Richman, J.S. (2015). Peer coaches to improve diabetes outcomes in Rural Alabama: A Cluster Randomized Trial. <i>Annals of Family Medicine</i> , 13(S1), S18–S26. Alabama, USA	compares with brief education alone in Rural Alabama			quality of life					
					Frequencies and p values					
17	Spencer, M.S., Rosland, A.M., Kieffer, E.C., Sinco, B.R., Valerio, M., Palmisano, G., Anderson, M., Guzman, J.R., & Heisler, M. (2011). Effectiveness of a community health worker intervention among African American and Latino adults with type 2 diabetes: a randomized controlled trial. <i>American Journal of Public Health</i> , 101(12), 2253–2260. Detroit, USA	To test a culturally tailored CHW intervention for diabetes self-management improved diabetes clinical measures, self-management and distress among African American and Latino adults	T2DM	RCT	HbA1C, PA, nutrition	Communit y health center	136	Home visits Group classes Telephone calls	6	21
					Student t test, Pearson χ^2 test					
18	Tang, T.S., Funnell, M., Sinco, B., Piatt, G., Palmisano, G., Spencer, M.S., Kieffer, E.C., & Heisler, M. (2014). Comparative effectiveness of peer leaders and community health workers in diabetes self-	To compare a peer leader (PL) versus a community health worker (CHW) telephone intervention	T2DM	RCT	HbA1C	Communit y setting	69	Group Classes Home visits Primary care provider visits	18	23
					Linear mixed methods, Student's t test, log-rank test, Fisher exact test,					

	management support: Results of a randomized controlled trial. <i>Diabetes Care</i> , 37 (6), 1525–1534. Detroit, USA	in diabetes self- management education			Pearson χ^2 test			Telephone calls		
19	Tang, T.S., Funnell, M.M., Sinco, B., Spencer, M.S., & Heisler, M. (2015). Peer- Led, Empowerment-Based Approach to Self-Management Efforts in Diabetes (PLEASED): A Randomized Controlled Trial in an African American Community. <i>Annals of Family Medicine</i> , 13(S1), S27– S35. Michigan, USA	To investigate whether a peer support model could sustain improvements achieved in a short-term diabetes self-management education program for African American adults with type 2 diabetes	T2DM	RCT	HbA1C Linear mixed model, Spearman correlation, Student’s <i>t</i> test, log rank test, Fisher’s exact test, Pearson’s χ^2	Communit y setting	64	Group sessions Face to face meetings Telephone calls	15	25
20	Thom, D., Ghorob, A., Hessler, D., DeVore, D., Chen, E., & Bodenheimer, T.A. (2013). Impact of peer health coaching on glycemic control in low-income patients with diabetes: A randomized controlled trial. <i>Annals of Family Medicine</i> , 11(2), 137–144. San Fransisco, USA	To test the impact of individual peer coaching on glucose control on patients with poorly controlled diabetes	T2DM	RCT	HbA1C Linear mixed model, logistic regression	Public clinics	275	In person interactions Telephone calls	6	20

21	van der Wulp, I., de Leeuw, J.R.J., Gorter, K.J., & Rutten, G.E.H.M. (2012). Effectiveness of peer-led self-management coaching for patients recently diagnosed with Type 2 diabetes mellitus in primary care: a randomized controlled trial. <i>Diabetic Medicine</i> , 29(10), e390–e397. Netherlands	To study the effectiveness of a self-management coaching intervention in recently diagnosed patients with Type 2 diabetes	T2DM	RCT	Self-efficacy, coping, physical activity, dietary habits, psychological well-being, depressive symptoms and diabetes related distress	General practices	119	Home visits Telephone calls Emails	18	22
22	Whittle, J., Schapira, M.M., Fletcher, K.E., Hayes, A., Morzinski, J., Laud, P., Eastwood, D., Ertl, K., Patterson, L., & Mosack, K.E. (2014). A randomized trial of peer-delivered self-management support for hypertension. <i>American Journal of Hypertension</i> , 27(11), 1416–1423. Milwaukee, USA	To compare changes in BP control among veterans participating in a peer-delivered vs. Professionally delivered health education intervention	CVD (Hypertension)	RCT	Systolic BP Mixed model, generalized linear model	Veterans' service organizations	379	Group sessions	12	24
23	Assah, F.K., Atanga, E.N., Enoru, S., Sobngwi, E., & Mbanya, J.C. (2015).	To examine the effectiveness of a	T2DM	Trial	HbA1C, BP, blood lipids, BMI, waist	Communit	192	Group meetings	6	17

	Community-based peer support	structured peer support			circumference, y setting			Personal		
	significantly improves metabolic control in	diabetes intervention in			diabetes self-care			encounters		
	people with Type 2 diabetes in Yaounde,	Cameroon			(also PA and			Telephone calls		
	Cameroon. <i>Diabetic Medicine</i> , 32(7), 886–				nutrition)					
	889. Cameroon				Continuous					
					variables and					
					differences, Student					
					<i>t</i> test					
24	Carey, M.E., Mandalia, P.K., Daly, H.,	To develop and test a	T2DM	trial	Diabetes coherence,	Primary	242	Group meeting	1 day	20
	Gray, L.J., Hale, R., Stacey, L.M., Taub,	format of delivery of			diabetes perception	health				
	N., Skinner, T.C., Stone, M., Heller, S.,	diabetes self-			care					
	Khunti, K., & Davies, M.J. (2014).	management education			Intra-class-					
	Increasing capacity to deliver diabetes self-	by paired professional			correlations,					
	management education: Results of the	and lay educators			continuous and					
	DESMOND lay educator non-randomized				categorical					
	controlled equivalence trial. <i>Diabetic</i>				variables, <i>t</i> test, χ^2 ,					
	<i>Medicine</i> , 31(11), 1431–1438. England and				Wilcoxon test					
	Scotland									

25	Castillo, A., Giachello, A., Bates, R., Concha, J., Ramirez, V., Sanchez, C., Pinsker, E., & Arrom, J. (2010). Community-based diabetes education for Latinos: The Diabetes Empowerment Education Program. <i>Diabetes Educator</i> , 36(4), 586–594. California, USA	To test the feasibility and effectiveness of a linguistic and culturally appropriate diabetes education program among Latinos	T2DM	trial	HbA1C, PA, nutrition	Communit y setting	47	Group meeting	2.5	15
26	Cene, C.W., Haymore, L.B., Ellis, D., Whitaker, S., Henderson, S., Lin, F.C. & Corbie-Smith, G. (2013). Implementation of the power to prevent diabetes prevention educational curriculum into rural African American communities: A feasibility study. <i>The Diabetes Educator</i> , 39(6), 776–785. North Carolina, USA	To describe the feasibility of using a community-based approach to implement a diabetes prevention education curriculum in rural African-American settings	T2DM	Trial	BG, BP, BMI, PA Mc Nemar test, <i>t</i> test	Communit y setting	30	Small group sessions	7.5	11
27	Collinsworth, A.W, Vulimiri, M., Schmidt, K. L., & Snead, C.A. (2013). Effectiveness of a community health worker–led diabetes self-management education program and implications for CHW involvement in care	To evaluate the effectiveness of a diabetes self-management education program and to	T2DM	Trial	HBA1C, BMI, Blood pressure <i>t</i> test	Communit y clinic	497	Group meetings Clinical assessments	12	12

		coordination strategies. <i>The Diabetes Educator</i> , 39(6), 792–799. Dallas, USA	understand how CHWs and primary care providers work together							
28	DePue, J.D., Rosen, R., Seiden, A., Bereolos, N., Chima, M., Goldstein, M., Nu’usolia, O., Tuitele, J., & McGarvey, S.T. (2013). Implementation of a culturally tailored diabetes intervention with community health workers in American Samoa. <i>The Diabetes Educator</i> , 39(6), 761–771. American Samoa, USA	To investigate a primary care-based, nurse–community health worker (CHW) team intervention to support type 2 diabetes self-management in American Samoa	T2DM	Trial	HBA1C, BP, smoking status, alcohol use, depression score, treatment dose	Primary care	104	Group visits	12	16
29	Dye, C., Williams, J., & Hoffman Evatt, J. (2015). Improving hypertension self-management with community health coaches. <i>Health Promotion Practice</i> , 16(2), 271–281. Appalachians, USA	To improve hypertension self-management among rural residents older than 60 years through education and support	CVD (Hyper-tension)	Trial	Hypertension knowledge and self-management, BP, weight, waist circumference, blood lipids and	Communit y setting	146	Group classes	4	20
								Education program		

						BG, PA, nutrition				
						Student <i>t</i> test,				
						McNemar's test,				
						Bonferroni				
						correction				
30	Fernandes, R., Braun, K., Spinner, J., Sturdevant, C., Ancheta, S., Yoshimura, S., Compton, M., Wang, J-H., & Lee, C. (2012). Healthy heart, healthy family: A NHLBI/HRSA collaborative employing community health workers to improve heart health. <i>Journal of Health Care for the Poor and Underserved</i> , 23(3), 988–999. Hawaii, USA	To evaluate the impact of the heart health curriculum on low- income Filipinos with CVD risk factors in Hawaii	CVD	Trial	Disease and medication histories, BMI, waist circumference, BP, BG, lipid profile, HBA1C, PA, nutrition <i>t</i> tests, chi-squared	Communit y setting	92	Group sessions	12	16
31	Islam, N., Wyatt, L., Patel, S., Shapiro, E., Darius Tandon, S., Runi Mukherji, B., Tanner, M., Rey, M.J., & Trinh-Shevrin, C. (2013). Evaluation of a community health	To explore the impact and feasibility of a pilot intervention to improve diabetes management	T2DM	Trial	HBA1C, weight, nutritional and physical activity behaviors, access to	Clinical and communit y setting	26	Group sessions Individual visits	9	20

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	worker pilot intervention to improve	among Bangladeshi-			health care, diabetes					
	diabetes management in Bangladeshi	American individuals			knowledge, self-					
	immigrants with type 2 diabetes in New	with type 2 diabetes			management, self-					
	York City. <i>The Diabetes Educator</i> , 39(4),	living in New York City			efficacy, mental					
	478–493. New York, USA				health					
					Fisher’s exact test, <i>t</i>					
					test, frequencies,					
					means, standard					
					deviations					
32	Lorig, K., Ritter, P.L., Plant, K., Laurent,	To implement and	CC	Trial	Pain/physical	Online-	194	Interactive web	1.5 + 12	21
	D.D., Kelly, P., & Rowe, S. (2013). The	investigate the			discomfort,	based,		program		
	South Australia Health Chronic Disease	effectiveness of a			shortness of breath,	communit				
	Self-management Internet Trial. <i>Health</i>	chronic condition self-			tiredness, impact of	y setting				
	<i>Education & Behavior</i> , 40(1), 67–77.	management internet			disease, health					
	South Australia	trial in South Australia			distress, self-rated					
					disability, number					
					of illness days, PA					
					Paired <i>t</i> tests					

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	Texas, USA	Americans								
36	Ryabov, I. (2011). The impact of community health workers on behavioral outcomes and glycemic control of diabetes patients on the U.S.-Mexico border. <i>International Quarterly of Community Health Education</i> , 31(4), 387–399. Texas, USA	To determine the impact of CHW on the self-management practices of people in with diabetes on the US–Mexico border	T2DM	Trial	DM knowledge	NR	30	NR	24	12
37	Saxe-Custack, A., & Weatherspoon, L. (2013). A patient-centered approach using community-based paraprofessionals to improve self-management of Type 2 Diabetes <i>American Journal of Health Education</i> , 44(4), 213–220. Michigan, USA	To examine if a lifestyle management program can initiate positive impacts on self-management and behavior change among participants with type 2 diabetes	T2DM	Trial	BP, BMI, HbA1c, demographic information, lifestyle behaviors (also PA and nutrition), behavior change by stages of change, appraisal of diabetes Paired <i>t</i> tests	Communit y setting	122	Group sessions Individual meetings Home visits	2.5+6	16
38	Tsoh, J., Burke, N., Gildengorin, G., Wong,	To evaluate a smoking	CC	Trial	7-day and 30-day	Communit	192	Small group	2+3	21

	C Le, K., Nguyen, A., Chan, J.L., Sun, A.,	cessation program:	(smoking		smoking abstinence,	y setting		sessions		
	McPhee, S.J. & Nguyen, T.T. (2015). A	intention to quit, use of	cessation)		assessed by smokers			Telephone calls		
	Social network family-focused intervention	cessation recourses and			and family members					
	to promote smoking cessation in Chinese	smoking abstinence								
	and Vietnamese American male smokers: A				Descriptive					
	feasibility study. <i>Nicotine & Tobacco</i>				statistics,					
	<i>Research</i> , 17(8), 1029–1038. USA				significance, linear					
					model adjustment					
39	Tully, M., Kos, A., Eastwood, D., Kusch,	To describe the	CVD	Trial	BP	Health	83	Group sessions	6	16
	J., & Kotchen, T. (2015). Implementation	development,	(blood		<i>t</i> tests and χ^2 tests.	center				
	of an adjunct strategy to reduce blood	implementation, and	pressure)							
	pressure in blacks with uncontrolled	evaluation of a BP								
	hypertension: a Pilot Project. <i>Ethnicity &</i>	program								
	<i>Disease</i> , 25(2), 168–174.									
	Wisconsin, USA									
40	Turner, A., Anderson, J.K., Wallace, L.M.	To investigate a self-	CC	Trial	Demographic data,	Communit	486	Group meetings	2	19
	& Bourne, C. (2015). An evaluation of a	management program			Patient Activation,	y setting				
	self-management program for patients with	among patients with			EuroQol, Hospital					
	long-term conditions. <i>Patient Education</i>	long-term conditions			Anxiety and					
	<i>and Counseling</i> , 98(2), 213–219. UK				Depression, Health					
					Education Impact					

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Questionnaire

Paired *t* tests,
General linear
model, and analysis
of covariance,
McNemar's test

NR = not reported
CVD = cardiovascular disease
CC = chronic conditions or its prevention
CHC = community health center
'=estimated
BMI = body mass index
BP = blood pressure
BG = blood glucose

For Peer Review

Characteristics and training of LHWs			Theories and guidelines behind the intervention
Experience with long-term conditions	Self-management intervention components and delivery by LHWs		National guidelines for DM, hypertension and cardiovascular diseases
	Participants recruited by LHWs or health professionals	Interaction frequency from once a week to every second month, often besides usual health care	Transtheoretical model of change
	Attrition prevention by providing, e.g., make-up sessions, telephone support calls, gift cards.	Principles of implementation: individual-empowering, culture and language sensitiveness, peer education, family-centering, social networking	Social cognitive theory
	Elements of training: classroom training, hands-on activities, home visits, clinical measurements	Elements: PA, nutrition, medication, clinical measurements, and other education classes; online programs	Chronic care model
	Training contents: LTCs, motivation, self-monitoring, self-management, medication	Formats: Individual or group meetings delivered by a LHW or a group of LHWs; LHW as a	provided face to face, via telephone, online, at clinics or community centers or home visits.

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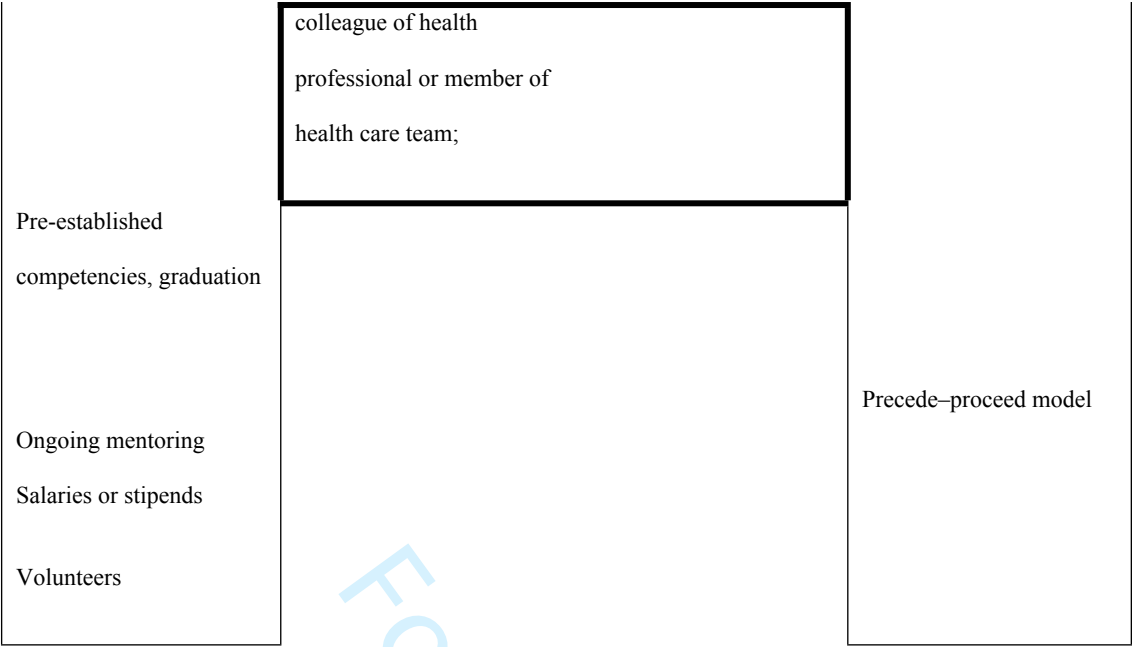


Figure 2. Synthesis of LHW-led self-management interventions for diabetes, cardiovascular diseases and prevention.

Table 4. Reported theories and principles.

Theories and models applied and reported	<i>n</i>
Transtheoretical model of change ^(7,8,11,23,29,30,33,37,38)	9
Social cognitive theory ^(1,8,14,21,38)	5
Chronic care model ^(22,40)	2
Self-efficacy theory ^(31,32)	2

Precede-proceed model ^(2,28)	2
Socioecological model ^(5,17)	2
Health belief model ⁽³³⁾	1
Self-management theory ⁽¹⁵⁾	1
Principles and methods applied and reported	<i>n</i>
Individual-empowerment ^(17–19,23,25,33,34,38–40)	10
Peer education principles ^(4,8,9,23,32,39,40)	7
Culture-sensitivity ^(11,12,14,23,33,34)	6
Understanding of the context in which behavior changes take place ^(4,8,21,23,33,30)	6
The active role of recipients ^(4,12,25)	3
Motivational interview ^(25,30,37)	3

Table 5. Examples of the most often reported BCTs.

BCT	<i>n</i>
Self-monitoring ^(3,4,6–8,12–14,16,18,19,21,22,25,27–32,37,39)	24
taking clinical measurements: blood sugar and blood pressure ^(2,6,15,16,19,28,30,39)	
monitoring of symptoms and health behavior related to the	

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assessed goals ^(4,7,28,29)	
using self-management monitors: blood glucose, blood	
pressure and pedometers ^(12,14,22,29,30,39)	
Goal setting ^(3,7,8,15,16,18–20,21,25,27–29,32–34,35,37,38)	20
Information providing ^(6,8,11,14,15,17,19,21,22,25,28,30–32)	17
Individual action plans to support health-related behavior ^(6,10,11,14,19,20,29,31–33,38,39)	12
Enhancing participants’ social support ^(6,7,15,16,18,22,23,25,29,32,40)	11
Practicing problem solving techniques ^(2,6,7,15,18,19,28,29,32,37)	10
Possibilities to tailor intervention activities towards participants’ personal needs ^(11,14,18,28,30,31,33,38–40)	10

Table 6. Original studies that reported outcomes of NB and/or PA

Original paper	Theory	Format	Individual / Group	Additional info	Number of BCTs	Frequency	Length + follow- up (month)	Improv ment in NB	Improv ment in PA	Improv- ment in CM
(7) Lynch et al., 2014	Models of behavior change	Telephone calls Education lectures	Individual + group	18 group sessions by dietitian and LHW weekly for three months, afterwards every second week; phone calls weekly by LHW	9	weekly	6	yes	yes	yes / no
(15) Rothschild et al., 2014	Self- management theory	Home visits Telephone calls	Individual	36 home visits	7	monthly	24	no	no	yes / no
(17) Spencer et al., 2011	Empowerment theory	Education lectures, Home visits, Accompanied clinic	Individual	Group session once every two weeks Telephone calls once	4	weekly	6	no	yes	yes / no

		visits,	every two weeks								
		Telephone									
		counselling,									
		Peer activities									
(21) van der	Social	Home visits,	Individual	Monthly meetings,	5	two weeks	18	yes	no	-	
Wulp et al.,	cognitive	Education lectures,		Telephone calls two							
2012	theory	Telephone		weeks after meetings.							
		counselling,		Plus calls and emails							
		Emails		when needed.							
(23) Assah et	Socioculturally	Group meeting,	Individual	Six group meetings,	3	monthly	6	yes	yes	yes	
al., 2015	adapted	Individual	+ group	personal encounters,							
	community-	appointments,		telephone calls (five							
	based	Telephone		calls)							
	approach	counselling,									
		Home visits									

(25) Castillo et al., 2010.	Empowerment theory, Adult education	Group meeting, Individual appointments, Education lectures	Individual + group	Ten group education sessions + individual contacts between sessions	9	weekly	2.5	yes	yes	yes / no
(26) Cene et al., 2013	Community capacity building	Group meeting, Education lectures	Group	Group meetings weekly for six weeks, then monthly, 12 sessions total	2	six times weekly, afterwards monthly	7.5	-	no	no
(29) Dye et al., 2015	Transtheoretic al model of change	Group meeting, Education lectures	Group	Self-management curriculum: 7 meetings plus additional lectures on NB or PA	8	weekly	4	yes	yes	yes
(30) Fernandes et al., 2012	Transtheoretic al model of change	Group meeting, Education lecture, Peer work shop	Group	Group meetings, afterwards monthly meetings up to 12 months	9	11 times weekly, afterwards monthly	12	yes	yes	yes / no

(31) Islam et al., 2013	Community-based approach	Group meeting, Individual appointments, Education lectures, Make-up sessions	Individual + group	six monthly group meetings plus individual meetings at months 3, 6, and 9	4	monthly up to 6 months, individual at 9 months	9	yes	yes	no
(32) Lorig et al., 2013	Self-efficacy theory	Online group meetings, Education lectures, Weekly activities	Online: Individual + group	Online program	15	available every day	1.5 + 12	-	yes	-
(33) Micikas et al., 2015	Stages of change, Health belief model	Group meetings, Education lectures, Home visits	Individual + group	Individual home visits, group meetings	7	weekly	4	-	no	yes
(37) Saxe-Custack et al., 2013	Community-based approach	Group meetings, Individual appointments,	Individual + group	four individual weekly meetings at home, afterwards six home	9	weekly	2.5 + 6	yes	no	yes / no

Education lectures,	visits or group meetings
Home visits	weekly

NB = nutrition behavior

PA = physical activity

CM = clinical measurements

- = was not measured

Table 7. Outcomes in nutrition behavior and physical activity and their links to intervention components and clinical measurements

Measured outcome	Type of effect	Original paper	Formats	BCTs	Clinical measurements
					+improvement
					-no improvement
NB + PA	NB + PA improved	7	Telephone calls + Education lectures	9: Goal setting, motivating, emotional support, teaching problem-solving techniques, enhancing social support, self-monitoring, role	+HbA1C

(individual + group)	model narratives, hands-on activities, taking and monitoring clinical measurements	+Weight loss
		-Blood lipids
		-Blood pressure
23	Group meeting + Individual appointments + Telephone counselling + Home visits	3: Teaching self-management skills, enhancing social support, discussion
		+HbA1C
		+Blood lipids
		+Blood pressure
		+BMI
		+Fast BC
		+Waist circ
		+Weight loss
25	Group meeting + Individual appointments + Education lectures	9: Goal setting, self-efficacy support, motivating, teaching self-management skills, enhancing social support, support decision making, information providing, self-monitoring, hands-on activities
		+HbA1C
		+Blood pressure
		-Weight loss
29	Group meeting + Education lectures (group)	8: Goal setting, self-efficacy support, teaching problem-solving techniques, enhancing social support, action plans, self-monitoring, personal health diary, taking and monitoring clinical measurements
		+Blood pressure
		+Fast BC
		+Weight loss
		+Blood lipids

	30	Group meeting + Education lectures (group) + peer work shop	9: Information providing, self-monitoring, using written counselling materials, reminders, tailoring, hands-on exercises, taking and monitoring clinical measurements, healthy snacks, incentives	+Blood lipids +Fast BC -HBA1c -Blood pressure -BMI
		31	Group meeting + Individual appointments + Education lectures + Make-up sessions	4: Information providing, action plans, self-monitoring, tailoring -Blood lipids -HbA1c -Blood pressure -BMI
		21	Home visits + Education lectures + Telephone counselling + emails	5: Goal setting, self-efficacy support, motivating, information providing, self-monitoring NR
		37	Group meetings + Individual appointments + Education lectures + Home visits	9: Goal setting, motivating, teaching problem solving, teaching relapse prevention, information providing, self-monitoring, tailoring, guest speakers, hands-on exercises +HbA1C +BMI -Blood pressure
		17	Education lectures + Home visits + Accompanied clinic visits	4: Self -efficacy support, keeping appointments, information providing, hands-on exercises +HbA1C +Blood lipids

PA	no improvements	15	Home visits + Telephone calls	7: Goal setting, teaching self-management skills, teaching problem-solving techniques, enhancing social support, information providing, using metaphors, taking and monitoring self-management skills	-Blood pressure
					-BMI
					+HbA1C
					+Weight loss
					-Blood lipids
	improved	32	Online group meetings + Education lectures + Activities	15: Goal setting, self-efficacy support, teaching self-management skills, emotional or behavioral support, teaching problem-solving skills, sharing feelings, enhancing social support, stress managements, information providing, action plan, self-monitoring, feedback, discussion, role model narratives, hands-on exercises	-Blood pressure
					NR
	no improvements	26	Group meeting + Education lectures	2: Guest speakers, taking and monitoring clinical measurements	-Blood pressure
					-Fasting BC
					-Weight loss
					-Blood lipids
					-HbA1C
		33	Group meetings + Education lectures + Home visits	7: Goal setting, emotional and behavioral support, action plans, reminders, discussion, tailoring, hands-on exercises	+HbA1C

For Peer Review

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**Implementation and Outcomes of Lay Health Worker–Led Self–Management
Interventions for Long-Term Conditions and Prevention: A Systematic Review**

3 March 2019: revised version

A manuscript for Health Education & Behavior

Abstract

The aim of this study was to systematically review lay health worker (LHW)-led self-management interventions for adults with long-term conditions (LTCs) to see how the interventions have been implemented and to compose a synthesis of [research](#) findings, taking into consideration the intervention components that have been applied.

We conducted systematic searches for articles published between January 2010 and December 2015 in five databases: Cochrane, MEDLINE, CINAHL, PsycINFO and Web of Science. Forty original studies were found that met the inclusion criteria: self-management with diabetes ($n = 29$), cardiovascular diseases ($n = 8$), and those at risk of cardiovascular diseases ($n = 3$). [These](#) consisted of 22 randomized controlled trials and 18 other trials, with durations of one day to 24 months. The findings showed that the training of LHWs and the implementation of interventions varied widely. A synthesis of the implementation methods covers the background of the LHWs and the interventions as well as the components applied in each. Eight interventions had effects on physical activity and eight on nutrition behavior. The review also includes preliminary findings on intervention components effective in improving physical activity and nutrition behavior, including self-monitoring as a behavior change technique and group meetings as an intervention format. The same components and behavior change techniques were applied in effective and non-effective interventions.

The review found that LHW-led interventions have potential in promoting self-management in LTC. In the future, a qualified and evidence-based structure for LHW-led interventions is suggested in order to improve the systematization of interventions and their effects.

Keywords: lay health worker, long-term condition, self-management, intervention component, behavior change technique, systematic review

Introduction

Non-communicable diseases (NCD) are long-term conditions (LTC) that require ongoing self-management over a period of years as individuals learn to manage their health challenges (Eaton, Roberts, & Turner, 2015; Taylor et al., 2014; Nolte & McKee, 2008). The self-management of LTCs has been defined as a daily and flexible process where an individual, as a responsible actor, is able to perform individual goal-driven activities (Lorig & Holman, 2003; Ausili, Masotto, Dall’Ora, Salvini, & Di Mauro, 2014), such as adopting information, drug and symptom management, and adjustment to psychological consequences such as emotions and stress (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002).

Acquiring and applying individual skills related to self-management components demands effort from patients, peers, and health professionals (Kaptein, Fischer, & Scharloo, 2014; Kawi, 2012). People’s beliefs that they can cope in their everyday activities and meet the challenges of self-management have been labelled as self-efficacy (Bandura, 1977; Vervekina, Shi, Fuentes-Caceres & Scanlon, 2014). Self-management interventions provide support to modify one’s decisions and behavior for a healthier lifestyle. Interventions usually include a variety of observable and replicable behavior change techniques (BCT), such as goal setting, action planning, and self-monitoring (Michie et al., 2013; Duff et al., 2017).

The self-management of LTC has been supported by peers (Tang, Funnell, Gillard, Nwankwo, & Heisler, 2011; Dale, Williams, & Bowyer 2012; CADTH, 2013), who are usually people with the same diagnosis or health condition as the people they assist (Lorig & Holman, 2003; Carr et al., 2011; van Ginneken et al., 2013). Lay health workers (LHW) as LTC self-management supporters are especially able to share values, socioeconomic status or cultural background and, in some cases, also the experience of LTC (South, Meah, Bagnall & Jones, 2013; Hunt, Grant, & Appel, 2011; Islam et al., 2015).

LHWs act as peer supporters, educators, role models, and community capacity builders (South et al., 2013). LHWs have been shown to improve equity in health care services by reaching underserved people with a poorer health status (Walker & Jan, 2005; Shah & Patel, 2013). There has been a wide variety of LHW training in terms of duration and methods (O'Brien, Squires, Bixby, & Larson, 2009; South et al., 2013).

The effectiveness of LTC self-management interventions has been measured through individuals' knowledge, psychological state, behavior, and clinical outcomes (Dube, Van de Broucke, Housiaux, Dhoore, & Rendall-Mkosi, 2015). Lay-led self-management programs for those with chronic conditions may improve short-term self-management outcomes, such as physical activity (PA) and self-efficacy (Foster, Taylor, Eldridge, Ramsay, & Griffiths, 2009). Previous systematic reviews of LHW interventions for diabetes found that (a) LHWs' roles in individuals' self-management counseling were diverse in their ways to support, educate, advocate, and facilitate, and (b) interventions were partially effective in improving HbA1C levels and health behavior outcomes (Hunt et al., 2011; Little, Wang, Castro, Jimenez, & Rosal, 2014). Carr et al. (2011) investigated connections between the implementation of interventions and their outcomes, but found no firm relationships between them.

However, in this study we systematically reviewed previous LHW-led self-management interventions for adults with LTCs in terms of the implementation of interventions. The first objective was to investigate those characteristics of LHWs and their training that have been reported within the context of self-management. The second objective was to investigate the implementation of interventions. The third objective was to investigate what kind of relationships, if any, there are between intervention components and nutrition behavior (NB) and PA outcomes.

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Methods

Search strategies and selection criteria

The present review was conducted according to standard systematic review methodology (CRD, 2009) and reported according to the PRISMA Statement (Liberati et al., 2009). A systematic search for articles, reported full text in English (due to limited facilities and resources for translation) and published between 2010 and 2015, was undertaken in five databases between December 2015 and January 2016: Cochrane, MEDLINE, CINAHL, PsycINFO, and Web of Science. Search terms included Community Health Worker* OR Lay health* OR Lay supporter* OR Lay tutor* OR Advisor* OR counsellor* OR counselor* OR peer OR peer counsellor* OR peer counselor* OR peer-advisor* OR peer-coach* OR peer-counsellor* OR peer-counselor* OR peer-educator* OR peer-led* OR health trainer* AND Self-Management OR Self care. Both MeSH and free-text terms were used. The full search strategy is available from the authors on request.

One of the authors extracted independently the following data independently and discussed it with the other researchers who were involved with study selection. Disagreements between reviewers were resolved by consensus. The following inclusion criteria were applied: adults as recipients; non-communicable and somatic diseases or their prevention of them; LHW-led self-management intervention; organized by primary health care, community health center or corresponding organization; RCTs and quantitative trials. The exclusion criteria were the following: studies that reported outcomes of LHWs’ own self-management; intervention was led by non-trained peer supporter; family interventions; cancer, HIV, asthma or mental health self-management interventions; review papers; study protocols; and papers presenting baseline results only (Figure 1).

All of the included studies deal with self-management of diabetes and cardiovascular diseases. Both diseases, as long-term somatic and non-communicable conditions, can largely be prevented or treated by allied self-management activities covering certain daily behavioral and psychological actions taken by individuals. NB and PA are key self-management activities when dealing with type 2 diabetes and cardiovascular diseases on a daily basis (WHO, 2013; Donaldson & Rutter, 2017). In addition, there is a vital need for research with a scope that combines self-management and prevention in both diabetes and cardiovascular diseases. The quality of the included studies was assessed using the 14-item checklist from the Manual for Quality Scoring of Quantitative Studies **with a range of 0–28 points (MQSQ;** Kmet, Lee, & Cook, 2004). The quality evaluation was conducted by the first author, and the decisions have also been discussed with two other authors.

Analysis

The analysis of the first and second objectives ~~of the current study aimed to investigate~~ **concerned the contents of LHWs, their training and LHW-led self-management interventions.** **The interventions' components** were classified according to their formats (e.g., group, individual, telephone, home visit), elements (e.g., lectures, PA classes; Davidson et al., 2003), and BCTs (Michie et al., 2013). ~~For the first and the second research objectives,~~ The data were analyzed using content analysis (Schreier, 2012) by identifying the units of meaning, condensing them and finally creating subcategories. Based on similar subcategories, eight main categories were composed: (1) characteristics of LHWs, (2) training of LHWs, (3) intervention delivery by LHWs, (4) theoretical background and guidelines of the interventions, (5) principles of implementation, (6) intervention formats and

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elements, (7) behavior change techniques, and (8) intervention management and mediators. (Table 1.)

For the third objective of the review, self-management was investigated as a behavioral outcome of NB and PA in 13 original studies that measured them. The analysis was conducted by identifying the components and clinical measurements and their links to NB and PA. The data within these analyses was relatively narrow, however, it was eventually grouped according to their improvements in NB and PA and those groups were compared. This review describes and identifies the intervention features that indicate participants' behavior changes within the original studies.

All of the following aspects in the fields of NB and PA and clinical measurements were manually coded and categorized in Microsoft Excel: the reported intervention formats and elements, such as delivery in group or individual sessions, telephone or online contact, and education lectures (Davisdon et al., 2003); behavior change techniques (applied by Michie et al., 2013); intervention length and frequency; significantly improved and not improved self-management outcomes in terms of PA and NB; and clinical measurements.

This semi-qualitative metric was developed in the current study to extract and investigate the connections links between intervention components and PA and NB. Additionally, there were a large variety of measurements number of different scales and measures used to assess PA, NB, blood lipids, and blood pressure as self-management outcomes, which were difficult to bring together. Therefore, all of the tests that investigated similar items needed to be were classified as items of self-management (Table 2) in order to allow the data to be analyzed and for the results to be explained based on the study topic. All of the results are based on the published study results, and no original study data or intervention material have been examined.

Results

Included studies

The included studies ($n = 40$) originated from seven countries, most of them from the United States ($n = 31$). Twenty-nine studies examined self-management in diabetes, eight in cardiovascular diseases, and three in a risk of cardiovascular diseases. The included studies consisted of 22 randomized controlled trials and 18 other trials. The methodological quality of the studies ranged from 9 to 25 points, with a total possible MQSQ sum of 28 points (9–12 points, 5 studies; 13–20 points, 23 studies; 21–25 points, 12 studies; see Table 3). Points were typically subtracted due to an absence of randomization or blinding, or due to a lack of reporting about them. No original studies were excluded, since the focus of the review was on qualitative description of LHWs and interventions. Additionally, MQSQ does not set any score limits for the appropriate level of study quality.

The durations of the self-management interventions varied from one day to 24 months. The number of baseline recipients in all the included studies was 10,065 (female 55%) and follow-up 7,970, with a total attrition rate of 21%. The studies varied largely in their reporting. For example, in some papers the background, training, and duties of LHWs as well as intervention details were clearly presented, and in others they were not. Due to the high number of studies included in the current review, the original studies will be cited according to the numbers referred to in Table 3.

Characteristics of LHWs and their training

The individual skills and characteristics often included having the similar health condition or experience of it as the participants had^(8,10,12,16,20,21,32,38). LHWs came from the same community as the recipients did^(6,8,26), and some of them also had a professional background^(24,26). Many of the studies were located in minority communities, therefore LHWs were often bilingual, combining, for example, Spanish and English^(11,25,27,30,31).

Training educators were revealed to be health professionals^(7,14), specialists^(1,28), or university researchers^(25,29). Besides of self-management-related themes^(2,4,5,7,8,9,11,12,15,16,17,18,20,21,22,23,25,28,29,33,34,37,40), Training content consisted of using community resources, navigating health care services, and organizational issues.^(5,8,9,12,16,18,20,22,29) (See Figure 2.) Additionally LHWs' training also included themes of supporting effective self-management techniques, such as motivational, self-monitoring and measuring^(2,4,5,7,8,9,11,12,15,16,17,18,20,21,22,23,25,28,29,33,34,37,40), alongside clinical protocols^(8,11,16,25,34,35), medication^(9,20,34) and self-care routines^(9,16). The training elements varied from, for example, classroom activities^(8,28,38,40) to home visits⁽⁹⁾. The LHWs were also trained in research practices^(2,5,8,12,16,25,28,38), protecting human subjects^(5,18,25), and cultural awareness^(5,18).

The number of LHWs within one intervention varied from 1⁽¹⁴⁾ to 41⁽¹⁶⁾. LHWs had **multiple roles and duties related to intervention components**. Between the education sessions, LHWs contacted participants to provide support or to answer their questions^(1,7,17,25,35,39). They were also available for recipients' phone calls.⁽¹⁾ In a few interventions LHWs worked as equal members of health care teams^(5,11,12,24,27,29,30,33,34,40).

LHWs also collected research data^(1,25,31), contributed to intervention evaluations⁽²⁵⁾, and acted as a team leader for a group of LHWs.^(4,26,39) Some studies reported **supervision provided to LHWs** by program coordinators^(3,4,5,8,9,20,37), nurse care managers^(2,3,28), health

care teams of community centers^(5,37), and university professionals⁽³⁷⁾. In some cases, LHWs were provided with a written manual to ensure consistency of delivery.^(37,38,40) They consulted with health professionals on any serious symptoms or for measurements of recipients.^(11,12,27,32)

Intervention delivery of LHW-led interventions

Nearly half of the 40 studies reported no **theoretical background** for the intervention or program^(3,4,6,9,10,12,13,16,18-20,24,26,27,34-36,39), but some did (Table 4). In eight studies the theoretical background was presented as a combination of two theories^(5,8,11,23,25,33,38,40). The framework of an intervention's content or its components was often based on **national guidelines and recommendations** on diabetes^(1,2,5,11,12,14,15,26,27,32,35), hypertension^(8,29), or cardiovascular diseases^(30,39).

Meetings usually took place in community centers and churches, often held at a convenient location to the recipients^(1,2,4,22,23,25-27,31). **The length** of sessions, when reported, ranged from 30 to 90 minutes.^(26,27,29,37) **Group sizes** varied from two^(24,38) to twenty-five⁽³²⁾ participants. In a few interventions the interaction frequency was based on the needs of peers and recipients.^(2,21)

LHWs delivered educational activities for individuals or groups, including making action plans, motivating, problem solving, and self-management guidance with support given either face to face by telephone^(2,4,5,7,9,10,15,17,22,24,25,27,28,29,33,34,39,40), or online⁽³²⁾. Home visits were also conducted^(11,17). Some of the LHWs assessed goals⁽³⁹⁾, provided confident information⁽²⁹⁾, or helped patients to understand their long-term conditions and self-management^(2,9,25).

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3 All together, the studies reported thirty-five separate health behavior change techniques
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5 being applied (Table 5).
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9 Recruitment of potential individuals to participate in interventions was conducted at
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11 hospitals, health centers, community centers or churches^(6,7,8,12,15,34,35), or via the media,
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13 websites or seminars^(15,22,32). To ensure fidelity of program delivery, classes were
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15 monitored^(16,22) or audio recorded⁽¹²⁾, checklists were completed⁽²¹⁾ or activity reports were
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17 submitted⁽²²⁾. Interventions acted as bridges to local health and social services by
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19 encouraging participants to continue with their health care
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21 services^(3,5,6,14,16,17,18,19,21,22,28,31,37,38,39). Attrition prevention was performed by implementing
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23 make-up sessions⁽³¹⁾, providing cash incentives, stipends or gift cards^(14,19,20,37,39), and making
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25 telephone support calls to recipients who did not attend the sessions⁽¹⁸⁾.
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33 PA and NB outcomes in the LHW-led interventions
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36 Statistically significant improvements (minimum of $p < .05$) in all self-management
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38 outcomes, including psychological, behavioral, and clinical outcomes, were reported in many
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40 studies. Because our review concentrated on behavior, the outcomes of PA and NB as self-
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42 management activities, and their links connections to clinical outcomes, are presented. Ten
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44 studies measured both PA and NB, and three studies measured only PA (see Table 6).
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46 Measurements of the studies were mostly pre- and posttest, with only two studies having
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48 follow-ups^(32,37).
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53 Out of ten studies that investigated both PA and NB, six interventions improved reported
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55 both improved PA and NB^(7,23,25,29–31), two interventions reported improved NB^(21,37), one
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57 reported improved PA⁽¹⁷⁾, and one found no improvements⁽¹⁵⁾. NB- and PA-effective
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interventions were organized into groups, and four of ~~them~~ these had additional individual activities.^(7,23,25,31) Their length varied from two-and-a-half months⁽²⁵⁾ to 12 months⁽³⁰⁾. Four of them provided activities weekly, and five had education lectures. Their number of identified BCTs were eight⁽²⁹⁾ or nine^(7,25,30). Three of the NB- and PA-effective interventions also improved clinical measurements such as HbA1C^(7,23,25), blood pressure^(23,25,29), blood lipids^(23,29,30), and weight loss^(7,23,29), and one⁽³¹⁾ found no clinical improvements. (Table 7)

The current review also aimed to identify PA- and NB-effective interventions separately to get more accurate results concerning behavior change in LHW-led self-management

interventions. In PA-effective interventions^(7,17,23,25,29–32) the number of applied BCTs varied from three to fifteen. In ~~part~~ some of the interventions, group meetings were combined with individual face-to-face meetings, at recipients' homes, or via telephone. In PA-ineffective interventions^(15,21,26,33,37) the intervention components were mainly similar to effective PA interventions, with two of them providing only individual meetings. The number of BCTs ranged from two to nine. Regarding the high number of applied BCTs, certain remarks appeared in terms of PA as a form of self-management activity (Figure 3). Self-monitoring, enhancing social support, hands-on activities, and self-efficacy support were mainly ~~connected~~ linked to improvements, whereas goal setting was ~~connected~~ linked to both improvements and no improvements. Increased PA was often related to positive effects on clinical measurements, but not in all cases.

In NB-effective interventions^(7,21,23,25,29–31,37) the number of BCTs was from three to nine, with some variations in techniques, theoretical backgrounds, and durations. In those studies, it was more likely that self-monitoring, goal setting, and motivation were used as BCTs. (Figure 4.) For example, information providing ~~was~~ had been used in four studies where NB improved but also in both studies where no improvement was found. When measured alongside NB,

many studies also found positive effects on clinical measurements. Nevertheless, despite the improved NB, blood pressure was more likely to increase than decrease.

Discussion

The current review found that LHW-led self-management interventions have potential in promoting self-management in LTC. The implementation of interventions varied widely. Only about one third of the studies investigated NB and PA as indicators of behavior change, however, some of those that did had found positive outcomes.

The findings show that LHWs were often themselves trained LTC patients, who were personally interested in acting as LHWs. This study restates the previous descriptions of LHWs (Hunt et al., 2011; South, Kinsella & Meah, 2012; South et al., 2013), who are considered to be trained peer workers, as having similar cultural, ethnic or health backgrounds to their clients. LHWs’ roles were identified as educators, supporters, opinion leaders, organizers, and acting as bridges between communities, professionals, and clients. Interventions typically encompassed empowerment, social support, and tailoring-oriented principles, and they varied widely in length, frequency, and components. For example, group sessions, education lectures, and individual appointments were common formats, whereas self-monitoring, goal setting, information providing, action plans, and social support were frequently applied BCTs. Similar formats and BCTs were often applied in effective as well as in non-effective interventions.

The implementation of and reporting on both LHW training and LHW-led interventions diverged, as has been shown in previous studies (Hunt et al., 2011; Shah et al., 2013). A number of interventions lacked a theoretical background, or at least did not report one (Hunt

et al., 2011; Dale et al., 2012), which is a common issue in evidence-based health promotion. Implementation quality was assured in many interventions by providing continuous supervision during the intervention process (Hunt et al., 2011). That can be considered as a way to empower LHWs to be self-management tutors, and also assist them in cooperating with each other. As a non-professional workforce, they may benefit from organizational support for their work.

Interventions often followed national recommendations or guidelines for particular LTCs, as well the program for chronic disease self-management (Lorig et al., 2013). However, the current review highlights self-management as a person's own activities and emotions for taking care of a LTC by, for example, setting and modifying goals, solving problems, relying on peer support, and action planning (also Richardson et al., 2014). It seems that part of the interventions emphasized lecturing and giving advice, while many interventions consisted of behavioral and emotional elements that supported self-management (also Kawi, 2012; Lorig, Ritter, Ory & Whitelaw, 2013; Kaptein, et al., 2014). Effective self-management support should correspond to recipients' unique needs as well as assist individuals in strengthening their motivation and skills in coping in daily life with an LTC (Newbould, Taylor, & Bury, 2006). However, participants who lack knowledge and others with low self-efficacy may fail to benefit from similar activities and support in improving their self-management. These demands have been responded to in many interventions by tailoring intervention activities according to individual participants' requirements.

This review had similar findings to previous work, in that LHW-led self-management interventions can be effective in HbA1c (Hunt et al., 2011; Dale et al 2012; Little et al., 2014), and in a few interventions in PA, NB, blood pressure, and blood lipids (Hunt et al., 2011; Dale et al., 2012). Even though the same components and BCTs led to both significant and non-significant outcomes, some preliminary but not robust connections links were

observed. Group meetings and enhancing social support seemed to be particularly effective in improving PA. This reflects earlier findings (Greaney et al., 2017) and also highlights the need for social activities and for sharing motivation and feelings with LHWs and other recipients when improving one's PA. Furthermore, self-monitoring and hands-on activities and exercises as self-management actions were more likely ~~connected~~ linked to both improved PA and NB. Regarding the findings of generally applied BCTs in PA interventions (Duff et al., 2017), goal setting did not appear as an effective BCT at this time. However, in terms of behavior change interventions, only about one third of the studies measured NB and/or PA as an outcome of behavior change. In considerations of behavior changes among long-term patients, measuring their health behavior may provide beneficial knowledge on how patients manage with self-management in the context of their daily lives. Both research and clinical practice would benefit from this information.

Thus, a particular intervention component does not consistently lead to improvements. Firstly, identifying and understanding (Johnston et al., 2017) formats and BCTs and, second, applying them in self-management interventions are demanding processes, especially deciding how to maintain techniques based on recipients' unique needs, such as motivation or making action plans. When the training periods of LHWs last from days to months, it may have been challenging to learn the further ethos of the BCTs that were applied. In a portion of the interventions it remained unclear how the LHWs were trained in BCTs. Furthermore, based on the results of this study, it is possible that other intervention components, such as intensity (Palmas et al., 2015), duration, and overall personal interaction between LHWs and participants may play a role in effective interventions.

Nevertheless, as this review suggests, LHWs may have particular potential in self-management interventions among cultural and lingual minorities due to their reciprocal ability to share culture and experiences. They may have the potential to increase vulnerable individuals' involvement in services but also to promote self-management and health behavior change.

Limitations and strengths

The collected data enabled specific examinations of LHW-led self-management interventions, yet the current study has its limitations. The study protocols differed, combining RCT and trials with a variety of study participants. Due to the high variability and high numbers of different BCTs and self-management outcomes reported within the data, the evidence for making **connections** **links** between techniques and outcomes is limited.

However, only the most **obvious findings** **prominent themes** are presented in this paper. The **heterogeneity across interventions and outcomes** **variation** may also **cause** **lead to** limitations in identifying the intervention components (Abraham et al., 2015; Johnston et al 2017) and determining the results of this review, which itself contains reviews by Carr et al. (2011) and Little et al. (2014). The recipients of the original studies often represented cultural or linguistic minorities or low-income groups, so the results may not be transferable to other groups. In addition, there may be a risk of language bias because the included studies had to be reported only in English (CRD, 2009). Nevertheless, to our knowledge, the major studies regarding the topic have been conducted in an international context and reported in English.

This study has three primary strengths. First, it sets out a systematic synthesis of the characteristics and training of LHWs, the implementation and components of LHW-led interventions, and BCTs. The synthesis could serve as a framework for future research and

clinical practice considering LHW-led self-management interventions. Second, it contains a number of original studies that provide robust data on LHW-led self-management interventions among people with diabetes and cardiovascular disease. Third, it presents preliminary ~~connections~~ **links** between intervention components and outcomes in the field of LHW-led self-management interventions. To our knowledge, there is currently only scant evidence of such a ~~connection~~ **link**.

Implications for Policy and Practice

LHW interventions, as a mode of health services for multiple groups of people, have the potential to improve self-management for those with diabetes, cardiovascular diseases and chronic conditions as well as **assist** ~~aid~~ in prevention. LHW-led services in self-management support may reach people who are vulnerable or underserved. However, to improve self-management in LTC, systematic training in adopting and applying formats and BCTs should be provided to LHW candidates. In the future, an evidence-based standard for LHW training and interventions may be ~~formulated~~ for the field of LHW self-management interventions and their investigation. Such a standard, however, requires further research on its implementation.

Another suggestion for further research on self-management outcomes of LHW interventions would be to examine whether interaction frequency, meeting minutes, or group size have effects on self-management and, if so, what are the mechanisms that make them effective. A further line of study could determine how different combinations of intervention formats and BCTs interact.

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3 Additionally, promoting recipients' self-regulation strategies or improving their
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5 psychological flexibility as stages of health behavior change may offer new ways to achieve
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7 goals in LHW interventions. In summary, the results of this review suggest that LHW-led
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9 self-management interventions for diabetes and cardiovascular diseases have been
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11 implemented in multiple ways, and these interventions have seemed to improve, at least
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13 partially, behavioral and clinical self-management outcomes.
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References

- Abraham, C., Wood, C., Johnston, M., Francis, J., Hardeman, W., Richardson, M. & Michie, S. (2015). Reliability of identification of behavior change techniques in intervention descriptions. *Annals of Behavioral Medicine*, 49, 885-900.
- Ausili, D., Masotto, M., Dall'Ora, C., Salvini, L., & Di Mauro, S. (2014). A literature review on self-care of chronic illness: definition, assessment and related outcomes. *Professioni Infermieristiche*, 67(3), 180–189.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215.
- Barlow, J., Wright, C., Sheasby, J., Turner, A., & Hainsworth, J. (2008). Self-management approaches for people with chronic conditions: A review. *Patient Education and Counseling*, 48, 177–187.
- CADTH, Canadian Agency for Drugs and Technologies in Health (2013). *Peer support for diabetes, heart disease and HIV/AIDS: A review of the clinical effectiveness*,

cost-effectiveness, and guidelines. *Rapid response report: Summary with critical appraisal*. Retrieved from

<https://www.cadth.ca/sites/default/files/pdf/htis/dec-2013/RC0494%20Peer%20support%20for%20chronic%20disease%20Final.pdf>

Carr, S.M., Lhussier, M., Forster, N., Geddes, L., Deane, K., Pennington, M., ...Hildreth, A. (2011). An evidence synthesis of qualitative and quantitative research on component intervention techniques, effectiveness, cost- effectiveness, equity and acceptability of different versions of health-related lifestyle advisor role in improving health. *Health Technology Assessment*, 15(9).

CRD. (2009). Systematic Reviews. CRD's guidance for undertaking reviews in health care. *Centre for Reviews and Dissemination*. UK: York Publishing Services.

Dale, J.R., Williams, S.M., & Bowyer, V. (2012). What is the effect of peer support on diabetes outcomes in adults? A systematic review. *Diabetic Medicine*, 29, 1361–1377.

Davidson, K.W., Goldstein, M., Kaplan, R.M., Kaufmann, P.G., Knatterud, G.L., Orleans, T.C., ...Whitlock, E.P. (2003). Evidence-based behavioral medicine: What is it and how do we achieve it? *Annals of Behavioral Medicine*, 26, 161. doi:10.1207/S15324796ABM2603_01

Donaldson, L. & Rutter, P. (2017). Healthier, fairer, safer: The global health journey, 2007–2017. Geneva: World Health Organization. License: CC BY-NC- SA 3.0 IGO.

Dube, L., Van de Broucke, S., Housiaux, M., Dhoore, W., & Rendall-Mkosi, K. (2015). Type 2 diabetes self-management education programs in high and low mortality

developing countries: A systematic review. *The Diabetes Educator*, 41(1), 69–85.

Duff, O.M., Walsh, D.M.J., Furlong, B.A., O'Connor, N.E., Moran, K.A., & Woods, C.B. (2017). Behavior change techniques in physical activity eHealth interventions for people with cardiovascular disease: Systematic review. *Journal of Medical Internet Research*, 19(8), e281.

Eaton, S., Roberts, S., & Turner, B. (2015). Delivering person centred care in long term conditions. *BMJ*, 350, h181. doi: 10.1136/bmj.h181

Foster, G., Taylor, S.J.C., Eldridge, S., Ramsay, J., & Griffiths, C.J. (2009). Self-management education programmes by lay leaders for people with chronic conditions. *Cochrane Database of Systematic Reviews*, 4.

van Ginneken, N., Tharyan, P., Lewin, S., Rao, G.N., Meera, S.M., Pian, J., Chandrashekar, S., & Patel, V. (2013). Non-specialist health worker interventions for the care of mental, neurological and substance-abuse disorders in low and middle-income countries. *Cochrane Database of Systematic Reviews*, 11. Art. No.: CD009149. doi: 10.1002/14651858.CD009149.pub2

Greaney, M.L., Puleo, E., Sprunck-Harrild, K., Haines, J., Houghton, S.C. & Emmons, K.M. (2017). Social support for changing multiple behaviors: Factors associated with seeking and the impact of offered support. *Health Education & Behavior*, 1-9. doi: 10.1177/1090198117712333

Hunt, C.W., Grant, J.S., & Appel, S.J. (2011). An integrative review of community health advisors in type 2 diabetes. *Journal of Community Health*, 36, 883–893.

Islam, N., Zanowiak, J., Riley, L., Nadkarni, S., Kwon, S., & Trinh-Shevrin, C. (2015).

Characteristics of Asian American, Native Hawaiian and Pacific Islander
community health worker programs: A systematic review. *Journal of Health
Care for the Poor and Underserved*, 26, 238–268.

Johnston, M., Johnston, D., Wood, C., Hardeman, W., Francis, J. & Michie, S. (2017).

Communication of behavior change interventions: Can they be recognized from
written descriptions? *Psychology & Health*, doi:
10.1080/08870446.2017.1385784

Kaptein, A.A., Fischer, M.J., & Scharloo, M. (2014). Self-management in patients with

COPD: theoretical context, content, outcomes, and integration into clinical care.
International Journal of COPD, 9, 907–917.

Kawi, J. (2012). Self-management support in chronic illness care: A concept analysis.

Research and Theory for Nursing Practice, 26(2), 108–125.

Kmet, L.M., Lee, R.C., & Cook, L.S. (2004). Standard quality assessment criteria for

evaluating primary research papers from a variety of fields. HTA Initiative #13.
Alberta Heritage Foundation for Medical Research. Retrieved from
<http://www.biomedcentral.com/content/supplementary/1471-2393-14-52-s2.pdf>

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P.A., ...

Moher, D. (2009). The PRISMA statement for reporting systematic reviews and
meta-analyses of studies that evaluate health care interventions: Explanation
and elaboration. *PLoS Med*, 6(7): e1000100.
doi:10.1371/journal.pmed.1000100

- 1
2
3 Little, T.V., Wang, M.L., Castro, E.M., Jimenez, J., & Rosal, M.C. (2014). Community
4
5 health worker interventions for Latinos with type 2 diabetes: A systematic
6
7 review of randomized controlled trials. *Current Diabetes Reports*, 14(12), 558.
8
9
10
11 Lorig, K.R., & Holman, H.R. (2003). Self-management education: History, definition,
12
13 outcomes, and mechanisms. *Annals of Behavioral Medicine*, 26(1), 1–7.
14
15
16 Lorig, K., Ritter, P. L., Ory, M. G., & Whitelaw, N. (2013). Effectiveness of a generic
17
18 chronic disease self-management program for people with type 2 diabetes: A
19
20 translation study. *The Diabetes Educator*, 39(5), 655–663.
21
22
23
24 Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., ... Wood,
25
26 C.E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically
27
28 clustered techniques: Building an international consensus for the reporting of
29
30 behavior change interventions. *Annals of Behavioral Medicine*, 46, 81.
31
32 doi:10.1007/s12160-013-9486-6
33
34
35
36 Newbould, J., Taylor, D., & Bury M. (2006). Lay-led self-management in chronic illness: a
37
38 review of the evidence. *Chronic Illness*, 2, 249–261.
39
40
41
42 Nolte, E., & McKee, M. (2008). Caring for people with chronic conditions: an introduction.
43
44 In E. Nolte & M. McKee (Eds.) *Caring for people with chronic conditions*.
45
46 McGraw-Hill Education; Open University Press.
47
48
49
50 O'Brien, M.J., Squires, A.P., Bixby, R.A., & Larson, S.C. (2009). Role development of
51
52 community health workers: An examination of Selection and Training
53
54 Processes in the Intervention Literature. *American Journal of Preventive*
55
56 *Medicine*, 37 (6S1).
57
58
59
60

- Palmas, W., March, D., Darakjy, S., Findley, S. E., Teresi, J., Carrasquillo, O., & Luchsinger, J. A. (2015). Community health worker interventions to improve glycemic control in people with diabetes: A systematic review and meta-analysis. *Journal of General Internal Medicine*, 30(7), 1004–1012.
- Richardson, J., Loyola-Sanchez, A., Sinclair, S., Harris, J., Letts, L., MacIntyre, N. J., ...Ginis, K. M. (2014). Self-management interventions for chronic disease: a systematic scoping review. *Clinical Rehabilitation*, 28(11), 1067–1077.
- Schreier, M. (2012). *Qualitative content analysis in practice*. London: SAGE Publications.
- Shah, M., Kaselitz, E., & Heisler, M. (2013). The role of community health workers in diabetes: Update on current literature. *Current Diabetes Reports*, 13, 163–171.
- Shah, D., & Patel, V. (2014). Utilisation of Hispanic community workers and case managers to increase adherence to diabetes treatment in Hispanic populations. *Journal of Diabetes Nursing*, 18(10), 396–404.
- South, J., Kinsella, K., & Meah, A. (2012). Lay perspectives on lay health worker roles, boundaries and participation within three UK community-based health promotion projects. *Health Education & Research*, 27(4), 656–670.
- South, J., Meah, A., Bagnall, A-M., & Jones, R. (2013). Dimensions of lay health worker programmes: results of a scoping study and production of a descriptive framework. *Global Health Promotion*, 20(1), 5–12.
- Tang, T.S., Funnell, M.M., Gillard, M., Nwankwo, R., & Heisler, M. (2011). Training peers to provide ongoing diabetes self-management support (DSMS): Results from a pilot study. *Patient Education and Counseling*, 85, 160–168.

- Taylor, S., Pinnock, H., Epiphaniou, E., Pearce, G., Parke, H., Schwappach, A., ...Sheikh, A. (2014). A rapid synthesis of the evidence on interventions supporting self-management for people with long-term conditions: PRISMS – Practical systematic Review of Self-Management Support for long-term conditions. *Health Services and Delivery Research*, 2(53). National Institute for Health Research. doi:10.3310/hsdr02530
- Vervekina, N., Shi, Y., Fuentes-Caceres, V.A., & Scanlon, P.A. (2014). Attrition in chronic disease self-management programs and self-efficacy at enrollment. *Health Education & Behavior*, 41(6), 590-8.
- Walker, D.G., & Jan, S. (2005). How do we determine whether community health workers are cost-effective? Some core methodological issues. *Journal of Community Health*, 30(3), 221–229.
- WHO (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*. Geneva: World Health Organization. Retrieved from http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf

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For Peer Review

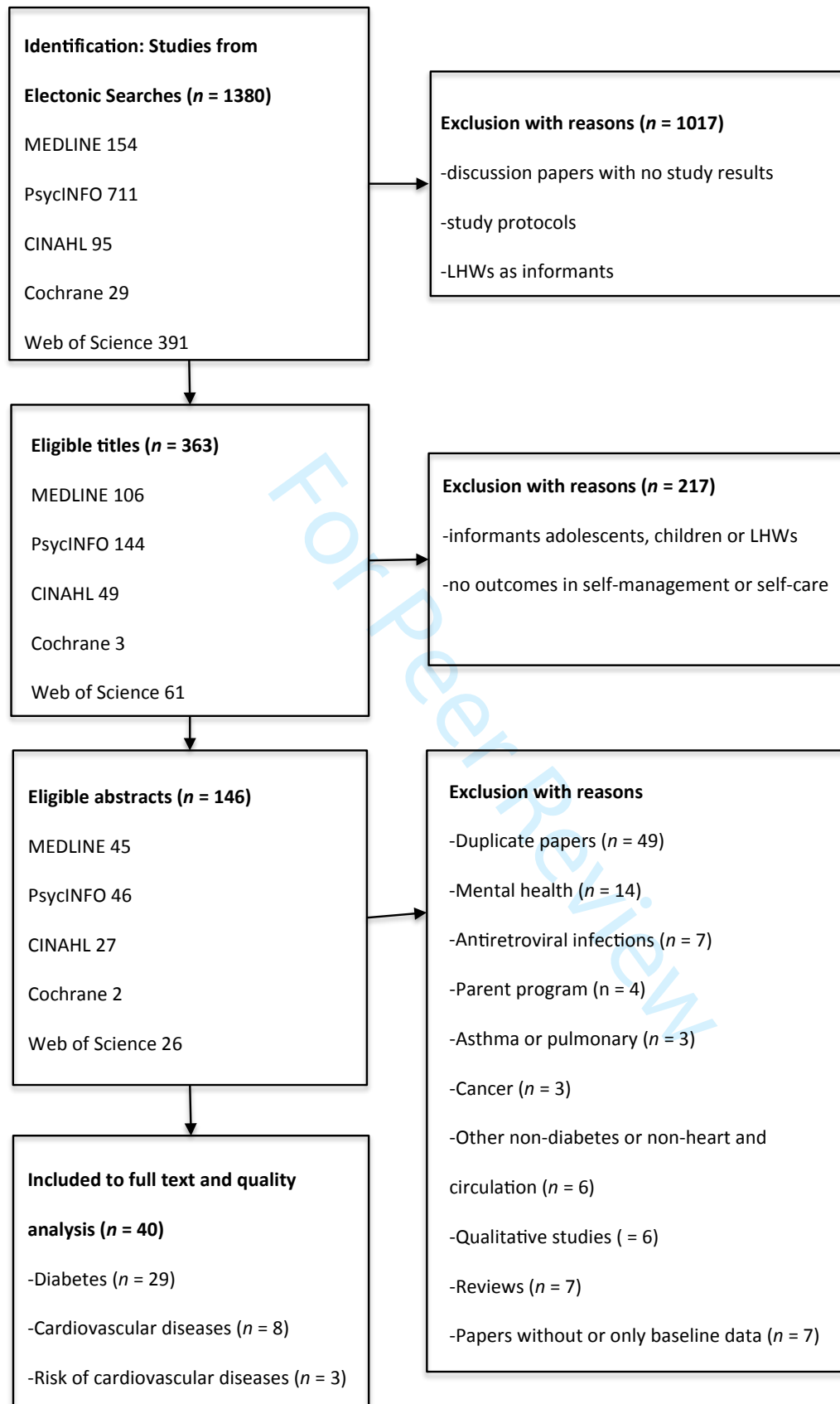


Figure 1. Flowchart of the searches.

Table 1. Example of the content analysis phase concerning LHW characteristics

Examples of the original expressions	Condensed expression	Subcategory	Main category
[The facilitators were six lay people with experience of heart disease, either personally -- or as carers of people with heart disease. 3.10]	The facilitators were six lay people with experience of heart disease self-management	Background and experience	Characteristics of LHWs
[The CHWs had an average of 6 years' experience leading DSME at CHASS. 18.22]	The CHWs had an average of six years' experience in leading diabetes self-management programs		
[--co-delivered by -- a patient (lay) tutor who had experience in these services 40.11.1]	Patient lay tutor had experience of services related to self-management support		
[-- an organization devoted to the education of people with diabetes and health care team members, on the basis of their excellent diabetes control, self-motivation, communication and support skills and interest. 4.21]	On the basis of their excellent diabetes control, self-motivation, communication and support skills and interest.	Eligibility criteria	
[simply interest of being a diabetes educator 24.9]	Simply one's own interest of being a diabetes educator		

[someone with diabetes or with a family member or friend with diabetes 24.8]	Having diabetes her/himself or a family member who has		
[16 hours training by the project manager or principal investor. 1.14]	Training provided by the project manager or principal investor	Training educators	LHWs' training
[The trainings were delivered by an interdisciplinary team of academics and practitioners with expertise in clinical medicine, health inequities, Latino health, diabetes self-management, diabetes medications, nutrition, exercise, cross-cultural counseling, and mental health. 11.27]	The culturally sensitive training delivered by an interdisciplinary team of academics and practitioners		
[CHWs trained by research staff from the University of Illinois at Chicago (UIC) 25.2.1]	CHWs trained by research staff from the University		
[to teaching blood pressure and glucose readings 1.18]	Training prepared CHWs in teaching blood pressure and glucose readings	Training purposes	
[building and reinforcing the participants' knowledge on diabetes, 23.22]	Building and reinforcing the participants' knowledge on diabetes		
[We trained community volunteers to be "Health	To train community volunteers to be health coaches		

Coaches” for our project -- 29.34]

Table 2. Examples of self-management outcomes transferred to self-management items

Item of self-management	An example of original self-management measurement
Physical activity (PA)	Summary of Diabetes Self-Care Activities measure ^{(7)*} Moderate levels of physical activity 30 min per day at least 5 days per week ⁽¹⁷⁾ Physical Activity Scale for Elderly ⁽²¹⁾ Survey of Diabetes Self-Care Activities: Exercise ⁽²³⁾ Minutes of daily physical activity ⁽²⁵⁾ Questionnaire on physical activity ⁽³⁷⁾

Nutrition behavior (NB)	Number of days to follow a diet ⁽⁷⁾
	Amount of daily servings of vegetable and fruits ⁽¹⁷⁾
	Survey of Diabetes Self-Care Activities: Nutrition ⁽²³⁾
	Following a healthy eating plan, eating fruits/vegetables ^(25,30)
	Self-reported eating behavior ⁽²⁹⁾
	Questionnaire on nutrition ^(31,37)
Blood lipids	HDL ^(23,30,35) LDL ^(17,30)
	Total cholesterol ^(23,30) Triglycerides ⁽³⁰⁾
Blood pressure	Systolic ^(23,25,29)
	Diastolic ⁽²³⁾
*References in Table 3.	

Table 3. Studies included in the analysis

Num	Original Paper	Purpose of LHW intervention	Field	Method	Main outcome, analysis	Setting	Follow-up, N =	Format (briefly)	Months of duration + follow-up	Quality assessment score
1	Daniels, E., Powe, B., Metoyer, T., McCray, G., Baltrus, P., & Rust, G. (2012). Increasing knowledge of cardiovascular risk factors among African Americans by use of community health workers: The ABCD community intervention pilot project. <i>Journal of the National Medical Association, 104</i> (3-4), 179–185. USA	To increase knowledge of cardiovascular risk among African- Americans	CVD	RCT	Knowledge of CVD, health literacy, Depression, HBA1C, BP, cholesterol, BMI, waist circumference <i>t</i> tests	Church	25	Group meeting Telephone counselling	1.5	17
2	DePue, J., Dunsiger, S., Seiden A., Blume, J., Rosen, R., Goldstein, M., Nu'usolia, O., Tuitele, J., & McGarvey, S. (2013). Nurse-community health worker team improves diabetes care in American Samoa: results of a randomized controlled trial. <i>Diabetes Care, 36</i> (7), 1947–1953.	To support diabetes self-management among American Samoans	T2DM	RCT	HBA1C, BP, BMI, waist circumference, dietary intake Wilcoxon, <i>t</i> test, mixed effects	CHC	243	Group meetings Individual meetings	12	22

American Samoa, USA		longitudinal regression model								
3	Furze, G., Cox, H., Morton, V., Chuang, L- H., Lewin, R.J.P., Nelson, P., Carty, R., Norris, H., Patel, N., & Elton, P. (2012). Randomized controlled trial of a lay- facilitated angina management programme. <i>Journal of Advanced Nursing</i> , 68(10), 2267–2279. England	To assess the effectiveness of a angina management program	CVD (Angina manage- ment)	RCT	Angina frequency (1-week angina diary)	Home- based	124	Individual interview Home visits Telephone calls	3	20
4	Gagliardino, J.J., Arrechea, V., Assad, D., Gagliardino, G.G., González, L., Lucero, S., Rizzuti, L., Zufriategui, Z., & Clark, C Jr. (2013). Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals. <i>Diabetes/Metabolism Research & Reviews</i> , 29(2), 152–160. Argentina	To compare standard care and the care and ongoing support of trained peers for people with T2DM	CVD (Hyper- tension)	RCT	HBA1C, BMI, BP, cholesterol, attitudes regarding diabetes and their care Chi-square test, <i>t</i> test	Health education center	198	Peer support group Face-to-face visits Telephone communicatio n	1.5	15

5	Hargraves, J.L., Ferguson, W.J., Lemay, C.A., & Pernice, J. (2012). Community health workers assisting patients with diabetes in self-management. <i>Journal of Ambulatory Care Management</i> , 35(1), 15–26. Massachusetts, USA	To integrate community health workers into work with diabetes type 2 patients and support diabetes self-management	T2DM	RCT	HbA1C, cholesterol, BP, self-management	CHC	1,415	LHW in health care teams	13	9
6	Kronish, I.M., Goldfinger, J.Z., Negron, R., Fei, K.Z., Tuhim, S., Arniella, G., & Horowitz, C.R. (2014). Effect of peer education on stroke prevention: The Prevent Recurrence of All Inner-City Strokes Through Education (PRAISE) randomized controlled trial. <i>Stroke</i> , 45(11), 3330–3336. New York City, USA	To determine the effect of peer education on secondary stroke prevention	CVD (Stroke)	RCT	BP, cholesterol, use of antithrombotic medications, control of the stroke risk factors <i>t</i> test for continuous variables, χ^2 analysis for categorical variables, mixed models	Primary health care	510	Group meetings	1.5 + 6	20
7	Lynch, E.B., Liebman, R., Ventrelle, J., Avery, E., & Richardson, D. (2014). A self-	To determine the effectiveness of	T2DM, CVD	RCT	Medical history, clinical variables,	Community setting	55	Group sessions	6	19

		management intervention for African Americans with comorbid diabetes and hypertension: A pilot randomized controlled trial. <i>Preventing Chronic Disease</i> , 11, 130349. Chicago, USA	comorbid diabetes and hypertension self-management intervention for African Americans	(hypertens ion)	BMI, medications, dietary intake, PA, health literacy, nutrition knowledge and quality of life	Telephone calls				
					<i>t</i> tests, χ^2 tests, Fisher's exact test, continuous variables, Wilcoxon rank-sum test					
8	Martin, M.Y., Kim, Y.I., Kratt, P., Litaker, M.S., Kohler, C.L., Schoenberger, Y.M., Clarke, S.J., Prayor-Patterson, H., Tseng, T.S., Pisu, M., & Williams, O.D. (2011). Medication adherence among rural, low-income hypertensive adults: a randomized trial of a multimedia community-based intervention. <i>American Journal of Health Promotion</i> , 25(6), 372–378. Alabama, USA	To examine the effectiveness of community-based multimedia intervention in medication adherence among hypertensive patients	CVD (hypertens ion)	RCT	Pill count Means, standard deviations, frequencies. χ^2 analysis, general linear model	Online, CHC	338	Online program	6 + 6	16
						Home visits		Telephone calls		

9	McDermott, R.A., Schmidt, B., Preece, C.,	To test the effectiveness	T2DM	RCT	HbA1C	Primary	191	LHW in	18	20
	Owens, V., Taylor, S., Li, M., & Esterman,	of a community-based			<i>t</i> tests, Wilcoxon	health		health care		
	A. (2015). Community health workers	approach to intervention			rank sum tests, chi-	care		team		
	improve diabetes care in remote Australian	for indigenous adults			square test,					
	Indigenous communities: results of a	with poorly controlled			generalized					
	pragmatic cluster randomized controlled	T2DM in Australian			estimating equations					
	trial. <i>BMC Health Services Research</i> , 15,	indigenous communities			regression models					
	68. Australia (north)									
10	Moskowitz, D., Thom, D.H., Hessler, D.,	To examine the effect	T2DM	RCT	HbA1C	Public	299	NR	6	18
	Ghorob, A., & Bodenheimer, T. (2013).	of peer health coaching			<i>t</i> tests, Fischer's	health				
	Peer coaching to improve diabetes self-	on HbA1C modified by			exact test	care				
	management: Which patients benefit most?	diabetes control								
	<i>Journal of General Internal Medicine</i> ,	characteristics								
	28(7), 938–942. San Francisco, USA									
11	Perez-Escamilla, R., Damio, G., Chhabra,	To evaluate home-based	T2DM	RCT	HbA1c, BG and	Primary	148	Home visits	12 + 6	22
	J., Fernandez, M.L., Segura-Perez, S.,	culturally appropriate			lipid profile	health				
	Vega-Lopez, S., Kollannor-Samuel, G.,	CHW-integrated T2DM			χ^2 test for	care				
	Calle, M., Shebl, F.M., & D'Agostino, D.	counselling among			categorical variables					
	(2015). Impact of a Community Health	Latino adults			and independent					
	Workers-Led Structured Program on Blood				samples ANOVA					

	Glucose Control Among Latinos With Type 2 Diabetes: The DIALBEST Trial. <i>Diabetes Care</i> , 38(2), 197–205. Connecticut, USA					for continuous variables, a linear mixed effects					
12	Philis-Tsimikas, A., Fortmann, A., Lleva-Ocana, L., Walker, C., & Gallo, L.C. (2011). Peer-Led Diabetes Education Programs in High-Risk Mexican Americans Improve Glycemic Control Compared With Standard Approaches A Project Dulce Promotora Randomized Trial. <i>Diabetes Care</i> , 34(9), 1926–1931. San Diego, USA	To evaluate the effect of a culturally sensitive diabetes self-management program among Mexican-American with T2DM	T2DM	RCT	HbA1C	CHC	156	Learning class	10 + 4	15	
					Multilevel models, within-group analysis			Support group	Telephone calls		
13	Prezio, E.A., Pagan, J.A., Shuval, K., & Culica, D. (2014). The Community Diabetes Education (CoDE) program: cost-effectiveness and health outcomes. <i>American Journal of Preventive Medicine</i> , 47(6), 771–779. USA	To examine the long term cost effectiveness and improvements in diabetes-related complications	T2DM	RCT	HBA1c	NR	10 000'	NR	NR	15	
					Archimedes model						
14	Prezio, E.A., Cheng, D., Balasubramanian, B.A., Shuval, K., Kendzor, D.E., & Culica, D. (2013). Community Diabetes Education	To determine the impact of a culturally tailored diabetes education	T2DM	RCT	HbA1C	CHC	156	LHW	12	23	
					t test to continuous			appointments along with			

	(CoDE) for uninsured Mexican Americans:	program for uninsured			variables and			usual care		
	a randomized controlled trial of a culturally	Mexican-American with			Pearson χ^2 for					
	tailored diabetes education and	DM			categorical					
	management program led by a community				variables, linear					
	health worker. <i>Diabetes Research &</i>				mixed-models					
	<i>Clinical Practice</i> , 100(1), 19–28. Texas,									
	USA									
15	Rothschild, S.K., Martin, M.A., Swider,	To assess whether	T2DM	RCT	DM empowerment,	Communit	121	Telephone	24	25
	S.M., Tumialan Lynas, C.M., Janssen, I.,	community health			DM self-care	y setting		calls		
	Avery, E.F., & Powell, L.H. (2014).	workers could improve			Activities (also PA,			Home visits		
	Mexican American trial of community	glycemic control among			nutrition),					
	health workers: a randomized controlled	Mexican-Americans			depression, stress					
	trial of a community health worker	with diabetes			scale, anxiety					
	intervention for Mexican Americans with				<i>t</i> test, Wilcoxon					
	type 2 diabetes mellitus. <i>American Journal</i>				rank sum test,					
	<i>of Public Health</i> , 104(8), 1540–1548.				mixed effect linear					
	Chicago, USA				model analysis.					
16	Safford, M.M., Andreae, S., Cherrington,	To test the effectiveness	T2DM	RCT	HbA1c, systolic BP,	Communit	270	Meetings	10 + 5	23
	A.L., Martin, M.Y., Halanych, J., Lewis,	of peer coaches plus			LDL-C, BMI, and	y setting		Telephone		
	M., Patel, A., Johnson, E., Clark, D.,	brief diabetes education								

	Gamboa, C., & Richman, J.S. (2015). Peer compares with brief quality of life calls									
	Coaches to Improve Diabetes Outcomes in education alone in Rural									
	Rural Alabama: A Cluster Randomized Alabama									
	Trial. <i>Annals of Family Medicine</i> , 13(S1),									
	S18–S26. Alabama, USA									
17	Spencer, M.S., Rosland, A.M., Kieffer, E.C., Sinco, B.R., Valerio, M., Palmisano, G., Anderson, M., Guzman, J.R., & Heisler, M. (2011). Effectiveness of a community health worker intervention among African American and Latino adults with type 2 diabetes: a randomized controlled trial. <i>American Journal of Public Health</i> , 101(12), 2253–2260. Detroit, USA	To test a culturally tailored CHW intervention for diabetes self-management improved diabetes clinical measures, self-management and distress among African American and Latino adults	T2DM	RCT	HbA1C, PA, nutrition	Communit y health center	136	Home visits	6	21
					Student <i>t</i> test, Pearson χ^2 test			Group classes		
								Telephone calls		
18	Tang, T.S., Funnell, M., Sinco, B., Piatt, G., Palmisano, G., Spencer, M.S., Kieffer, E.C., & Heisler, M. (2014). Comparative effectiveness of peer leaders and community health workers in diabetes self-	To compare a peer leader (PL) versus a community health worker (CHW) telephone intervention	T2DM	RCT	HbA1C	Communit y setting	69	Group Classes	18	23
					Linear mixed methods, Student's <i>t</i> test, log-rank test, Fisher exact test,			Home visits		
								Primary care provider visits		

		management support: Results of a	in diabetes self-		Pearson χ^2 test			Telephone		
		randomized controlled trial. <i>Diabetes Care</i> ,	management education					calls		
		37 (6), 1525–1534. Detroit, USA								
19	Tang, T.S., Funnell, M.M., Sinco, B.,	To investigate whether	T2DM	RCT	HbA1C	Communit	64	Group	15	25
	Spencer, M.S., & Heisler, M. (2015). Peer-	a peer support model				y setting		sessions		
	Led, Empowerment-Based Approach to	could sustain			Linear mixed					
	Self-Management Efforts in Diabetes	improvements achieved			model, Spearman			Face to face		
	(PLEASED): A Randomized Controlled	in a short-term diabetes			correlation,			meetings		
	Trial in an African American Community.	self-management			Student's <i>t</i> test, log			Telephone		
	<i>Annals of Family Medicine</i> , 13(S1), S27–	education program for			rank test, Fisher's			calls		
	S35.	African American			exact test, Pearson's					
	Michigan, USA	adults with type 2			χ^2					
		diabetes								
20	Thom, D., Ghorob, A., Hessler, D.,	To test the impact of	T2DM	RCT	HbA1C	Public	275	In person	6	20
	DeVore, D., Chen, E., & Bodenheimer,	individual peer				clinics		interactions		
	T.A. (2013). Impact of peer health coaching	coaching on glucose			Linear mixed					
	on glycemic control in low-income patients	control on patients with			model, logistic			Telephone		
	with diabetes: A randomized controlled	poorly controlled			regression			calls		
	trial. <i>Annals of Family Medicine</i> , 11(2),	diabetes								
	137–144. San Fransisco, USA									

21	van der Wulp, I., de Leeuw, J.R.J., Gorter, K.J., & Rutten, G.E.H.M. (2012). Effectiveness of peer-led self-management coaching for patients recently diagnosed with Type 2 diabetes mellitus in primary care: a randomized controlled trial. <i>Diabetic Medicine</i> , 29(10), e390–e397. Netherlands	To study the effectiveness of a self-management coaching intervention in recently diagnosed patients with Type 2 diabetes	T2DM	RCT	Self-efficacy, coping, physical activity, dietary habits, psychological well-being, depressive symptoms and diabetes related distress	General practices	119	Home visits Telephone calls Emails	18	22
22	Whittle, J., Schapira, M.M., Fletcher, K.E., Hayes, A., Morzinski, J., Laud, P., Eastwood, D., Ertl, K., Patterson, L., & Mosack, K.E. (2014). A randomized trial of peer-delivered self-management support for hypertension. <i>American Journal of Hypertension</i> , 27(11), 1416–1423. Milwaukee, USA	To compare changes in BP control among veterans participating in a peer-delivered vs. Professionally delivered health education intervention	CVD (Hypertension)	RCT	Systolic BP Mixed model, generalized linear model	Veterans' service organizations	379	Group sessions	12	24
23	Assah, F.K., Atanga, E.N., Enoru, S., Sobngwi, E., & Mbanya, J.C. (2015).	To examine the effectiveness of a	T2DM	Trial	HbA1C, BP, blood lipids, BMI, waist	Communit	192	Group	6	17

	Community-based peer support	structured peer support			circumference,	y setting		meetings	
	significantly improves metabolic control in	diabetes intervention in			diabetes self-care			Personal	
	people with Type 2 diabetes in Yaounde,	Cameroon			(also PA and			encounters	
	Cameroon. <i>Diabetic Medicine</i> , 32(7), 886–				nutrition)			Telephone	
	889. Cameroon				Continuous			calls	
					variables and				
					differences, Student				
					<i>t</i> test				
24	Carey, M.E., Mandalia, P.K., Daly, H.,	To develop and test a	T2DM	trial	Diabetes coherence,	Primary	242	Group	1 day
	Gray, L.J., Hale, R., Stacey, L.M., Taub,	format of delivery of			diabetes perception	health		meeting	
	N., Skinner, T.C., Stone, M., Heller, S.,	diabetes self-			care				
	Khunti, K., & Davies, M.J. (2014).	management education			Intra-class-				
	Increasing capacity to deliver diabetes self-	by paired professional			correlations,				
	management education: Results of the	and lay educators			continuous and				
	DESMOND lay educator non-randomized				categorical				
	controlled equivalence trial. <i>Diabetic</i>				variables, <i>t</i> test, χ^2 ,				
	<i>Medicine</i> , 31(11), 1431–1438. England and				Wilcoxon test				
	Scotland								

25	Castillo, A., Giachello, A., Bates, R., Concha, J., Ramirez, V., Sanchez, C., Pinsker, E., & Arrom, J. (2010). Community-based diabetes education for Latinos: The Diabetes Empowerment Education Program. <i>Diabetes Educator</i> , 36(4), 586–594. California, USA	To test the feasibility and effectiveness of a linguistic and culturally appropriate diabetes education program among Latinos	T2DM	trial	HbA1C, PA, nutrition Frequency tables and cross- tabulations, <i>t</i> tests, χ^2 tests	Communit y setting	47	Group meeting Group and individual activities	2.5	15
26	Cene, C.W., Haymore, L.B., Ellis, D., Whitaker, S., Henderson, S., Lin, F.C. & Corbie-Smith, G. (2013). Implementation of the power to prevent diabetes prevention educational curriculum into rural African American communities: A feasibility study. <i>The Diabetes Educator</i> , 39(6), 776–785. North Carolina, USA	To describe the feasibility of using a community-based approach to implement a diabetes prevention education curriculum in rural African-American settings	T2DM	Trial	BG, BP, BMI, PA Mc Nemar test, <i>t</i> test	Communit y setting	30	Small group sessions	7.5	11
27	Collinsworth, A.W, Vulimiri, M., Schmidt, K. L., & Snead, C.A. (2013). Effectiveness of a community health worker–led diabetes self-management education program and implications for CHW involvement in care	To evaluate the effectiveness of a diabetes self- management education program and to	T2DM	Trial	HBA1C, BMI, Blood pressure <i>t</i> test	Communit y clinic	497	Group meetings Clinical assessments	12	12

	coordination strategies. <i>The Diabetes Educator</i> , 39(6), 792–799. Dallas, USA	understand how CHWs and primary care providers work together								
28	DePue, J.D., Rosen, R., Seiden, A., Bereolos, N., Chima, M., Goldstein, M., Nu’usolia, O., Tuitele, J., & McGarvey, S.T. (2013). Implementation of a culturally tailored diabetes intervention with community health workers in American Samoa. <i>The Diabetes Educator</i> , 39(6), 761–771. American Samoa, USA	To investigate a primary care–based, nurse–community health worker (CHW) team intervention to support type 2 diabetes self-management in American Samoa	T2DM	Trial	HBA1C, BP, smoking status, alcohol use, depression score, treatment dose	Primary care	104	Group visits	12	16
					ANOVA, Tukey’s post hoc test, nonparametric comparison of medians, χ^2 -tests			Individual visits		
29	Dye, C., Williams, J., & Hoffman Evatt, J. (2015). Improving hypertension self-management with community health coaches. <i>Health Promotion Practice</i> , 16(2), 271–281. Appalachians, USA	To improve hypertension self-management among rural residents older than 60 years through education and support	CVD (Hypertension)	Trial	Hypertension knowledge and self-management, BP, weight, waist circumference, blood lipids and	Community setting	146	Group classes	4	20
								Education program		

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	worker pilot intervention to improve	among Bangladeshi-			health care, diabetes			visits		
	diabetes management in Bangladeshi	American individuals			knowledge, self-					
	immigrants with type 2 diabetes in New	with type 2 diabetes			management, self-					
	York City. <i>The Diabetes Educator</i> , 39(4),	living in New York City			efficacy, mental					
	478–493. New York, USA				health					
					Fisher’s exact test, <i>t</i>					
					test, frequencies,					
					means, standard					
					deviations					
32	Lorig, K., Ritter, P.L., Plant, K., Laurent,	To implement and	CC	Trial	Pain/physical	Online-	194	Interactive	1.5 + 12	21
	D.D., Kelly, P., & Rowe, S. (2013). The	investigate the			discomfort,	based,		web program		
	South Australia Health Chronic Disease	effectiveness of a			shortness of breath,	communit				
	Self-management Internet Trial. <i>Health</i>	chronic condition self-			tiredness, impact of	y setting				
	<i>Education & Behavior</i> , 40(1), 67–77.	management internet			disease, health					
	South Australia	trial in South Australia			distress, self-rated					
					disability, number					
					of illness days, PA					
					Paired <i>t</i> tests					

<http://mc.manuscriptcentral.com/heb>

	Texas, USA	Americans								
36	Ryabov, I. (2011). The impact of community health workers on behavioral outcomes and glycemic control of diabetes patients on the U.S.-Mexico border. <i>International Quarterly of Community Health Education</i> , 31(4), 387–399. Texas, USA	To determine the impact of CHW on the self-management practices of people in with diabetes on the US–Mexico border	T2DM	Trial	DM knowledge	NR	30	NR	24	12
37	Saxe-Custack, A., & Weatherspoon, L. (2013). A patient-centered approach using community-based paraprofessionals to improve self-management of Type 2 Diabetes <i>American Journal of Health Education</i> , 44(4), 213–220. Michigan, USA	To examine if a lifestyle management program can initiate positive impacts on self-management and behavior change among participants with type 2 diabetes	T2DM	Trial	BP, BMI, HbA1c, demographic information, lifestyle behaviors (also PA and nutrition), behavior change by stages of change, appraisal of diabetes Paired <i>t</i> tests	Community setting	122	Group sessions Individual meetings Home visits	2.5+6	16
38	Tsoh, J., Burke, N., Gildengorin, G., Wong,	To evaluate a smoking	CC	Trial	7-day and 30-day	Community	192	Small group	2+3	21

	C Le, K., Nguyen, A., Chan, J.L., Sun, A.,	cessation program:	(smoking		smoking abstinence,	y setting		sessions		
	McPhee, S.J. & Nguyen, T.T. (2015). A	intention to quit, use of	cessation)		assessed by smokers			Telephone		
	Social network family-focused intervention	cessation recourses and			and family members			calls		
	to promote smoking cessation in Chinese	smoking abstinence								
	and Vietnamese American male smokers: A				Descriptive					
	feasibility study. <i>Nicotine & Tobacco</i>				statistics,					
	<i>Research</i> , 17(8), 1029–1038. USA				significance, linear					
					model adjustment					
39	Tully, M., Kos, A., Eastwood, D., Kusch,	To describe the	CVD	Trial	BP	Health	83	Group	6	16
	J., & Kotchen, T. (2015). Implementation	development,	(blood		<i>t</i> tests and χ^2 tests.	center		sessions		
	of an adjunct strategy to reduce blood	implementation, and	pressure)							
	pressure in blacks with uncontrolled	evaluation of a BP								
	hypertension: a Pilot Project. <i>Ethnicity &</i>	program								
	<i>Disease</i> , 25(2), 168–174.									
	Wisconsin, USA									
40	Turner, A., Anderson, J.K., Wallace, L.M.	To investigate a self-	CC	Trial	Demographic data,	Communit	486	Group	2	19
	& Bourne, C. (2015). An evaluation of a	management program			Patient Activation,	y setting		meetings		
	self-management program for patients with	among patients with			EuroQol, Hospital					
	long-term conditions. <i>Patient Education</i>	long-term conditions			Anxiety and					
	<i>and Counseling</i> , 98(2), 213–219. UK				Depression, Health					
					Education Impact					

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Questionnaire

Paired *t* tests,
General linear
model, and analysis
of covariance,
McNemar's test

NR = not reported
CVD = cardiovascular disease
CC = chronic conditions or its prevention
CHC = community health center
'=estimated
BMI = body mass index
BP = blood pressure
BG = blood glucose

For Peer Review

Characteristics and training of LHWs			Theories and guidelines behind the intervention
Experience with long-term conditions	Self-management intervention components and delivery by LHWs		National guidelines for DM, hypertension and cardiovascular diseases
	Participants recruited by LHWs or health professionals	Interaction frequency from once a week to every second month, often besides usual health care	Transtheoretical model of change
	Attrition prevention by providing, e.g., make-up sessions, telephone support calls, gift cards.	Principles of implementation: individual-empowering, culture and language sensitiveness, peer education, family-centering, social networking	Social cognitive theory
	Elements of training: classroom training, hands-on activities, home visits, clinical measurements	Elements: PA, nutrition, medication, clinical measurements, and other education classes; online programs	Chronic care model
	Training contents: LTCs, motivation, self-monitoring, self-management, medication	Formats: Individual or group meetings delivered by a LHW or a group of LHWs; LHW as a	provided face to face, via telephone, online, at clinics or community centers or home visits.

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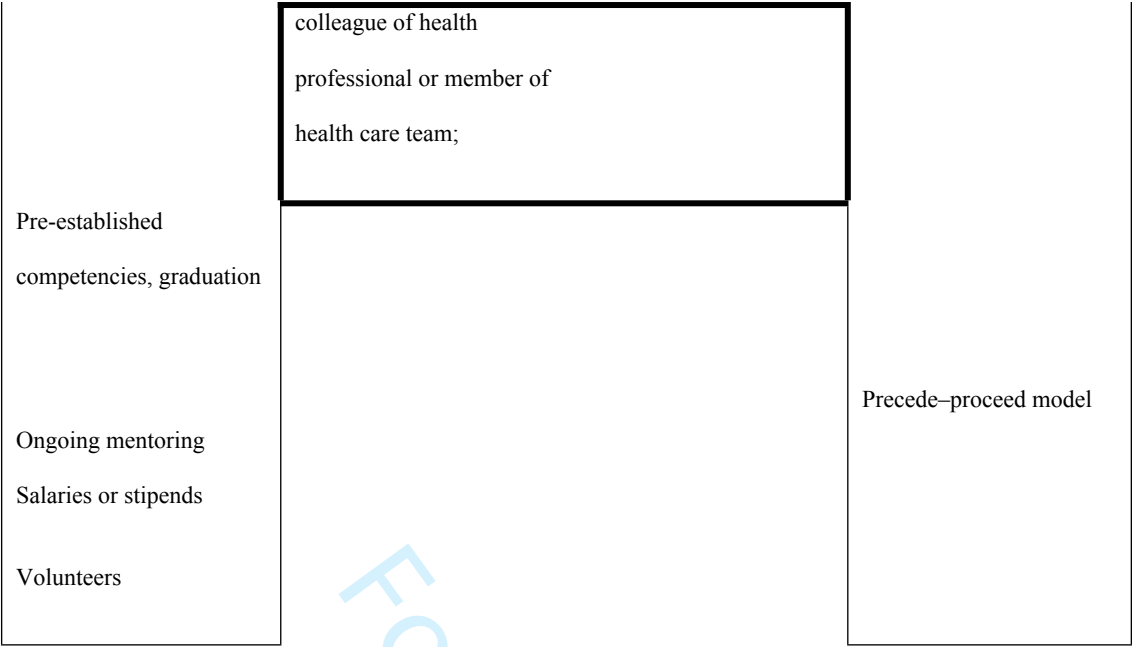


Figure 2. Synthesis of LHW-led self-management interventions for diabetes, cardiovascular diseases and prevention.

Table 4. Reported theories and principles.

Theories and models applied and reported	<i>n</i>
Transtheoretical model of change ^(7,8,11,23,29,30,33,37,38)	9
Social cognitive theory ^(1,8,14,21,38)	5
Chronic care model ^(22,40)	2
Self-efficacy theory ^(31,32)	2

Precede–proceed model ^(2,28)	2
Socioecological model ^(5,17)	2
Health belief model ⁽³³⁾	1
Self-management theory ⁽¹⁵⁾	1
Principles and methods applied and reported	<i>n</i>
Individual-empowerment ^(17–19,23,25,33,34,38–40)	10
Peer education principles ^(4,8,9,23,32,39,40)	7
Culture-sensitivity ^(11,12,14,23,33,34)	6
Understanding of the context in which behavior changes take place ^(4,8,21,23,33,30)	6
The active role of recipients ^(4,12,25)	3
Motivational interview ^(25,30,37)	3

Table 5. Examples of the most often reported BCTs.

BCT	<i>n</i>
Self-monitoring ^(3,4,6–8,12–14,16,18,19,21,22,25,27–32,37,39)	24
taking clinical measurements: blood sugar and blood pressure ^(2,6,15,16,19,28,30,39)	
monitoring of symptoms and health behavior related to the	

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assessed goals ^(4,7,28,29)	
using self-management monitors: blood glucose, blood pressure and pedometers ^(12,14,22,29,30,39)	
Goal setting ^(3,7,8,15,16,18–20,21,25,27–29,32–34,35,37,38)	20
Information providing ^(6,8,11,14,15,17,19,21,22,25,28,30–32)	17
Individual action plans to support health-related behavior ^(6,10,11,14,19,20,29,31–33,38,39)	12
Enhancing participants’ social support ^(6,7,15,16,18,22,23,25,29,32,40)	11
Practicing problem solving techniques ^(2,6,7,15,18,19,28,29,32,37)	10
Possibilities to tailor intervention activities towards participants’ personal needs ^(11,14,18,28,30,31,33,38–40)	10

Table 6. Original studies that reported outcomes of NB and/or PA

Original paper	Theory	Format	Individual / Group	Additional info	Number of BCTs	Frequency	Length + follow- up (month)	Improv ment in NB	Improv ment in PA	Improv- ment in CM
(7) Lynch et al., 2014	Models of behavior change	Telephone calls Education lectures	Individual + group	18 group sessions by dietitian and LHW weekly for three months, afterwards every second week; phone calls weekly by LHW	9	weekly	6	yes	yes	yes / no
(15) Rothschild et al., 2014	Self- management theory	Home visits Telephone calls	Individual	36 home visits	7	monthly	24	no	no	yes / no
(17) Spencer et al., 2011	Empowerment theory	Education lectures, Home visits, Accompanied clinic	Individual	Group session once every two weeks Telephone calls once	4	weekly	6	no	yes	yes / no

		visits,	every two weeks								
		Telephone									
		counselling,									
		Peer activities									
(21) van der Wulp et al., 2012	Social cognitive theory	Home visits, Education lectures, Telephone counselling, Emails	Individual	Monthly meetings, Telephone calls two weeks after meetings. Plus calls and emails when needed.	5	two weeks	18	yes	no	-	
(23) Assah et al., 2015	Socioculturally adapted community-based approach	Group meeting, Individual appointments, Telephone counselling, Home visits	Individual + group	Six group meetings, personal encounters, telephone calls (five calls)	3	monthly	6	yes	yes	yes	

(25) Castillo et al., 2010.	Empowerment theory, Adult education	Group meeting, Individual appointments, Education lectures	Individual + group	Ten group education sessions + individual contacts between sessions	9	weekly	2.5	yes	yes	yes / no
(26) Cene et al., 2013	Community capacity building	Group meeting, Education lectures	Group	Group meetings weekly for six weeks, then monthly, 12 sessions total	2	six times weekly, afterwards monthly	7.5	-	no	no
(29) Dye et al., 2015	Transtheoretic al model of change	Group meeting, Education lectures	Group	Self-management curriculum: 7 meetings plus additional lectures on NB or PA	8	weekly	4	yes	yes	yes
(30) Fernandes et al., 2012	Transtheoretic al model of change	Group meeting, Education lecture, Peer work shop	Group	Group meetings, afterwards monthly meetings up to 12 months	9	11 times weekly, afterwards monthly	12	yes	yes	yes / no

(31) Islam et al., 2013	Community-based approach	Group meeting, Individual appointments, Education lectures, Make-up sessions	Individual + group	six monthly group meetings plus individual meetings at months 3, 6, and 9	4	monthly up to 6 months, individual at 9 months	9	yes	yes	no
(32) Lorig et al., 2013	Self-efficacy theory	Online group meetings, Education lectures, Weekly activities	Online: Individual + group	Online program	15	available every day	1.5 + 12	-	yes	-
(33) Micikas et al., 2015	Stages of change, Health belief model	Group meetings, Education lectures, Home visits	Individual + group	Individual home visits, group meetings	7	weekly	4	-	no	yes
(37) Saxe-Custack et al., 2013	Community-based approach	Group meetings, Individual appointments,	Individual + group	four individual weekly meetings at home, afterwards six home	9	weekly	2.5 + 6	yes	no	yes / no

Education lectures,
visits or group meetings

Home visits
weekly

NB = nutrition behavior

PA = physical activity

CM = clinical measurements

- = was not measured

Table 7. Outcomes in nutrition behavior and physical activity and their links to intervention components and clinical measurements

Measured outcome	Type of effect	Original paper	Formats	BCTs	Clinical measurements
					+improvement
					-no improvement
NB + PA	NB + PA improved	7	Telephone calls + Education lectures	9: Goal setting, motivating, emotional support, teaching problem-solving techniques, enhancing social support, self-monitoring, role	+HbA1C

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	(individual + group)	model narratives, hands-on activities, taking and monitoring clinical measurements	+Weight loss
			-Blood lipids
			-Blood pressure
	Group meeting + Individual appointments + Telephone counselling + Home visits	3: Teaching self-management skills, enhancing social support, discussion	+HbA1C
			+Blood lipids
			+Blood pressure
23			+BMI
			+Fast BC
			+Waist circ
			+Weight loss
	Group meeting + Individual appointments + Education lectures	9: Goal setting, self-efficacy support, motivating, teaching self-management skills, enhancing social support, support decision making, information providing, self-monitoring, hands-on activities	+HbA1C
25			+Blood pressure
			-Weight loss
	Group meeting + Education lectures (group)	8: Goal setting, self-efficacy support, teaching problem-solving techniques, enhancing social support, action plans, self-monitoring, personal health diary, taking and monitoring clinical measurements	+Blood pressure
29			+Fast BC
			+Weight loss
			+Blood lipids

		Group meeting + Education lectures (group) + peer work shop	9: Information providing, self-monitoring, using written counselling materials, reminders, tailoring, hands-on exercises, taking and monitoring clinical measurements, healthy snacks, incentives	+Blood lipids +Fast BC -HbA1c -Blood pressure -BMI
	30			
		Group meeting + Individual appointments + Education lectures + Make-up sessions	4: Information providing, action plans, self-monitoring, tailoring	-Blood lipids -HbA1c -Blood pressure -BMI
	31			
		Home visits + Education lectures + Telephone counselling + emails	5: Goal setting, self-efficacy support, motivating, information providing, self-monitoring	NR
	21			
NB improved		Group meetings + Individual appointments + Education lectures + Home visits	9: Goal setting, motivating, teaching problem solving, teaching relapse prevention, information providing, self-monitoring, tailoring, guest speakers, hands-on exercises	+HbA1C +BMI -Blood pressure
	37			
PA improved		Education lectures + Home visits + Accompanied clinic visits	4: Self -efficacy support, keeping appointments, information providing, hands-on exercises	+HbA1C +Blood lipids
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					-Blood pressure
					-BMI
			Home visits + Telephone calls	7: Goal setting, teaching self-management skills, teaching problem-solving techniques, enhancing social support, information providing, using metaphors, taking and monitoring self-management skills	+HbA1C
	no improvements	15			+Weight loss
					-Blood lipids
					-Blood pressure
			Online group meetings + Education lectures + Activities	15: Goal setting, self-efficacy support, teaching self-management skills, emotional or behavioral support, teaching problem-solving skills, sharing feelings, enhancing social support, stress managements, information providing, action plan, self-monitoring, feedback, discussion, role model narratives, hands-on exercises	NR
	improved	32			
			Group meeting + Education lectures	2: Guest speakers, taking and monitoring clinical measurements	-Blood pressure
PA					-Fasting BC
		26			-Weight loss
	no improvements				-Blood lipids
					-HbA1C
			Group meetings + Education lectures + Home visits	7: Goal setting, emotional and behavioral support, action plans, reminders, discussion, tailoring, hands-on exercises	+HbA1C
		33			

For Peer Review

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Identification: Studies from Electronic Searches (= 1380)

MEDLINE 154
PsycINFO 711
CINAHL 95
Cochrane 29 →

Web of Science 391

Eligible titles (= 363)

↓
MEDLINE 106
PsycINFO 144
CINAHL 49 →
Cochrane 3
Web of Science 61

↓

Eligible abstracts (= 146)

MEDLINE 45 →
PsycINFO 46
CINAHL 27
Cochrane 2
↓
Web of Science 26

Included to full text and quality analysis (= 40)

-Diabetes (n = 29)
-Cardiovascular diseases (n = 8)

-Risk of cardiovascular diseases (n = 3)

Health Education & Behavior

Exclusion with reasons (= 1017)

-discussion papers with no study results
-study protocols
-LHWs as informants

Exclusion with reasons (= 217)

-informants adolescents, children or LHWs
-no outcomes in self-management or self-care

Exclusion with reasons

- Duplicate papers (n = 49)
-Mental health (n = 14)
-Antiretroviral infections (n = 7)
-Parent program (n = 4)
-Asthma or pulmonary (n = 3)
-Cancer (n = 3)
-Other non-diabetes or non-heart and circulation (n = 6)
-Qualitative studies (= 6)
-Reviews (n = 7)
-Papers without or only baseline data