BMJ Open

A systematic review of interventions by healthcare professionals to improve management of non-communicable diseases and communicable diseases requiring long-term care in adults who are homeless

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ABSTRACT

Objective Identify, describe and appraise trials of interventions delivered by healthcare professionals to manage non-communicable diseases (NCDs) and communicable diseases that require long-term care or treatment (LT-CDs), excluding mental health and substance use disorders, in homeless adults.

Design Systematic review of randomised controlled trials (RCTs), non-RCTs and controlled before–after studies. Interventions characterised using Effective Practice and Organisation of Care (EPOC) taxonomy. Quality assessed using EPOC risk of bias criteria.

Data sources Database searches (MEDLINE, Embase, PsycINFO, Scopus, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Applied Social Sciences Index and Abstracts (ASSIA) and Cochrane Central Register of Controlled Trials), hand searching reference lists, citation searches, grey literature and contact with study authors.

Setting Community.

Participants Adults (≥18 years) fulfilling European Typology of Homelessness criteria.

Intervention Delivered by healthcare professionals managing NCD and LT-CDs.

Outcomes Primary outcome: unscheduled healthcare utilisation. Secondary outcomes: mortality, biological markers of disease control, adherence to treatment, engagement in care, patient satisfaction, knowledge, self-efficacy, quality of life and cost-effectiveness.

Results 11 studies were included (8 RCTs, 2 quasi-experimental and 1 feasibility) involving 9–520 participants (67%–94% male, median age 37–49 years). Ten from USA and one from UK. Studies included various NCDs (n=3); or focused on latent tuberculosis (n=4); HIV (n=2); hepatitis C (n=1) or type 2 diabetes (n=1). All interventions were complex with multiple components. Four described theories underpinning intervention. Three assessed unscheduled healthcare utilisation: none showed consistent reduction in hospitalisation or emergency department attendance. Six assessed adherence to specific treatments, of which four showed improved adherence to latent tuberculosis therapy. Three concerned education case management, all of which improved disease-specific knowledge. No improvements in biological markers of disease (two studies) and none assessed mortality.

Conclusions Evidence for management of NCD and LT-CDs in homeless adults is sparse. Educational case-management interventions may improve knowledge and medication adherence. Large trials of theory-based interventions are needed, assessing healthcare utilisation and outcomes as well as assessment of biological outcomes and cost-effectiveness.

Strengths and limitations of the study

► This is the first systematic review to explicitly focus on non-communicable disease (NCD) and communicable disease that requires long-term care or treatment (LT-CD) management for adults who are homeless.
► A comprehensive search strategy was supplemented with hand searching, grey literature searches and contact with study authors.
► Interventions are described using the Effective Practice and Organisation of Care taxonomy.
► Significant heterogeneity precluded meta-analysis, so a narrative synthesis is presented along with a harvest plot summarising study findings.
► Evidence available is mostly limited to the USA, with one study from the UK.

INTRODUCTION

The prevalence of homelessness is increasing across high-income countries.[1] The experience of homelessness is associated with increased morbidity and mortality.[2–4] Social exclusion and socioeconomic deprivation,[5 6] adversity over the life course,[7] and environmental and behavioural risk factors[8] typical of

homelessness contribute to an increased prevalence of a range of health problems compared with the rest of the population.[1] This review focuses on both non-communicable diseases (NCDs) and communicable diseases that require long-term care or treatment (LT-CDs), excluding mental health and substance use disorders. We take this focus because compared with interventions for mental health disorders or substance use disorders, the management of NCD and LT-CDs in the context of homelessness has not been synthesised in the systematic review literature.[9] Such conditions disproportionately affect people who are homeless (eg, tuberculosis (TB) rates 20 times higher than general population, generally poorer control of diabetes and hypertension and higher cardiovascular mortality).[1] Innovative models of care and expanded roles of healthcare professionals offer potential strategies to target NCDs and LT-CDs.

Outcomes of both NCDs and LT-CDs are poorer among people who are homeless.[10 11] Engagement with scheduled appointments, preventative health services and adherence to treatment are typically lower.[12–15] Barriers to access, conflicting priorities, physical and mental multimorbidity are thought to contribute to poorly coordinated use of healthcare services.[15] Consequently, there is a need for tailored services.[15–17] Healthcare delivery models for people experiencing homelessness include specialised or generalist primary care services[18]; and integrated housing and health interventions. There is insufficient evidence of reach and effectiveness to favour one model over another.[19] The expanding role of various healthcare professionals, for example, registered nurses and pharmacists, targeting NCD/LT-CDs,[20] offers a complementary model of healthcare for people who are homeless. Sharing clinical roles may be welcome given the increasing evidence of multimorbidity and polypharmacy.[21]

Controlled evaluations of models of healthcare for people who are homeless are relatively few and optimal delivery varies between different health and social care systems.[17] There have been calls to evaluate more interventions to improve the health of people who are homeless,[22] including long-term prospective studies with economic analyses.

Previous systematic reviews have identified the potential benefit of tailored interventions for addressing mental health disorders and at-risk substance use.[23 24] These have shown potential for monetary incentives to improve adherence for people who are homeless with latent TB,[23] and that provision of housing improved health outcomes in HIV.[24] However, to the authors' knowledge, no previous systematic reviews have specifically focused on the potential impact of healthcare professional or other intervention on NCDs and LT-CDs for adults experiencing homelessness.

Aims

This review aims to systematically identify, describe and appraise trials of interventions focusing on the management of NCD and LT-CDs, delivered by healthcare professionals for adults who are homeless. It addresses the following two research questions:

1. What are the key components of interventions delivered by healthcare professionals aimed at improving management of NCD and LT-CDs including theoretical underpinnings?
2. What impact has been demonstrated by trials of interventions delivered by healthcare professionals aimed at improving management of NCD and LT-CDs?

METHODS

This systematic review followed a prespecified protocol[25] (registered with International Prospective Register of Systematic Reviews, ID: CRD42016046183, available at http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016046183) and is described according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[26]

Eligibility criteria

Eligibility criteria and search process are described in detail in our published protocol paper,[25] and are outlined briefly below. Full details are given in online supplementary file 1. Homelessness was defined according to the European Typology of Homelessness (ETHOS) criteria.[27] Eligible studies included adult participants who met the ETHOS-defined homelessness criteria with one or more NCDs or LT-CDs or those concerning management of these conditions as part of a broader intervention (eg, access to primary care). We considered any change to the organisation or delivery of care to be an intervention. Delivery by a healthcare professional was required, defined as a person with professional training or registration to provide healthcare. Peer-health advisors (lacking professional training) and social workers (lacking health-specific training) were not considered healthcare professionals, however, interventions involving a wider range of roles were eligible for inclusion if a healthcare professional was involved in delivery as part of a wider team.

We considered a range of prespecified outcomes. Studies including any of our primary or secondary outcomes were eligible for inclusion. Unscheduled healthcare utilisation was our primary outcome. Secondary outcomes included physical measures of disease control, quality of life, behavioural outcomes, emotional well-being, satisfaction with care and cost-effectiveness. These are fully detailed in online supplementary file 1.

Literature search

MEDLINE, Embase, Scopus, PsycINFO, CINAHL, ASSIA and Cochrane Central Register of Controlled Trials were searched from 1966 (or inception) to October 2016. The search was updated in November 2017. Our search strategy was 'homelessness' and 'NCD/LT-CDs or healthcare delivery terms' and 'trial or evaluation

terms'. The full search terms for MEDLINE are shown in online supplementary file 1 and were adapted for other databases. Database searches were supplemented by hand searching of reference lists of all eligible studies, hand searching the *Journal of Health Care for the Poor and Underserved*, and forward citation searches of included studies using Web of Science. A number of 'grey Literature' sources were also searched (online supplementary file 1). Grey literature and relevant conference abstracts were used to identify recently published studies.

Two reviewers (PH plus LY, RL or RE), using DistillerSR software, independently screened titles and abstracts of all records identified. Full texts of all potentially eligible studies were obtained and assessed independently by two reviewers (PH, LY or RE) against the eligibility criteria. At all levels disagreements were resolved by discussion, involving a third reviewer (RL or LY) when consensus could not be reached. Where studies included homeless participants but analysis of these participants was not presented separately, we contacted the study authors to request these data. Studies were excluded if these were not available. Using a standardised data extraction form, two reviewers (PH plus LY or LG) independently extracted data from each study eligible for inclusion. The components of each intervention were described according to the Cochrane Effective Practice and Organisation of Care (EPOC) taxonomy.[28] Two reviewers independently assessed each study according to the criteria outlined in the Cochrane EPOC guidelines for assessing risk of bias (ROB) in randomised controlled trials (RCTs), non-RCTs and controlled before-after (CBA) studies.[28] After grading each study, a judgement of the overall ROB was made for each outcome, taking into account the relative importance of potential sources of bias to the outcome in question.

Synthesis

We assessed the clinical and methodological heterogeneity of the eligible studies. Few studies considered similar outcomes, and those that did had either different comparator groups,[29 30] differing methods of assessing similar outcomes (eg, survey vs routine data for emergency department (ED) attendance)[31 32] or concerned complex interventions, the diversity of which would limit the utility of a pooled analysis.[31 33] Consequently, a meta-analysis was deemed inappropriate and we performed a narrative synthesis of the study findings. Studies were grouped by outcome and the strength of the body of evidence for each outcome was assessed using the Grades of Recommendation, Assessment, Development and Evaluation approach.[34]

We constructed a harvest plot post hoc to display the results. Harvest plots use bars representing individual studies placed on a plot matrix to indicate whether the review intervention showed an overall positive, negative or no consistent effect for the outcome in question. They enable data to be summarised when study designs and outcomes are diverse and heterogeneous.[35 36] We used

the following criteria to decide how each study should be displayed:

► height of the bar represented the number of participants in the study;
► RCTs were displayed in bold with other designs in grey;
► the ROB for the outcome of each study was indicated as low, moderate or high using a coloured dot above the bar;
► statistically significant differences were displayed as a positive effect if they favoured the intervention; negative if they favoured the comparator and neutral if not statistically significant;
► where some, but not all, findings in a group of outcomes showed a positive or negative effect, bars were hatched to indicate inconsistency.

RESULTS

Study selection

The results of abstract and full-text screening are shown in the PRISMA diagram in figure 1. A full list of studies excluded at full-text level, along with reasons for exclusion, is shown in online supplementary file 2.

Description of studies

Sixteen papers were eligible for inclusion which described 11 unique studies.[29–33 37–47] Ten studies were from the USA[29 30 32 33 37–47] and one from UK.[31] Eight were RCTs, two quasi-experimental and one was a pilot study.

Three studies included a range of NCDs.[31–33] None of these studies included specific diagnoses as inclusion criteria, but rather recruited at hospital admission or from homeless accommodation targeting access to community health services. It was not specified if participants included also had LT-CDs. The three studies including a range of NCDs each focused on access to care and services. Identification and management of health needs were included in this, however, the interventions did not target specific conditions or management strategies. With the exception of one small (n=9) pilot study in type two diabetes, all other studies focusing on management of specific conditions concerned LT-CDs: four studies concerned latent TB[29 30 37–41]; one concerned hepatitis C[46]; two studies concerned HIV.[43–45 47]

Study populations

Details of the study populations are summarised in table 1. Sample sizes ranged from 9 to 520. Median age ranged from 37 to 49 years. In all of the studies, the majority of participants were male (percentage male participants ranged from 67% to 94% in the intervention groups). Age and sex distributions were consistent with previous literature on homelessness.[1] Six studies, all from the USA, reported details of ethnicity.[29 30 37 41 43 46] African-American participants were the most prevalent in five of these. Only two studies included any detail
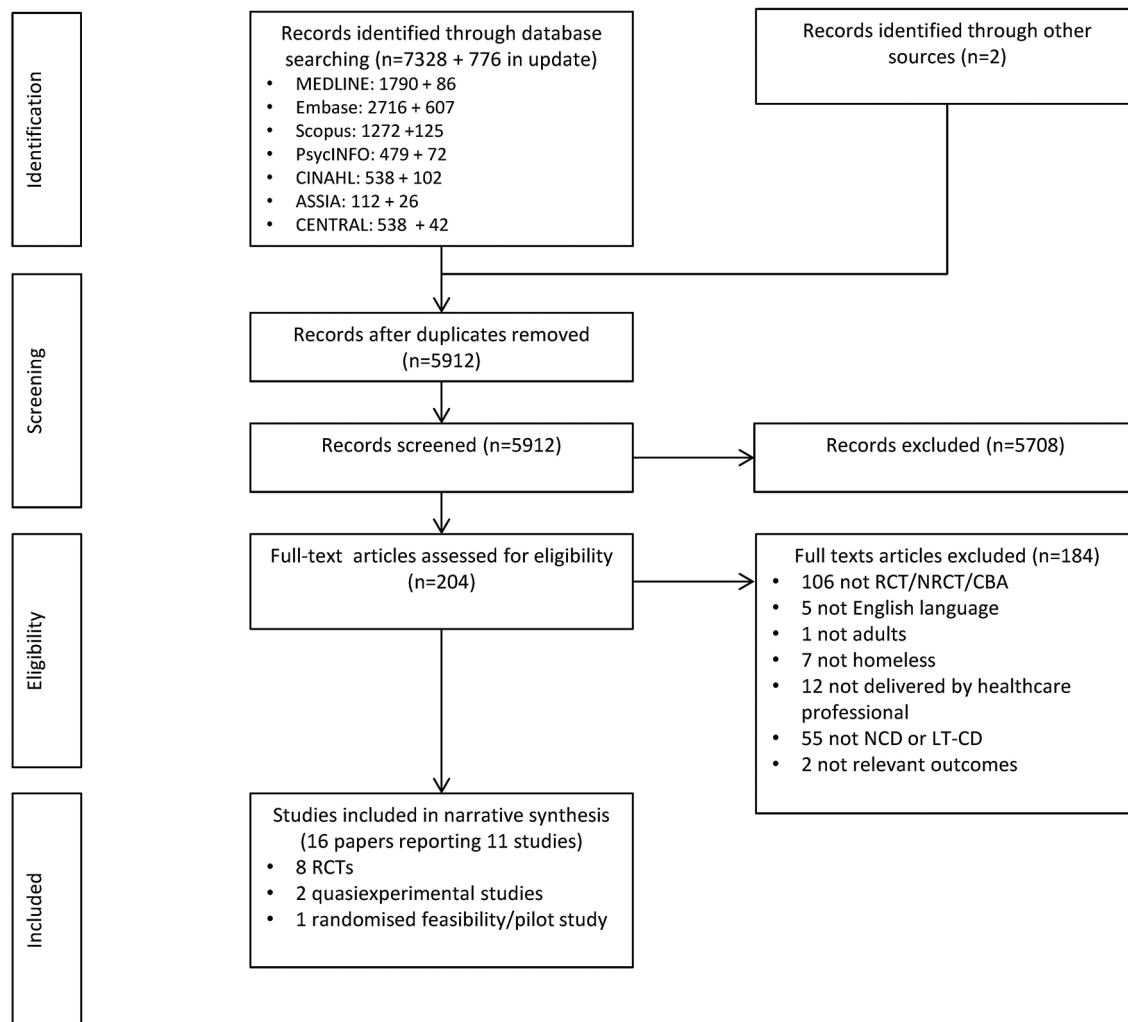
Figure 1 PRISMA diagram of search results and screening. ASSIA, Applied Social Science Index and Abstracts; CBA, controlled before-after; CENTRAL, Cochrane Central Register of Controlled Trials; CINAHL, Cumulative Index to Nursing and Allied Health Literature; LT-CD, Communicable disease requiring long-term care; NCD, Non-communicable Disease; NRCT, non-randomised controlled trial; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, randomised controlled trial.

of comorbidities.[31 37] Details of attrition are shown in online supplementary file 3.

Quality assessment

Results of the EPOC ROB assessment for each of the included studies are shown in table 2. None of the included studies scored low risk for each of the criteria. These were used to inform outcome-level ROB assessment. These are displayed, along with justification, in online supplementary file 3.

Intervention components and theoretical underpinnings

Multidisciplinary teams including both a physician and nurse working alongside social workers delivered two of the interventions.[31 32] The nine remaining interventions were delivered primarily by a nurse, alone[46 47] or alongside psychiatrists,[43] peer-health advisors[29 30 41] or outreach workers.[37]

Each of the studies described interventions that were complex and included multiple components. These included changes to how, and where, care was delivered, the personnel delivering care, how care delivery was coordinated and the provision of financial support. The components of the EPOC taxonomy relating to each of the interventions are shown in table 3, along with a summary of the intervention and control interventions. Descriptions of the specific aspects of each intervention relating to the taxonomy are shown in online supplementary file 4.

Four of the 11 studies reported an explicit theoretical framework underpinning the intervention (table 3). These included the comprehensive health seeking and coping paradigm underpinning two of the studies, and self-efficacy theory and the health belief model each underpinning one intervention.

Impact of interventions on healthcare outcomes

The overall findings of the included studies for impact on unscheduled healthcare utilisation, adherence or

Table 1 Summary of study populations

Study	Design	Location	Number of participants	Age, mean (SD)	Sex (%)	Ethnicity (%)	Condition	Homelessness definition
Pilote et al[41]	RCT	USA	244 I[1]: 83 I[2]: 82 C: 79	I[1]: median 40 I[2]: median 39 C: median 40	I[1]: M (71%) I[2]: M (67%) C: M (66%)	African-American (I[1]: 48%, I[2]: 57%, C: 54%) White (I[1]: 33%, I[2]: 27%, C: 27%) Hispanic (I[1]: 16%, I[2]: 11%, C: 13%)	Latent TB	Homeless: not further defined
Tulsky et al[30]	RCT	USA	118 I[1]: 43 I[2]: 37 C: 38	Median 37	M (89%)	African-American (52%) White (21%) Hispanic (27%)	Latent TB	Homeless or marginally housed
Tulsky et al[29]	RCT	USA	141 I: 72 C: 69	Median 41 (range 21–79)	M (85%)	African-American (47%) White (32%) Other (20%)	Latent TB	Homeless or marginally housed
Samet et al[47]	RCT	USA	151 (34 homeless) I: 19 C: 15	Median 44 (range 26–60)	M (82%)	n/a	HIV with alcohol problems	Homeless: not further defined
Ciaranello et al[32]	Quasi-experimental	USA	Six transitional housing facilities I:219 sampled C: 50 sampled	I: 41.6 (9.6) C: 41.3 (10.4)	I: M (81%) C: M (44%)	n/a	Various*	'Formerly homeless' residents of transitional housing
Nyamathi et al[37] Nyamathi et al[38] Schumann et al[39] Nyamathi et al[40]	RCT	USA	520 I: 279 C: 241	41.5 (8.5)	M (79.6%)	African-American (81%) White (7.3%) Hispanic (9.4%) Other (2.3%)	Latent TB	Sleeping in homeless shelters
Tsai et al[43] Tsai et al[44] Grelotti et al[45]	RCT	USA	137 I: 66 C: 71	I: median 44 (IQR: 37–53) C: median 42 (IQR: 37–79)	I: M (91%) C: M (89%)	I: Caucasian (48%) C: Caucasian (51%)	HIV with comorbid depression	'Homeless or marginally housed'
Savage et al[42]	Randomised pilot/feasibility	USA	9 I: 6 C: 3	n/a	n/a	n/a	Type 2 diabetes	Living without shelter or adequate accommodation
Tyler et al[46]	Randomised quasi-experimental	USA	107 (hepatitis C positive subset) I: 46 C: 61	Males: 44 (7.1) Females: 45.3 (8.9)	M (79%)	African-American (63%) White (17%) Latino (18%)	Hepatitis C	Homeless: not further specified

Continued

Table 1 Continued

Study	Design	Location	Number of participants	Age, mean (SD)	Sex (%)	Ethnicity (%)	Condition	Homelessness definition
O'Toole et al[33]	RCT	USA	185 I¹: 39 I²: 40 I¹+²: 44 C: 62	48.6 (10.8)	M (94%)	'Minority population' (43%)	Various†	'Lacking fixed, regular and adequate night-time residence'
Hewett et al[31]	RCT	UK	410	I: 41.6 (12.1) C: 42.5 (11.3)	I: M (81.6%) C: M (81.4%)	N.S. Nationality: UK: I (69.4%), C (72.5%) European Union: I (22.3%), C (17.6%) Other: I (8.3%) C (9.8%)	Various‡	No fixed residence on hospital discharge

*Included hypertension, otherwise not fully specified.
†Asthma, COPD, hepatitis, cirrhosis, diabetes, hypertension and arthritis.
‡Categorised by organ system (included liver, pulmonary, musculoskeletal, central nervous system, cardiovascular system, endocrine, skin, gastrointestinal and haematological pathology). Causes for hospital attendance also categorised by aetiology, 35% related to cardiovascular disease and 15% to metabolic conditions.
C, Comparator group; COPD, chronic obstructive pulmonary disease; I, Intervention group; M, male; RCT, randomised controlled trial; TB, tuberculosis.

access to care and knowledge of self-efficacy are illustrated in the harvest plot shown in figure 2. The text that follows synthesises these findings under each outcome.

Primary review outcomes
Unscheduled healthcare utilisation

Three studies assessed the impact of interventions on hospital admissions and ED attendance.[31–33] None focused on a specific condition, however, participants reported a range of NCDs and each intervention included identification and engagement with medical, as well as wider needs. The highest quality evidence was from two RCTs, neither of which showed any significant reduction in unscheduled healthcare utilisation.[31 33] One RCT evaluated a multidisciplinary, multicomponent intervention targeting patients in two inner-city hospitals involving goal setting, discharge planning and liaising with community services.[31] Neither hospital admissions nor ED attendance after 1 year were significantly different compared with usual care. The other RCT was a four-arm trial comparing usual care; a brief nurse-led physical health needs assessment; a guided orientation to clinical facilities with introduction to staff; and clinic orientation in combination with the physical health assessment.[33] Hospital admissions and ED attendance were assessed at 6 months postintervention in a post hoc analysis and showed no significant difference to usual care. A third study, with a quasi-experimental design and high ROB, concerned a 'comprehensive health assessment' delivered to residents at transitional housing facilities. ED attendances were reportedly lower at 18 months follow-up, but not at 6 months. There was no difference in hospitalisation at either follow-up point.

Taken together the available evidence does not suggest that the multidisciplinary, multifaceted interventions described reduced rates of unscheduled healthcare utilisation. The overall confidence in the estimate of effect is low. There were no studies targeting specific NCD or LT-CDs.

Secondary review outcomes
Access to primary healthcare

One RCT, including a range of NCDs, concerned access to primary healthcare.[33] A brief nurse-led physical health needs assessment, a guided orientation to clinical facilities with introduction to staff and clinic orientation in combination with the physical health assessment were compared with usual care. All three intervention groups showed higher uptake of primary healthcare services after 6 months with clinic orientation alone and in combination with a physical health assessment significantly improving primary care access in adjusted analyses. Overall confidence in effect for improvement in this outcome was high, but limited to one study so should be interpreted with caution.

Table 2 Risk of bias within individual studies

Criteria	Ciaranello 2006[32]	Hewett et al[31]	Nyamathi et al[37 38 40] and Schumann et al[39]	O'Toole et al[33]	Pilote et al[41]	Samet et al[47]*	Savage et al[42]	Tsai et al[43 44] and Grelotti et al[45]	Tulsky et al[30]	Tulsky et al[29]	Tyler et al[46]
Random sequence generation	High	Low	Unclear	Low	Unclear	Unclear	High	Low	Low	Low	High
Allocation concealment	High	Low	Low	Unclear	Unclear	Unclear	High	Low	Low	Low	Unclear
Blinding of participants/personnel	High	High	High	High	High	High	High	High	High	Unclear	High
Similar baseline outcome measures	High	Low	Low	Low	Unclear	Low	Unclear	Low	Unclear	Unclear	Low
Similar baseline characteristics	High	Low	Low	Low	Low	Low	Unclear	Low	Low	Low	Low
Blinding of outcome assessment	High	Low	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	High
Incomplete outcome data	High	High	Low	Low	Low	Low	High	Low	Low	Low	Low
Protection from contamination	High	Unclear	Low	Unclear	Low	Low	Unclear	Low	Low	Low	Low
Selective outcome reporting	High	Low	Low	Low	Low	Unclear	High	Unclear	Low	High	Unclear
Other bias	High	Low	Low	Low	Low	Low	High	Low	High	High	Low

*Assessment based on methods and results as described in the original manuscript. Unpublished data were supplied by authors for secondary analysis of homeless study participants.

Table 3 Intervention components, theoretical underpinning and outcomes

Study	Components	Healthcare professional delivering the intervention	Theory	Intervention	Comparator	Outcomes
Pilote et al[41]	*How care is delivered:* individual delivery; *Location/environment:* orientation to environment/facilities; transportation services; *Finance:* incentives	Nurse plus peer-health advisor	None specified	Monetary incentive for TB clinic attendance (group 1). Peer-health advisor assisting with clinic attendance (group 2).	Usual care (clinic appointment and tokens for travel expenses)	Attendance at initial TB clinic appointment.
Tulsky et al[30]	*How care is delivered:* individual delivery; *Location/environment:* orientation to environment/facilities; transportation services; *Finance:* incentives	Nurse, outreach worker and peer-health advisor	None specified	Monetary incentive for uptake of DOT (group 1). Peer-health advisor supporting DOT (group 2).	Usual care	Completion of 6 months isoniazid therapy
Tulsky et al[29]	*How care is delivered:* individual delivery; *Location/environment:* transportation services; *Finance:* incentives	Nurse, outreach worker and peer-health advisor	None specified	Monetary incentive for uptake of DOT.	Non-cash incentive of equal value (vouchers)	Completion of 6 months isoniazid therapy; Cost-effectiveness
Samet et al[47]	*How care is delivered:* individual delivery; Self-management; *Location/environment:* outreach services; *Coordination of care:* disease management	Nurse	Health belief model and motivational interviewing	Adherence support for ART.	Usual care (written instructions/advice regarding treatment adherence)	Adherence to ART; CD4+ count; HIV viral load
Ciaranello et al[32]	*How care is delivered:* individual delivery. Self-management; *Location/environment:* outreach services; changing site of service delivery; *Coordination of care:* communication between providers; disease management; multidisciplinary teams	Medical director, nurse practitioner, medical clerk and social worker	None specified	Weekly visits including health assessment, education, referral and social support.	Transitional houses in a different area not receiving the intervention	ED attendance; Hospital admission; Blood pressure; Satisfaction with care
Nyamathi et al[37]; Nyamathi et al[38]; Schumann et al[39]; Nyamathi et al[40]	*How care is delivered:* group delivery. Self-management; *Location/environment:* outreach services; transportation services; *Coordination of care:* case management; disease management; *Finance:* incentives	Nurse and outreach worker	Comprehensive health seeking and coping paradigm	DOT plus eight education sessions. Information provided on community resources and participants escorted to appointments.	DOT plus 20 min educational lecture	Completion of directly observed TB therapy; TB knowledge; HIV knowledge; Self-efficacy
Tsai et al[43]; Tsai et al[44]; Grelotti et al[45]	*How care is delivered:* individual delivery; *Coordination of care:* case management; disease management; *Finance:* incentives	Psychiatrist and study nurse	None specified	Directly observed fluoxetine and weekly psychiatric interview	Advice on sources of mental health support	Adherence to antiretroviral therapy; HIV viral load; Depression
Savage et al[42]	*How care is delivered:* individual delivery; Self-management	Nurse	Self-efficacy theory	Nurse-led case-management and diabetes education	Usual care	Self-efficacy
Tyler et al[46]	*How care is delivered:* group delivery; Self-management; *Coordination of care:* case management; communication between providers	Nurse	Comprehensive health seeking and coping paradigm	Case management with group sessions, self-management training and education	Single, brief educational intervention	Hepatitis C knowledge

Table 3 Continued

Study	Components	Theory	Healthcare professional delivering the intervention	Intervention	Comparator	Outcomes
O'Toole et al[33]	*How care is delivered*: individual delivery. Self-management. *Location/environment*: orientation to environment/facilities; outreach services; transportation services. *Coordination of care*: case management; disease management	None specified	Nurse	Nurse-led brief health assessment with motivational interviewing (group 1). Guided orientation to primary care clinic facilities (group 2). Both interventions together (group 3).	Usual care (social work assessment and description of available services)	ED attendance Hospital admission Access to primary care
Hewett et al[31]	*How care is delivered*: individual delivery; coordination of care providers. Role expansion; recruitment of specific professionals. *Coordination of care*: care pathways; communication between professionals; discharge planning; integration of services; shared care; multidisciplinary teams	None specified	General practitioner and specialist nurse	Nurse- and GP-led inpatient intervention. Goal setting. Discharge planning. Liaison and multiagency meetings.	Initial meeting with nurse and signposting of services	ED attendance Hospital readmission Quality of life

ART, antiretroviral treatment; DOT, directly observed therapy; ED, emergency department; GP, general practitioner; TB, tuberculosis.

Adherence to specific treatment

Six studies (seven papers), all of which concerned LT-CDs, assessed adherence to treatment or attendance at appointments.[29 30 37 41 43 44 47] Four recruited patients with latent TB undergoing directly observed therapy (DOT),[29 30 37 41] one included participants with HIV and alcohol problems[47] and one (two papers) concerned participants with HIV and comorbid depression.[43 44] Of the TB studies, three were conducted by the same research group and assessed the impact of monetary incentives (cash and/or voucher) on attendance at initial TB clinic follow-up[41] or on completion of DOT with isoniazid.[29 30] Clinic attendance and DOT completion rates were significantly higher with cash incentives compared with usual care or peer-health advisors.[30] There was no statistically significant difference in DOT completion between cash and voucher incentives.[29] Details of the availability to the participants of social security or other sources of financial support are not described in either study. Although the cash incentive and delivery of the intervention were similar in both studies assessing DOT completion, the completion rate in the intervention group differed widely between the two studies (44% and 89%, respectively).[29 30] The authors speculate that the location of the clinic (the higher completion rate being in an area more accessible and frequented by people who are homeless) or alterations in the follow-up protocol for non-attendees may explain the differences.

The final study concerning TB evaluated the impact of a nurse-led case management intervention on completion of latent TB treatment and TB knowledge (described in the Knowledge and self-efficacy section). They found odds of DOT completion were three times greater with the intervention compared with usual care.[37]

An RCT concerning people with HIV and comorbid depression assessed fluoxetine prescription and weekly psychiatric evaluation compared with the provision of information about how to access local psychology services without the prescription of fluoxetine. Both arms were given a weekly cash incentive for attending. Outcomes included rate of uptake of antiretroviral treatment (ART), and adherence to ART (assessed by unannounced pill counts) for those receiving treatment. Neither outcome was significantly different between the groups despite an improvement in depression severity and remission in the fluoxetine group.[43 44]

Finally, an RCT aimed at supporting antiretroviral medication adherence among HIV-positive participants with a history of alcohol dependence or harmful drinking showed no change in antiretroviral adherence.[47] Findings were similar to a secondary analysis of participants who described themselves as homeless (unpublished results).

Overall, there is a moderate level of evidence for interventions improving adherence to treatment for latent TB, including a case-management educational approach and provision of monetary incentives (cash or non-cash). However, the efficacy of such interventions may be dependent on the social and cultural context in which it
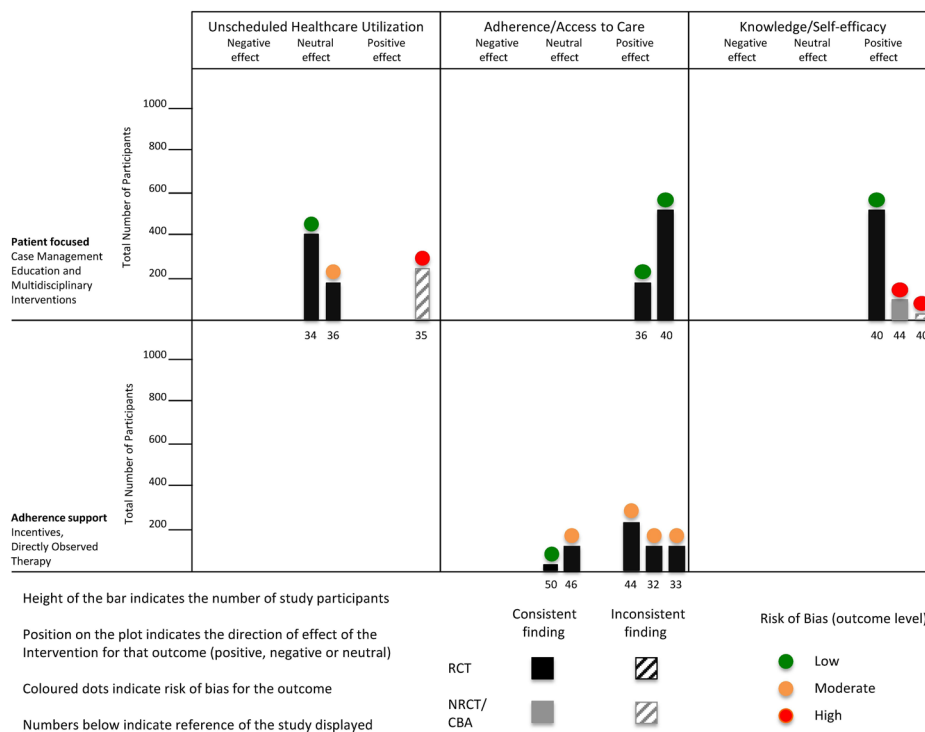
Figure 2 Harvest plot of findings of included studies. CBA, controlled before-after study; NRCT, non-randomised controlled trial; RCT, randomised controlled trial.

is delivered (highlighted by variation in completion rates between evaluations of similar interventions), of which there is limited description in the available studies.

Knowledge and self-efficacy

Three studies (five papers) assessed the impact of interventions on disease-specific knowledge and self-efficacy.[37–39 42 46] Two (four papers) concerned LT-CDs (TB, HIV and hepatitis) and one concerned type 2 diabetes. Two were trials incorporating nurse-led case management (for patients with latent TB or hepatitis C, respectively) combined with a regular educational intervention focusing on self-management, self-esteem, communication skills and social support. One was an RCT focusing on DOT for latent TB and assessed the impact on TB knowledge in all participants.[37] The intervention also involved HIV education and the impact of this was evaluated in a subset judged to be 'at risk' of HIV (ie, sexually active or known to be intravenous drug users). Two analyses using structural equation modelling showed that the nurse-led case management intervention was associated with greater improvement in TB knowledge[38] and in HIV knowledge in the 'at risk' subset.[39] The latter also showed improved self-efficacy for condom use.[39] The other evaluated a similar approach concerning hepatitis education for participants enrolled in a hepatitis A/B vaccination programme (only the hepatitis C positive subset was included in this review).[46] The case-management group showed a greater improvement in hepatitis C knowledge than the control group. However, the randomisation

procedure was designed for the vaccine trial, not for the evaluation of the case-management intervention, and the statistical analysis was not designed to compare the intervention with control in the hepatitis C subset alone.[46]

The third study reported improved knowledge in a small (n=9) pilot study using a self-efficacy-based approach for type 2 diabetes mellitus. However, the small sample size meant there was insufficient power to detect any difference between groups and there was incomplete reporting of outcomes and no clear comparison is made between the intervention and comparator.[42]

Taken together, there is a moderate quality of evidence showing that an educational case-management approach can improve disease-specific knowledge in the context of specific LT-CDs when delivered alongside wider interventions, such as DOT or a vaccine study. The available studies, however, do not assess the impact on behavioural outcomes or the retention of knowledge beyond the trial period.

Biological markers of disease control

Two studies (three papers) concerning LT-CDs assessed the impact of interventions on disease control outcomes. One RCT assessed the impact on HIV-1 viral load of directly observed fluoxetine in comorbid HIV and depression. There was no difference in viral suppression between intervention and comparator groups.[43–45] The other RCT found no difference in viral load or CD4+ count with adherence support for antiretroviral therapy in HIV-infected individuals with a history of alcohol problems.[47]

Cost-effectiveness

Only one study, including participants with a range of conditions including NCDs, assessed cost-effectiveness, within the hospital sector.[31] Patients in the intervention group also had multiagency care plans devised before, and implemented after hospital discharge. Quality of life was a secondary outcome, with health gain measured by translating generic EQ-5D-5L (five level EuroQol quality of life questionnaire) index scores into generic quality-adjusted life years (QALYs). EQ-5D-5L scores were completed by approximately one quarter of participants in both arms. There was a non-statistically significant increase in EQ-5D-5L scores at follow-up, and there was no impact of the intervention on inpatient costs, therefore the authors compared the costs of the intervention with the effect on health gain as measured by QALYs. On this basis the incremental cost-effectiveness ratio was £26 000 with the authors describing circumstances in which the intervention may be cost-effective, and an accompanying sensitivity analysis.[31]

DISCUSSION
Summary of findings

The available evidence from controlled trials of interventions by healthcare professionals improving access to care for people with NCDs who are homeless does not show any convincing effects on unscheduled healthcare utilisation.[31–33] There is also a lack of evidence to inform the management of specific NCDs in this context. One multidisciplinary intervention did demonstrate improved access to primary healthcare.

Seven interventions were identified targeting specific LT-CDs. All of these involved a nurse primarily delivering the intervention, sometimes with support of peer-health advisors. Patient-centred interventions—incorporating case management, education, self-management support and social support—may improve disease-specific knowledge in TB, HIV and hepatitis C; improve completion of DOT in latent TB and increase access to primary care in combination with clinic orientation.[33 37–39 46] Cash and non-cash incentives, in the context of DOT for latent TB, may improve clinic attendance and treatment adherence; however, treatment completion rates vary between different studies of similar interventions.[29 30 41] It is not clear if improvement in these intermediate outcomes impacts other clinical outcomes, or if effects are sustained beyond the course of treatment evaluated in these studies. The impact on mortality was not assessed, and evidence for the impact on biological markers of disease control is limited to a few studies on HIV, which did not show any evidence of benefit on viral load.[43 44] There was only one study of cost-effectiveness.

Strengths and limitations

The strengths of this review include a priori methods with a robust process for study identification, appraisal, data extraction and description.[25] The comprehensive search strategy included database searches supplemented by hand searching, forward citation searching, grey literature and contact with study authors. All screening and data extraction was performed by two reviewers independently. We also described the components of each intervention using a previously defined taxonomy,[28] which is important when reviewing complex interventions such as those included.[48 49] However, many of the findings, particularly those concerning adherence to treatment, were in the context of specific conditions (eg, latent TB), included a time-limited course of treatment and were conducted in a single centre. All but one of the included studies were from the USA. As such the findings may not be directly applicable to other disease areas or other health and social care contexts. Limitations in the existing evidence base also meant that we were unable to undertake a formal meta-analysis. Contacting study authors to obtain results pertaining to participants who were homeless (when not reported separately) contributed to the comprehensiveness of the review, however, this strength needs to be balanced against the potential bias of performing post hoc secondary analyses on existing trial data. Furthermore, in such circumstances studies are not specifically powered to assess outcomes in this subgroup.

This review is timely given the increasing number and complexity of health problems among people who are homeless,[1] the pressure on healthcare services to address this burden and the potentially expanding roles of various healthcare professionals to support management of NCDs and LT-CDs.[20] However, by focusing on interventions by healthcare professionals this review may overlook evidence for housing or social interventions that may impact on such conditions.[50 51]

Implications for practice, policy and research

Despite the social complexity and exclusion that typify the experience of homelessness, a patient-focused case-management approach was shown to positively impact disease-specific knowledge and self-efficacy in the management of selected LT-CDs.[37–39 46] These interventions were primarily delivered by a study nurse, with or without peer-health advisors, adopting a case-management approach.

It is not clear to what extent the findings presented here are generalisable to wider social or healthcare contexts, or to other conditions. The evidence for improved adherence was predominantly in the context of DOT for latent TB and in some cases involved cash incentives. Further research would be required to establish whether these principles of adherence support are transferable to the management of NCDs. Furthermore, the potential efficacy of cash incentives will vary between societal contexts where access to, and the extent of, financial support varies widely. Finally, the available literature focuses mainly on the role of nurses and physicians, often alongside other ancillary staff (such as peer advisors, case managers and care coordinators), with little consideration of the

potential role of other healthcare professionals, for example, pharmacists.

The extent to which the improvements in knowledge or adherence that have been demonstrated may impact on physical or behavioural outcomes has not been evaluated. This raises the question of how such issues may be best addressed by future research. It is likely, given their apparent scarcity, that further evaluation of complex interventions to address both NCD and LT-CDs management (including aspects of randomisation, longer follow-up and consideration of broader outcomes) will be needed to inform practice. Based on existing patterns of need and service utilisation, as well as the need to demonstrate effectiveness and cost-effectiveness of novel models of care, well-designed and conducted studies following a framework for testing complex interventions[49] for people who are homeless are overdue.

However, the intrinsic complexity of the experience of homelessness, and the impact this has on health, may require a broader methodological approach (eg, realist synthesis) to understand the context and process of potential interventions in this area.

CONCLUSIONS

Trials of interventions delivered by healthcare professionals targeting NCD in people who are homeless do not show convincing evidence of the primary outcome measure for this review—an impact on unscheduled healthcare utilisation. Despite their high prevalence and associated morbidity and mortality, little evidence was identified to inform the management of specific NCDs.

In the context of specific LT-CDs (HIV, TB and hepatitis C), patient-centred case-management interventions may improve knowledge and self-efficacy. Available evidence supports interventions delivered by a nurse and incorporating peer-health advisors. These interventions, as well as incentives, may also improve adherence in specific contexts. The impact on biological outcomes and mortality remains largely unexplored, as does the effectiveness of alternative models of care involving different professions. The economic impact of successful interventions is also largely unexplored. Future complex intervention evaluation research is needed to test innovative models of care, and expand those interventions showing promise, into diverse health and social care contexts.

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A systematic review of interventions by healthcare professionals to improve management of non-communicable diseases and communicable diseases requiring long-term care in adults who are homeless

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