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Review

Self-management of diabetes and associated comorbidities in rural and remote communities: a scoping review

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Abstract. Chronic health conditions are more prevalent in rural and remote areas than in metropolitan areas; living in rural and remote areas may present particular barriers to the self-management of chronic conditions like diabetes and comorbidities. The aims of this review were to: (1) synthesise evidence examining the self-management of diabetes and comorbidities among adults living in rural and remote communities; and (2) describe barriers and enablers underpinning self-management reported in studies that met our inclusion criteria. A systematic search of English language papers was undertaken in PsycINFO, Medline Complete, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete, EMBASE and the Cochrane Database of Systematic Reviews, searching for literature indexed from the beginning of the database until 6 March 2020. Essential key concepts were diabetes, comorbidities, self-management and rural or remote. Twelve studies met the inclusion criteria. Six of these reported interventions to promote self-management for adults with diabetes in rural and remote communities and described comorbidities. These interventions had mixed results; only three demonstrated improvements in clinical outcomes or health behaviours. All three of these interventions specifically targeted adults living with diabetes and comorbidities in rural and remote areas; two used the same telehealth approach. Barriers to self-management included costs, transport problems and limited health service access. Interventions should take account of the specific challenges of managing both diabetes and comorbidities; telehealth may address some of the barriers associated with living in rural and remote areas.

Keywords: chronic health conditions, comorbidities, diabetes, rural and remote communities, self-management.

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Introduction

People living in rural and remote areas experience higher levels of chronic diseases than people living in metropolitan areas (Australian Institute of Health and Welfare (AIHW) 2018; Disler *et al.* 2020). One reason is that people living in rural and remote areas have less access to health services, such as GPs, than people living in urban areas (Glazier *et al.* 2008; AIHW 2017). Diabetes is one of the most prevalent chronic diseases, currently ranking seventh in the World Health Organization's (WHO's) global burden of disease estimation and accounting for 2.8% of all deaths (WHO 2018). Globally, the prevalence of diabetes is slightly higher in urban (10.8%) than rural (7.2%) areas, although this gap is narrowing with increasing urbanisation (Saeedi *et al.* 2019). However, in some countries like Australia, rates of hospitalisations and deaths due to diabetes are twice as high in remote and very remote areas than in major cities (AIHW 2019). Some of the common risk factors for diabetes, such as poverty and obesity (O'Connor and Wellenius

2012), are also more prevalent in rural and remote areas than in metropolitan areas.

Diabetes is often associated with one or more serious comorbidity; 85% of people in Australia with diabetes have one or more diabetes-related comorbidity (AIHW 2016). Compared with people without diabetes, people living with a diagnosis of diabetes are significantly more likely to experience conditions like blindness, cardiovascular disease, hypertension, kidney failure, overweight/obesity, hyperlipidaemia, amputation and metabolic syndrome (Pambianco *et al.* 2006; Iglay *et al.* 2016). The risk of comorbidities can vary depending on location (i.e. rural or urban areas) and ethnicity (Mainous *et al.* 2004). There are positive associations between diabetes and both depression (Roy and Lloyd 2012; Moulton *et al.* 2015) and anxiety (Smith *et al.* 2013; Chaturvedi *et al.* 2019). Among people aged ≥65 years, hypoglycaemia is associated with dementia and cognitive impairment (Yerrapragada *et al.* 2019).

Despite general awareness of the high prevalence of comorbidities, policy and practice are often based on evidence about preventing and managing single disease processes, rather than comorbidities (Ording and Sørensen 2013; Iglay *et al.* 2016).

Barlow *et al.* (2002, p. 178) define self-management as 'the individual's ability to manage the symptoms, treatment, physical and psychological consequences and life style changes inherent in living with a chronic condition'. Self-management of chronic conditions by individuals is believed to be a complex behavioural process that involves individual decision making, which can be affected by multiple social, cognitive and developmental factors, as well as characteristics of the healthcare system (Bodenheimer *et al.* 2002; Grady and Gough 2015). Managing diabetes requires lifelong self-care, with particular attention required to balance physical activity, food intake and medication such as insulin (American Association of Diabetes Educators 2014). In research not specific to rural and remote-dwelling people, there is inconsistent evidence as to whether having comorbidities impedes the self-management of diabetes (Piette and Kerr 2006; Jowsey *et al.* 2009) or encourages people to focus more on their diabetes (Beverly *et al.* 2011; Teljeur *et al.* 2013). Although self-management can be successfully promoted through education and goal setting, this can be challenging in rural and remote areas, where health services and transport may be limited (Si *et al.* 2008).

In summary, although substantial research offers important insights into the self-management of diabetes, and other research informs the self-management of comorbidities, it is unclear whether these insights are applicable to people living in rural and remote settings with diabetes and comorbidities.

Study aims

The first aim of this study was to synthesise the body of evidence examining self-management among adults with a diagnosis of diabetes and comorbidities living in rural and remote communities. The second aim of the study was to describe any barriers and enablers emerging from the systematic search that may underpin self-management among this target population.

Methods

A scoping review was identified as the most appropriate methodology to respond to the broad aims described above. Scoping reviews are defined as 'exploratory projects that systematically map the literature on a topic, identifying key concepts, theories and sources of evidence' (Levac *et al.* 2010). The rigorous methodologies used by the systematic review are used to find studies and extract data (Arksey and O'Malley 2005). However, a formal evaluation of methodological quality of included studies is not performed because the aim is to provide a broad overview of the topic and types of evidence available regardless of quality (Colquhoun *et al.* 2014; Joanna Briggs Institute 2015). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher *et al.* 2009) were followed to conduct the review and to report the results.

Box 1. Search strategy in EMBASE

(diabet* OR "Diabetes Mellitus, Type 1" OR "Diabetes Mellitus, Type 2") **AND** (comorbid* OR "metabolic comorbidity" OR multimorb* OR "multiple conditions" OR polymorbid* OR "multiple diseases") **AND** ("heart failure" OR "heart diseases" OR "heart disorders" OR "coronary heart disease" OR "ischemic heart disease" OR hypertension OR "cardiovascular disease" OR CVD OR "chronic obstructive pulmonary disease" OR COPD OR "chronic condition" OR "chronic disease" OR "mental health" OR "mental illness" OR "renal failure" OR "kidney failure" OR "Mental Disorders" OR anxiety OR "Diabetes distress") **AND** ("health literacy" OR self-management OR "self management" OR self-care OR "self care" OR "manage symptoms" OR "emotional management" OR "glucose monitoring" OR "self-monitoring of blood glucose" OR "self monitoring of blood glucose" OR "glucose testing" OR "blood glucose test*" OR SMBG OR SBGM OR "metabolic control" OR "glycemic control" OR "glycaemic control" OR appointment* OR "appointment adherence" OR "appointment compliance" OR non-adheren* OR "non adheren*" OR nonadheren* OR non-complian* OR "non complian*" OR noncomplian* OR adheren* OR complian* OR ("lifestyle change" AND adherence) OR ("lifestyle change" AND compliance) OR ("behavi* change" AND adherence) OR ("behavi* change" AND compliance) OR exerci* OR "physical activit*" OR diet OR "medication adherence" OR "medication compliance" OR "treatment compliance") **AND** (rural OR regional OR remote OR isolated OR country OR outback OR bush OR farm* OR "Rural Population")

Search strategy

The PsycINFO, Medline Complete, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete and EMBASE databases were searched. Keywords were organised into five concepts and combined using the 'AND' Boolean operator: diabet* AND comorbid* AND ('chronic condition' OR 'chronic disease') AND ('health literacy' OR 'self management' OR 'self care') AND (rural OR regional). In addition, we used controlled vocabulary (MeSH and equivalent terms). We applied the English language limiter to all database searches. Box 1 shows the search strategy in EMBASE.

One author (NI), conducted the search under the guidance of a health librarian and exported references to EndNote. Duplicate records were removed. A two-stage screening process was undertaken by two reviewers (BR with NI or KW): records were screened first by title and abstract, and second by full text. Discrepancies at both stages were resolved via discussion between the reviewers.

Reference lists of all included studies, as well as any review papers found in the search, were harvested for additional eligible studies. A search of the Cochrane Database of Systematic Reviews was also conducted.

All searches were conducted on 6 March 2020, searching for literature from the beginning of each database.

Inclusion and exclusion criteria

Inclusion criteria related to study design, population, intervention or interest and outcomes, as detailed below:

- Study design: any primary research (including cohort, case control and qualitative studies)
- Population: adults aged ≥40 years. Internationally, diabetes prevalence increases to over 10%, with a substantial economic impact, from the age of 45 years (International Diabetes Federation 2019) and comorbidities usually occur in adults over the age of 45 years (AIHW 2016). To capture studies assessing self-management among adults aged ≥45 years, we set our age cut-off point at ≥40 years. In addition, study participants had to be living in rural and remote areas with diabetes (Type 1 or Type 2) and any combination of the following comorbidities: cardiovascular disease, chronic obstructive pulmonary disease, mental health problems or renal failure
- Intervention or interest: effects of interventions on self-management, the experience or effect of living with diabetes and comorbidities, barriers and/or enablers to self-management of diabetes and comorbidities
- Outcomes: self-management i.e. health literacy, emotional management, metabolic control, treatment adherence (medication adherence, appointment compliance) or lifestyle change (physical activity, healthy eating).
- Although studies from any country were eligible for inclusion, they were only included if they were published in English.

Studies that were not primary research, did not include adults aged ≥40 years, did not include subjects living in rural or remote communities, had a sample in which <75% had diabetes and/or no comorbidities were excluded. In addition, studies in which self-management was not the focus and those published in any language other than English were excluded.

Data extraction and synthesis

Data were extracted into a data extraction form containing the following fields: author names, date of publication, country, setting, study aim, inclusion/exclusion criteria, sampling frame, number of participants, participant characteristics including age (range, mean if available) and comorbidities, study design, description of intervention if relevant, outcome measures, results regarding efficacy of interventions (including statistics where available) and, finally, results regarding any barriers and enablers to self-management that were reported.

Preliminary data synthesis involved summarising results separately for each study design type (e.g. randomised controlled trials (RCTs), feasibility trials, descriptive cohort studies, qualitative studies). Results from RCTs and other trials were then synthesised together, highlighting similarities and differences among findings, to report interventions to improve self-management strategies. Results from all other study designs were then synthesised together to describe comorbidities associated with better or poorer self-management and then barriers and enablers to self-management among people living with diabetes and comorbidities in rural and remote areas.

Results

The PRISMA flowchart is presented in Fig. 1.

Twelve studies reporting a large range of comorbidities met the inclusion criteria (see Table 1). Ten were conducted in the US (Utz *et al.* 2006, 2008; Bell *et al.* 2010; Brown *et al.* 2011; Ciemins *et al.* 2011; Schoenberg *et al.* 2011; Naik *et al.* 2012, 2019; Magnan *et al.* 2015; Carpenter *et al.* 2017), one in Australia (McDermott *et al.* 2015) and one in Denmark (Kristensen *et al.* 2018). The mean age of participants ranged from 48 to 62 years, and most had a diagnosis of Type 2 diabetes. The number of participants varied from 8 to 23 430. Among the studies, only two reported on RCTs; three were qualitative studies describing patient experiences, two described cross-sectional studies of associations between variables, two reported on feasibility studies with pre- and post-test control group design, one was a small pre-post study with no control group, one was a quasi-experimental study comparing two different formats of the same intervention and one was a large retrospective analysis of electronic records (see Table 1). Outcomes included the self-management of diabetes and other chronic conditions, depression, diabetes-related distress and experiences of living with diabetes and comorbidities. Six studies assessed the efficacy of interventions to promote self-management, four reported on the impact of specific comorbidities on self-management outcomes and five reported on barriers and enablers to self-management among adults with a diagnosis of diabetes and comorbidities in rural and remote communities (see Table 1).

Interventions to improve self-management strategies

Of the six studies that assessed the efficacy of an intervention to promote self-management among adults with a diagnosis of diabetes and comorbidities in rural and remote communities (Utz *et al.* 2008; Brown *et al.* 2011; Ciemins *et al.* 2011; Naik *et al.* 2012, 2019; McDermott *et al.* 2015), only three (Naik *et al.* 2012, 2019; McDermott *et al.* 2015) specifically recruited adults with diabetes and comorbidities. One study (McDermott *et al.* 2015) found that a culturally safe, community-level health worker-led case management approach to the care of Indigenous adults with poorly controlled Type 2 diabetes and comorbidities in Australia resulted in greater HbA1c reductions than in the control group. The other two studies reported on the Healthy Outcomes through Patient Empowerment (HOPE) intervention, with mixed results: small improvements in HbA1c were demonstrated in the feasibility trial (Naik *et al.* 2012), but not the subsequent study (Naik *et al.* 2019). A reduction in depression scores was reported in both studies (Naik *et al.* 2012, 2019).

The other three interventions targeted adults living with diabetes in rural and remote areas; although comorbidities were reported, these were not required for inclusion in the studies (Utz *et al.* 2008; Brown *et al.* 2011; Ciemins *et al.* 2011). No significant differences were reported between trial groups in any of these studies, which included: (1) a study that compared an intensive, interdisciplinary telehealth self-management

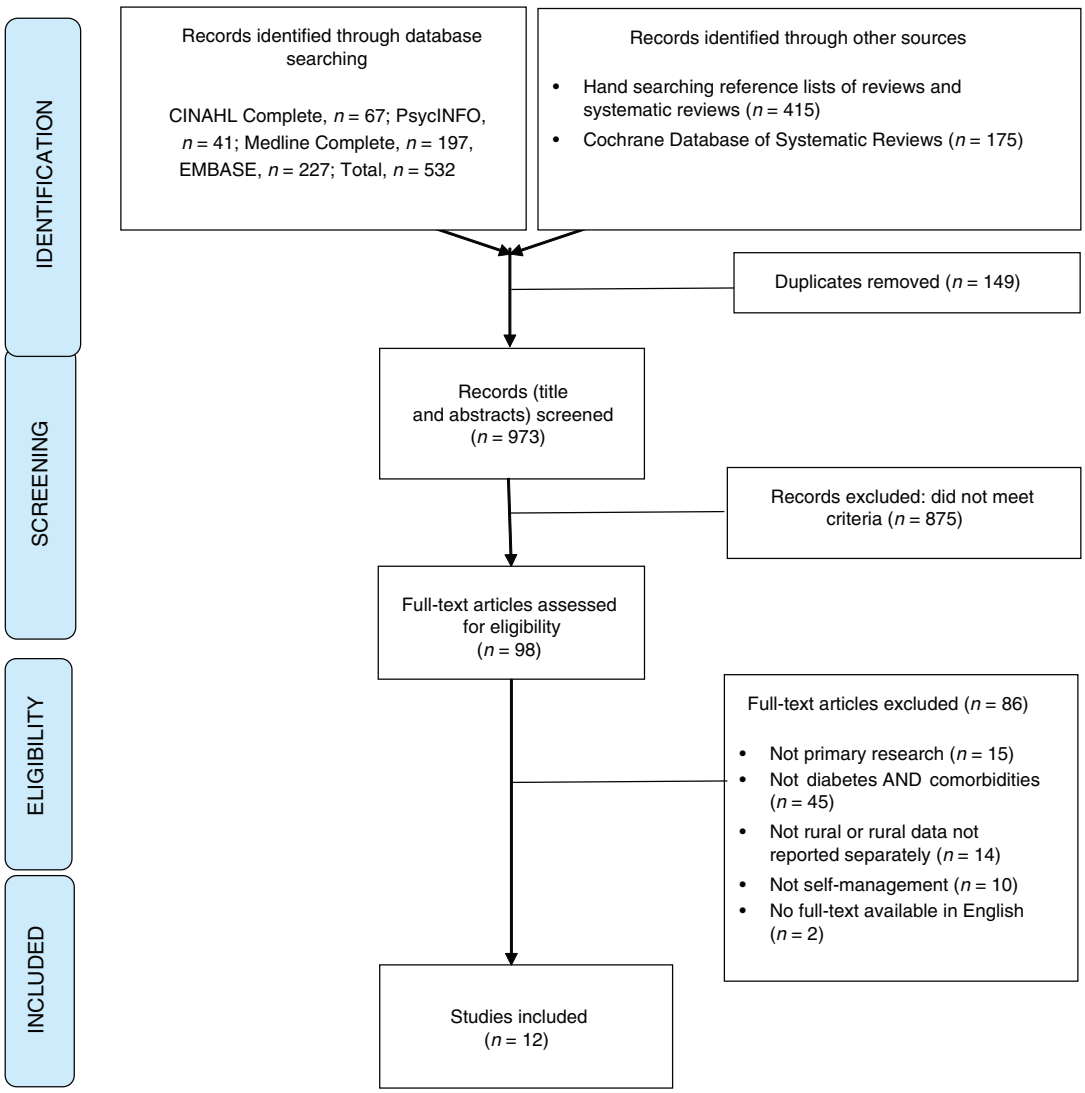

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart.

diabetes education program with face-to-face consultations in rural areas in the US (Ciemins *et al.* 2011); (2) an investigation of the effect of adding a nurse case manager to a diabetes self-management program among adults with diabetes (some with comorbidities) in a rural community in the US (Brown *et al.* 2011); and (3) an assessment of the effects of a culturally tailored diabetes self-management education program intervention in a small group of rural-dwelling African Americans with Type 2 diabetes and comorbidities (Utz *et al.* 2008).

Comorbidities associated with poorer self-management

Specific comorbidities were reported to predict poorer outcomes in self-management interventions, namely obesity, depression, anxiety disorders, disorders of the central and peripheral nervous systems, congestive heart failure, skin ulcer, degenerative eye problems and substance use disorders (Magnan *et al.* 2015). Bell *et al.* (2010) reported that rural-dwelling older adults with diabetes and depression are less likely to adhere to some aspects of self-management, healthy eating and physical activity, but not others, such as blood glucose self-monitoring and diabetes medication adherence. Similarly, Carpenter *et al.* (2017) found that higher diabetes-related distress and depressive symptoms negatively affected diet adherence among adults with Type 2 diabetes. In another study, patients with concurrent mental disorders and impaired self-care ability were more attentive to their mental disorder than other conditions such as diabetes (Kristensen *et al.* 2018).

Barriers and enablers to self-management

Particular barriers related to self-management of diabetes and comorbidities while living in rural areas were reported in two studies (Utz *et al.* 2006; Schoenberg *et al.* 2011). These barriers included financial costs, shortages of healthcare providers, delays in diagnosis and treatment, lack of access to fresh, healthy food and exercise facilities, and inadequate transportation to healthcare services (Utz *et al.* 2006; Schoenberg *et al.* 2011).

Table 1. Summary of included studies and their findings

AQoL, Assessment of Quality of Life; BMI, body mass index; CAHS, Cognitive Appraisal of Health Scale; CES-D, Center for Epidemiological Studies-Depression; DSME, diabetes self-management education; EUC, enhanced usual care; FBG, fasting blood glucose; HDL, high-density lipoprotein cholesterol; HOPE, Healthy Outcomes through Patient Empowerment; LDL, low-density lipoprotein cholesterol; MI, myocardial infarction; MM, multiple morbidity; NCM, nurse care manager; NP, nurse practitioner; OSA, obstructive sleep apnoea; PAID, Problem Areas in Diabetes; PHQ-4, Patient Health Questionnaire for Depression and Anxiety; PHQ-9, Patient Health Questionnaire-9 for Depression; PRISM, Promoting Realistic Individual Self-Management; SDSCA, Summary of Diabetes Self-Care Activities; SMBG, self-monitoring of blood glucose; T1D, Type 1 diabetes; T2D, Type 2 diabetes; TOFHLA, Test of Functional Health Literacy; USA, United States of America

Reference	Study aim	Sample	Baseline comorbidities	Design and intervention	Outcome measures	Findings
Bell *et al.* (2010)	To assess the association of depressive symptoms with diabetes self-management regimens	696 older African Americans, American Indians and Whites with T2D, living in a rural, ethnically diverse community in central North Carolina (USA) Age ≥65 years	Number with >5 chronic health conditions was 59/110 (53.6%) for participants with CES-D ≥9 and 161/586 (27.5%) for participants with CES-D <9 ($P < 0.001$) Chronic health conditions not specified	Cross-sectional: face-to-face interviews No intervention	Depressive symptoms (modified CES-D) and diabetes self-management (measures from the SDSCA): physical activity, SMBG, self-foot checks, following a healthy eating plan, and medication adherence	Approximately 16% of the sample had CES-D scores ≥9 Older adults with diabetes and depression are less likely to adhere to self-management, increasing their risk of complications
Brown *et al.* (2011)	To explore the feasibility of adding an NCM to DSME to foster DSME attendance and increase use of other available healthcare services	165 adults with T2D living in a rural community on the Texas–Mexico border (USA) Age 35–70 years	High cholesterol (60.2%), hypertension (50.6%), gall-bladder surgery (19.3%), MI (7.2%), angina (4.8%), stroke (2.4%), mean (±s.d.) BMI 33.6 ± 6.8 kg/m^2	Repeated-measures pre-test, post-test control group design The experimental group received a DSME intervention plus access to an NCM; the control group received DSME only	HbA1c, FBG, lipids (total cholesterol, HDL, LDL, triglycerides), blood pressure, BMI, diabetes-related knowledge, health behaviours, physical activity, dietary intake, glucose monitoring	Both groups reported positive changes in diet and physical activity, and showed improved clinical outcomes; no significant differences between groups Participants expressed acceptance of the NCM; they preferred face-to-face contact rather than telephone
Carpenter *et al.* (2017)	To enhance understanding of the relationships among diabetes-related distress, appraisal and self-management	102 adults (convenience sample) with T2D living rurally in Appalachia (USA), mostly low-income Mean (±s.d.) age 54.03 ± 10.89 years (range 20–75 years)	Mean (±s.d.) number of comorbidities 2.9 ± 1.3 in women, men 2.9 ± 1.5 in men (comorbidities include obesity, hypertension, dyslipidaemia, OSA, fatty liver disease, cancer, fractures, cognitive impairment, hearing impairment, periodontal disease) Mean (±s.d.) BMI 38.7 ± 8.8 kg/m^2 in women, 33.4 ± 6.2 kg/m^2 in men Mean (±s.d.) anxiety score on PHQ-4 2.8 ± 2.3 in women, 2.0 ± 2.3 in men Mean (±s.d.) depression score on PHQ-4 2.4 ± 2.2 in women, 2.9 ± 1.5 in men	Correlational design; no intervention	HbA1c, diabetes-related distress (PAID) Appraisal (CAHS) Self-management (SDSCA)	Participants reported adhering to medication >6 days per week but adhering to diet and exercise less frequently Women reported better diet adherence than men Mean (±s.d.) PAID score 32.1 ± 23.6 Scores on CAHS indicated participants perceived diabetes as a challenge rather than a threat, harm or benign stressor Diabetes-related distress and depressive symptoms both significantly inversely correlated to diet adherence Higher appraisals of diabetes as a challenge were significantly related to better medication adherence Higher appraisals of diabetes as a threat and as a harm both significantly inversely related to diet adherence

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Table 1. (Continued)

Reference	Study aim	Sample	Baseline comorbidities	Design and intervention	Outcome measures	Findings
Ciemins *et al.* (2011)	To establish the feasibility of providing a team approach to diabetes care via telehealth and to determine its effect on similar patient outcomes vs face-to-face care	206 adults with T2D and at least one uncontrolled vascular risk factor, living in rural areas of Montana (USA) referred by primary care providers from five rural and one urban clinic Age ≥21 years	Hypertension (73%), dyslipidaemia (75.7%), depression (25.7%)	Repeated-measures pre-test, post-test control group design; 118 received the PRISM Diabetes Program, (an NP-led patient-centred interdisciplinary intensive diabetes management program via telehealth) and 88 received face-to-face consultations	Receipt of recommended preventive guidelines, vascular risk factor control, patient satisfaction, and diabetes self-management at baseline and 1, 2 and 3 years after intervention, as well as program sustainability	Eye examinations 1 year after intervention, control of ≥2 risk factors and patient satisfaction increased (non-significant) in both groups Telehealth group reported (non-significant) increase in SMBG (97% vs 89%; $P = 0.63$) and dietary adherence (244% vs 159%; $P = 0.86$) vs face-to-face patients
Kristensen *et al.* (2018)	To investigate patients' experiences of disease and self-care and perceptions of the GP's role in supporting patients with impaired self-care ability	13 patients with T2D, concurrent chronic diseases and impaired self-care ability living in economically disadvantaged, rural municipalities in south-eastern Denmark Mean age 59.2 years (range 37–72 years)	Heart disease (46%), mental disorder (38%), obesity (38%), addiction (38%), musculoskeletal disorders (31%), respiratory disease (8%)	Interviews; no intervention	Experiences of: • living with multiple chronic conditions • following the regimens at home • collaborating with the GP, the hospital or the community	Most patients experienced challenges in adhering to recommended self-care activities, but many had developed additional personal self-care routines to improve their well-being Patients with concurrent mental disorders were more attentive to their mental disorder than other conditions Patients' perspectives on diseases shifted over time and were dominated by emotional considerations such as insisting on leading a normal life or struggling with limitations caused by disease Most patients found support in the ongoing relationship with the same GP
Magnan *et al.* (2015)	To determine which chronic conditions were related to lack of achievement or achievement of diabetes care quality goals	23 430 adults with T1D or T2D from 7 Midwestern health systems in rural, suburban and urban settings (USA) Age 18–75 years	Patients had 0–22 comorbid conditions, with a mean (±s.d.) of 3.8 ± 2.5 (median 3) The frequencies of all 62 chronic conditions ranged from 0.01% for tuberculosis to 77% for hyperlipidaemia	Retrospective analysis of 2 years of electronic health data, 2010 (baseline year) and 2011 (quality reporting year), for seven health systems No intervention	HbA1c control and testing LDL control and testing Blood pressure control Kidney testing	Nine conditions predicted lack of achievement of specific control goals: • obesity • depression • anxiety disorders • nervous system disorders (central, peripheral) • congestive heart failure • skin ulcers • degenerative eye problems • substance use disorders

McDermott *et al.* (2015)	To evaluate the effectiveness of a community-based health worker-led case management approach	213 adults with poorly controlled T2D and significant comorbidities in 12 remote Indigenous communities in northern Australia Age ≥18 years; mean age 47.9 years (95% CI 46.6 – 49.2 years); baseline mean HbA1c 10.7% (93 mmol/mol) and BMI 32.5 kg/m^2	Patient eligibility criteria included having T2D and at least one major comorbidity (comorbidities not specified)	A cluster randomised controlled trial 100 participants allocated to 18 months of chronic care coordination from a community-based health worker supported by a clinical outreach team 113 participants allocated to usual care (waitlist)	HbA1c Blood pressure Lipid profile BMI Renal function. Smoking rates Functional health literacy (TOFHLA) Quality of life (AQoL) Health care utilisation	At 18 months, HbA1c reduction was significantly greater in the intervention group (–1.0% vs –0.2%; s.e. of the difference = 0.2, $P = 0.02$) There were no significant differences between the groups for blood pressure, lipid profile, BMI or renal function
Naik *et al.* (2012)	To assess the acceptability, feasibility and preliminary outcomes of a telephone-delivered behavioural coaching intervention	Eight rural-dwelling older adults with uncontrolled T2D and depression drawn from a US Veteran Affairs patient registry Mean age 62 years (range 58–67 years)	Clinically significant depressive symptoms (i.e. PHQ-9 score ≥10)	A small open trial format with pre and post repeated measures HOPE: a 10-session (12-week) telephone-based coaching intervention using non-expert mental health coaches, based on the '5 As Model' for coping with chronic illness: Assess, Advise, Agree, Assist, Arrange	HbA1c Acceptability Feasibility Depressive symptoms (PHQ-9) Diabetes-related distress (PAID)	From baseline: • HbA1c improved by a mean (±s.d.) of 1.13 ± 1.70 after the intervention and 0.84 ± 1.62 at 6 months • PHQ-9 scores improved by a mean (±s.d.) of 5.14 ± 2.27 after the intervention and 7.03 ± 4.43 at 6 months • PAID scores improved by a mean (±s.d.) of 17.68 ± 10.7 after the intervention and 20.42 ± 20.66 at 6 months
Naik *et al.* (2019)	To evaluate the effectiveness of proactive population screening plus telephone-delivered goal-setting intervention among high-risk patients with uncontrolled diabetes and depression	225 participants enrolled from regional Veterans Healthcare System in southeast Texas (USA), each living more than 20 miles from the Veterans Affairs medical centre Mean (±s.d.) age 61.9 ± 8.3 years	Patients had uncontrolled diabetes[A] (HbA1c >7.5%) and clinically significant depression (PHQ-9 scores ≥10)	Randomised clinical trial: 89 participants allocated to control group (EUC, + notification of high-risk status); 136 participants received HOPE intervention (9 telephone coaching sessions with trained healthcare professionals using collaborative goal-setting and behavioural activation methods, included management of diet, physical activity and medication management)	PHQ-9 scores, HbA1c compared at baseline and 6 and 12 months	No significant interaction of treatment group (HOPE vs EUC) and time for PHQ-9 ($\beta = 1.56$; 95% CI –0.68, 3.81; $P = 0.17$) or HbA1c ($\beta = –0.005$; 95% CI –0.73, 0.72; $P = 0.82$) Change from baseline to 12 months significant for depression (HOPE vs EUC between-group mean difference for PHQ-9 = 2.14; 95% CI, 0.18, 4.10; $P = 0.03$), but not for HbA1c (between-group mean difference = –0.06%; 95% CI, –0.61%, 0.50%; $P = 0.83$)

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Table 1. (Continued)

Reference	Study aim	Sample	Baseline comorbidities	Design and intervention	Outcome measures	Findings
Schoenberg *et al.* (2011)	To improve understanding of the ways in which vulnerable, rural residents experience and manage MM	20 rural Appalachian residents (USA) Age ≥41 years; mean age 55 years	Inclusion criterion was a diagnosis of ≥2 chronic illnesses 15/20 (75%) had T2D	Semi structured and open-ended interviews guided by a socio-ecological framework No intervention	Understandings of how vulnerable rural residents experience and manage several simultaneously occurring chronic health conditions	MM has multifaceted challenges and is viewed as more than the sum of its parts; numerous challenges exist to optimal MM self-management Strategic methods of managing MM include prioritising and drawing on informal and formal supports
Utz *et al.* (2006)	To explore the experience of self-managing T2D among rural dwelling African Americans	73 rural African Americans (USA) Mean (±s.d.) age 60 ± 10.3 years (range 23–89 years)	Hypertension (82.4%), cardiovascular problems (32.3%), symptoms of neuropathy (41.2%), eye disease (25%), kidney disease (10.3%)	Focus groups No intervention	The experience of being diagnosed with diabetes Specific factors that enhanced or inhibited self-management Additional treatments sought The kind of program of care to help achieve self-management	Recommendations by participants focused on overcoming transportation barriers and lack of funding for programs Key themes: delay in diagnosis and treatment seeking; barriers to daily self-management; the key role of religion and spirituality in self-care; the use of alternative and complementary therapies; and variability in knowledge about self-management
Utz *et al.* (2008)	To assess the effects of a culturally tailored intervention for rural African Americans with T2D	21 rural African Americans (USA) Mean age 60 years (range 27–85 years)	Hypertension (90.5%), cardiovascular disease (33.3%), numbness/ tingling in legs or feet (23.8%), eye disease (19%), kidney disease (9.5%)	Quasi-experimental study A 10-week DSME program; 13 assigned to group DSME and 8 to individual DSME	Glycosylated haemoglobin (A1C) Self-care actions Self-efficacy level Goal attainment Satisfaction with DSME	Participants in both groups improved slightly over the 3-month period in self-care activities, HbA1c levels and goal attainment Although differences were not statistically significant, trends indicate improved scores on dietary actions, foot care, goal attainment and empowerment for those experiencing group DSME

[A]Not stated whether T1D or T2D.

Enablers reported to facilitate self-management of diabetes and comorbidities included religion and spirituality, the use of complementary and alternative therapies (Utz *et al.* 2006) and formal and informal support (Schoenberg *et al.* 2011). In particular, an ongoing relationship with the same GP was reported as an enabler to self-management among adults with Type 2 diabetes, concurrent chronic diseases and impaired self-care ability (Kristensen *et al.* 2018). Carpenter *et al.* (2017) reported that participants' cognitive appraisal of diabetes acted as both a barrier and an enabler for their self-management of diabetes: higher appraisals of diabetes as a challenge were significantly associated with better medication adherence, whereas higher appraisals of diabetes as a threat and as a harm were both significantly inversely related to better diet adherence.

Discussion

This scoping review identified only two interventions that specifically aimed to improve self-management of diabetes and comorbidities among people living in rural and remote communities. Only these interventions were associated with statistically significant differences in health outcomes, including HbA1c reduction (McDermott *et al.* 2015) and improvements in depression scores (Naik *et al.* 2012, 2019). Given that depression and distress are associated with poorer self-management (Bell *et al.* 2010; Carpenter *et al.* 2017; Kristensen *et al.* 2018), reducing depression levels is an important outcome. Indeed, a promising intervention currently being tested, COMRADE (COllaborative care Management foR distress And depression in rural DiabetEs), involves cognitive and/or behavioural interventions in a primary care setting among rural-dwelling adults with uncontrolled Type 2 diabetes and comorbid depression or distress (Lutes *et al.* 2018).

No significant differences were identified between the intervention and control groups in the three studies that did not specifically target adults with diabetes and comorbidities (Utz *et al.* 2008; Brown *et al.* 2011; Ciemins *et al.* 2011). Based on qualitative studies that have reported the experience of living with diabetes and comorbidities in rural communities, a focus on self-management of single diseases is likely to be ineffective because it does not account for the nuances and idiosyncrasies of having comorbidities, especially among vulnerable populations (Schoenberg *et al.* 2011; Corcoran *et al.* 2013). Thus, interventions may need to explicitly consider and address managing comorbidities in order to demonstrate significant effects on diabetes self-management.

It is notable that the intervention reported by McDermott *et al.* (2015) was effective in reducing HbA1c among Australian Indigenous adults with poorly controlled Type 2 diabetes and comorbidities. In Australia, diabetes accounts for 7.9% of deaths among Indigenous people, compared with 2.6% among non-Indigenous people, and contributes to a significant life expectancy gap between these groups (AIHW 2015). Indigenous people are also diagnosed at a significantly younger age than non-Indigenous people (McDermott *et al.* 2004). Given that approximately 65% of Australia's Indigenous people live in regional remote areas, compared with 29% of non-Indigenous Australians (National Rural Health Alliance 2011), any interventions designed for people with diabetes and comorbidities living in rural and remote areas should be tailored for specific communities living in those areas. This includes ensuring that the interventions are codesigned with community groups so that they are culturally safe.

Some of the barriers and enablers identified in this review are consistent with evidence on the self-management of diabetes in rural or remote communities, regardless of the presence of comorbidities. For example, among rural and remote-dwelling people, informal and formal support facilitates self-management among people with diabetes, with (Schoenberg *et al.* 2011; Kristensen *et al.* 2018) or without (Bardach *et al.* 2011; Grant and Steadman 2016; Vanderlee *et al.* 2016; Birabwa *et al.* 2019) comorbidities.

Our review identified a lack of financial resources as a barrier to the self-management of diabetes and comorbidities among rural and remote-dwelling adults (Utz *et al.* 2006), consistent with evidence among rural- (Grant and Steadman 2016; Vanderlee *et al.* 2016; Birabwa *et al.* 2019) and urban-dwelling adults with diabetes (Jeon *et al.* 2009). Lack of transport and limited access to health services and associated delays in diagnosis and treatment were identified as barriers to the self-management of diabetes and comorbidities in our review (Utz *et al.* 2006; Schoenberg *et al.* 2011); these barriers are commonly reported in general studies among rural-dwelling adults with chronic conditions (Jones *et al.* 2014; McLaren *et al.* 2014).

One telehealth intervention (Naik *et al.* 2012, 2019) identified in this review demonstrated that technology can help participants with uncontrolled diabetes and depression to overcome some of the barriers to self-management, such as distance and the availability of health services. A team approach to health care delivered by telehealth (Ciemins *et al.* 2011) did not result in statistically significant differences in outcomes compared with the face-to-face intervention; however, face-to-face health care is not always possible in rural and remote settings. Positive contributions of technology (including video conferencing and smartphones) to the self-management of diabetes among rural and remote communities have been reported in studies that did not specifically consider comorbidities (Shea *et al.* 2009; Stuckey *et al.* 2011; Jaglal *et al.* 2013; Jeffrey *et al.* 2019); expanding such interventions to address the self-management of diabetes and comorbidities simultaneously could potentially improve clinical outcomes and health behaviours in rural and remote-dwelling populations with these conditions. A promising protocol has been published of the mWellcare trial, which is testing an Android-based mobile application in India that generates clinical management prompts for treating hypertension and diabetes (Jha *et al.* 2017).

Limitations and suggestions for future research

Through this scoping review a limited number of studies meeting the search criteria were identified. Study limitations include that the review protocol was not published before the review was conducted. The search was limited to the published literature and did not include the grey literature. It is possible that health services are delivering successful programs to improve self-management of diabetes among the target population as part of usual health care delivery; however, these are not documented in current published peer-reviewed journals. Eligible studies were limited to those that included adults aged

≥40 years; this may have excluded relevant studies reporting on self-management interventions targeting Indigenous communities in rural and remote areas of Australia. Among Indigenous Australians, Type 2 diabetes is increasingly prevalent among adolescents and young adults (Haynes *et al.* 2016). Further study limitations include that only English language papers were assessed for eligibility because we did not have the resources to translate from other languages. We did not search explicitly for keywords such as 'barriers' and 'enablers'; thus, our description of barriers and enablers to self-management among the target population is limited to evidence reported in the papers that met the criteria for inclusion in the present review.

Further research is needed to separate the effects of, or investigate the interactions among, barriers and enablers related to personal resources, health systems, family and community factors and specific comorbidities. Further research is also required to disentangle the effects of interventions that target Indigenous groups in rural and remote areas to determine the key elements that determine the success of these interventions.

A few of the included studies did not specifically seek out people living with diabetes and who have comorbidities; some participants in these studies may have had comorbidities, whereas others may have not, and a range of comorbidities was represented across the studies. Therefore, the relative effect of an intervention on comorbidities and/or how the outcomes were modified by different comorbidities are not known. Similarly, although some studies focused on participants living in rural and remote settings, others included those living in these settings, as well as those living in urban areas. Synthesising results was therefore difficult. Except for the two studies that described RCTs (McDermott *et al.* 2015; Naik *et al.* 2019), the methodologies of the papers included in this review do not lend themselves to generalisation of the findings.

Conclusion

This scoping review on the self-management of diabetes and associated comorbidities in people living in rural and remote areas can inform the planning and delivery of health services for this vulnerable population. Our search revealed only two promising interventions targeting this population: (1) a case management diabetes care approach that includes an Indigenous community health worker; and (2) a telephone-delivered goal-setting intervention. We identified numerous barriers and few enablers that affect how people manage their diabetes and comorbidities. Well-documented reported barriers included limited access to health services and travelling long distances to access health services. These barriers may be overcome by the use of telehealth, which can enable people living with comorbidities to become more engaged in their self-management, particularly those who are hundreds of kilometres away from health services and have higher rates of chronic disease. However, any modern technologies rely on the ability of people to be connected with health services and, unfortunately, the least digitally connected areas are all outside metropolitan regions (Australian Government 2018).

This review suggests that interventions to improve self-management among rural and remote-living people with diabetes need to specifically address the management of comorbidities if they are to achieve positive outcomes. The two studies that report robust evidence on telehealth approaches and community-level interventions that take account of the experiences and cultural context of people with diabetes and comorbidities (McDermott *et al.* 2015; Naik *et al.* 2019) suggest that these approaches each hold promise to overcome barriers among people with these conditions living in rural and remote areas, particularly if codesigned with participating communities.

Conflicts of interest

The authors declare no conflicts of interest.

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