

REVIEW ARTICLE

Interventions incorporating a multi-disciplinary team approach and a dedicated care team can help reduce preventable hospital readmissions of people with type 2 diabetes mellitus: A scoping review of current literature

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Abstract

Aims: This review aimed to identify interventions that hospitals can implement to reduce preventable hospital readmissions of people with type 2 diabetes mellitus (T2DM).

Methods: A scoping review framework was utilised to inform the overall process. The electronic databases Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline, the University of New England (UNE) library search engine and Google Scholar were utilised to search for relevant literature.

Results: The results from this review demonstrate that interventions started at index admission for people diagnosed with T2DM can result in reductions in hospital readmissions. Common strategies which attributed to the success of interventions in reducing hospital readmissions of people with T2DM included a multidisciplinary team approach, a dedicated care team, certified diabetes educator appointments, basic survival skills education and influencing hospital protocol development and implementation.

Conclusion: This scoping review is an attempt at exploring and synthesising current research on interventions that hospitals can implement to reduce preventable hospital readmissions of people with T2DM.

KEYWORDS

hospital, intervention, preventable, readmission, type 2 diabetes

1 | INTRODUCTION

Diabetes affects hundreds of millions of people throughout the world and the number of individuals affected is growing due to an ageing population, increasing obesity and longer life expectancy.¹ Worldwide, approximately

537 million individuals between 20 and 79 years old had diabetes in 2021.² An estimated 784 million individuals between 20 and 79 years old are expected to have diabetes in 2045.² The prevalence of type 2 diabetes mellitus (T2DM) is growing at a quicker rate than other significant chronic conditions such as cancer and heart disease.^{3,4}

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Individuals with T2DM are more commonly admitted to hospital, are associated with longer length of stay (LOS) in hospital and are more likely to develop inpatient complications in comparison with individuals without diabetes.⁵ Furthermore, individuals with T2DM are more frequently readmitted to hospital in comparison with individuals without T2DM, and these readmissions are associated with a longer LOS in hospital.⁵ Unplanned hospital readmissions are seen as considerable contributors to overall healthcare costs and can be seen as an indicator of suboptimal quality of care.⁶ Accordingly, hospital readmissions are an important measure of health-care quality and focus for cost reduction.⁷ Studies show that the same individuals with T2DM are often readmitted multiple times a year for the same diabetes-related complications that could potentially be prevented.^{8,9,10} The burden of diabetes for inpatients is significant and costly, and hospital readmissions worsen this burden substantially.^{9,11} By reducing preventable readmissions for people with T2DM, health-care costs can potentially be reduced while improving care.^{9,12} Hospitalisation allows for the prospect of supporting persons with diabetes care with the goal of reducing hospital readmission and hospital LOS.^{13,14}

Predictors of readmission for those individuals with diabetes identified in previous literature include racial and socio-economic factors, non-diabetes-related comorbidities, failure of individuals to acknowledge diabetes post discharge, failure of the discharge process, poor health literacy, loss of control over illness, and social determinants of health.⁴ There is a substantial amount of past research which outlines social determinants of health as major factors which influence the management and complications of T2DM.^{1,15} The redesign of hospital diabetes care to recognise and acknowledge the social determinants in peoples' care plans including transportation, accommodation, care coordination, community outreach, service delivery and intersectoral collaboration across clinical and social care sectors has the potential to optimise health outcomes for individuals and reduce hospital readmissions and health care costs.¹⁶

The hospitalisation of people with diabetes allows for the prospect of supporting people with diabetes care with the goal of reducing hospital readmissions and hospital LOS.¹³ Several in-hospital interventions for people with T2DM reported in previous literature are single-component interventions which primarily focus on glycaemic control, diabetes education, the role of medical specialists, medication compliance or healthy lifestyle activities.^{9,10,13} Research indicates that the provision of structured hospital diabetes care such as optimising pharmacotherapy follow-up plans started during hospitalisation can minimise inpatient readmissions and hospital LOS.¹⁷ However, the optimal individual components and

What's new?

- Past research outlines that social determinants of health are major factors which influence the management and complications of type 2 diabetes mellitus (T2DM).
- The results from this review demonstrate that interventions started at index admission for people diagnosed with T2DM can result in reductions in hospital readmissions.
- Hospitals can implement interventions incorporating a multidisciplinary team (MDT) approach, dedicated care team and multiple health professionals to reduce preventable hospital readmissions of people with T2DM.

layout of inpatient intervention for diabetes care of people with T2DM in hospitals is not currently straightforward or clear.¹³

The aim of the research project is to increase knowledge on interventions that can be commenced within hospitals to reduce preventable hospital readmissions of people with T2DM. This will help to inform hospitals of interventions that can be implemented to reduce preventable hospital readmissions of people with T2DM. Importantly, this scoping review aims to research relevant studies to answer the following question:

What interventions can hospitals implement to reduce preventable hospital readmissions of people with T2DM?

2 | METHODS

2.1 | Search strategy

A scoping review framework was utilised to inform the overall process. The electronic databases Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Medline were utilised for the foremost literature search due to these databases primarily holding literature relevant to the research question.^{18,19} The University of New England (UNE) library search engine and Google Scholar were also utilised to search for relevant literature as part of the search strategy to expand search results and examine grey literature.²⁰ The search included examining the reference lists and citations of potential studies for the literature review to identify additional research relevant to the research question.

Search terms used while searching through the aforementioned databases included “type 2 diabetes” OR “T2DM” OR “diabetes” AND “readmission” OR

“re-admission” OR “rehospitalisation” OR “rehospitalization” OR “re-admittance” AND “hospital” AND “prevent” OR “intervention” OR “minimise” or “reduce”. These terms were used in conjunction with Boolean operators and independently to cover every likely combination. The preliminary search was restricted to the presence of these search terms in the title or abstract.

2.2 | Eligibility criteria

Following the preliminary search process, studies which met the following inclusion criteria were included:

- Published between January 2016 and September 2021
- Published in English
- Empirical research

Exclusion criteria was applied for studies which focused broadly on chronic condition readmissions but did not focus primarily on T2DM or diabetes.

2.3 | Search outcomes

The initial search utilising the search terms in conjunction with Boolean operators yielded a total of 697 studies. Results were further narrowed down by removing

duplicate studies and screening studies through the eligibility criteria of being empirical research, published in the last 5 years, and published in English ($n = 291$). The abstracts of the remaining eligible studies were analysed for their suitability in the scoping literature review, with studies excluded if they were not empirical research pertinent to the research question or did not focus primarily on T2DM or diabetes ($n = 30$). The full texts of the remaining eligible studies were analysed resulting in the final number of studies included in the literature review ($n = 12$). [Figure 1](#) which is shown below, outlines a summary of the search and screening process through a flow diagram adapted from the preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram by Moher, Liberati, Tetzlaff, and Altman.²¹

2.4 | Data extraction

A database was created with appropriate categories and subcategories to summarise the studies included in the literature review.^{18,22,23} Data of the included studies were independently carried out by the first author and the project coordinator (second author). [Table 1](#) which is shown below outlines a summary of the 12 studies included in the literature review and is comprised of the year the study was published, the authors, the study aim, sample size, main findings, and study limitations.

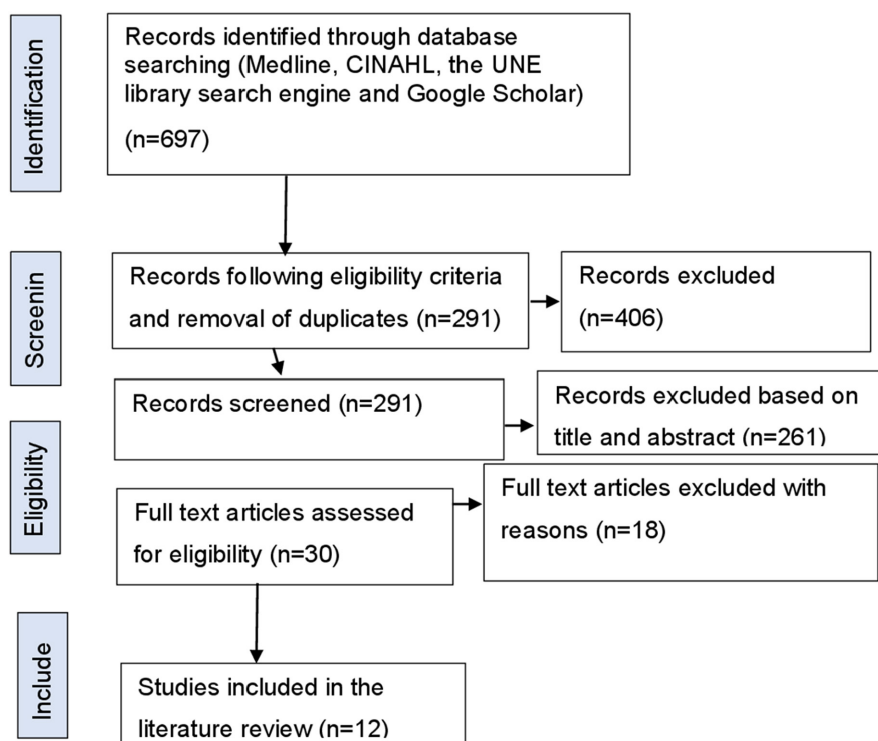


FIGURE 1 Summary of search and screening process.

TABLE 1 Main characteristics of final studies included in the scoping review

References	Country	Study aim	Study design	Sample characteristics	Data collection method
Brumm et al. ²⁵	USA	To evaluate the effectiveness of a diabetes transition care programme in a population of veterans with diabetes by calculating 30-day readmissions rates and assessing glycaemic control	Pre- and post-intervention retrospective study	40 veterans with diabetes	Quantitative approach; convenience sampling
Drincic et al. ⁴	USA	To evaluate the impact of diabetes case management and DRN programme on readmission rates of people with diabetes	Retrospective analysis study	66,518 individuals; 34,472 pre-intervention, 32,046 post-intervention	Quantitative approach
Ostling et al. ⁵	USA	To determine the incidence and causes of 30-day readmission rates for people with diabetes compared to those without diabetes To evaluate the impact on readmission of two specialised inpatient diabetes services: the HIIP and ENDO	Retrospective study	45,465 total inpatient discharges; with 7763 in the first study and 37,702 in the second study	Quantitative approach
Pembridge ²⁴	USA	To explore if there is a relationship between the degree of glucose control on admission, diabetes support services working with people with diabetes, or starting insulin at discharge as a new medication and the prevalence of hospital readmissions within 30 days post discharge	Quantitative correlational research study	16,539 adults living with diabetes	Quantitative approach

Main intervention strategy	Comparator(s)	Main findings and outcome	Limitations
Diabetes transition programme involving (1) a face-to-face visit by the adult nurse practitioner who was also the inpatient diabetes educator [ANP-IDE] in the hospital and (2) a handout listing telephone contacts and warning signs of when to contact the nurse practitioner or provider	Control group received standard care before discharge including diabetes self-management education from the primary care nurse on the unit and at times a follow-up phone call post discharge	The diabetes transition care programme was found to be associated with non-significant but likely clinically meaningful reductions in readmission risk Findings suggest that improved glycaemic control and reduced hospital readmission rates resulted from holistic, single-point person and protocol guided care	Study conducted in a single location Small sample size Limited to veterans Results are not generalisable to other veterans or non-veteran populations
Inpatient diabetes care model involving the role expansion of diabetes educators to include case management and the establishment of a DRN programme to increase staff nurse knowledge in caring for people with diabetes	Control group received usual diabetes care by unit nurses	The study found that the DRN programme is effective in significantly decreasing 30-day readmission rates for people with diabetes from 20.1% (pre) to 17.6% (post) intervention ($p = 0.0657$) People seen by clinical diabetes educators were found to have the lowest rates of readmission in comparison to people who received regular diabetes care by unit nurses	Accuracy of readmission data largely dependent on physician documentation Limited by retrospective design Analysis did not account for differences in various non-diabetes related risk factors including other co-morbidities, polypharmacy, or age
HIIP or ENDO consult on index admission	Control group did not receive HIIP or ENDO consult on index admission	Patients with diabetes were found to have higher readmission rates in comparison to the general population People who received either a HIIP or ENDO diabetes consult were found to be significantly less likely to represent to the emergency department [ED] or have an observation unit stay There was no difference found in inpatient readmission rates between people living with diabetes who received a HIIP, or ENDO diabetes consult and people living with diabetes that did not	Limitations associated with retrospective design Data derived from data warehouse and chart review Individuals without a billing notice of diabetes not included in the study and therefore not all people with diabetes were possibly captured
Diabetes consultation provided during admission	Control group did not receive a diabetes consultation during admission	The study found no statistically significant association between the provision of a diabetes consultation to people living with diabetes and reduced hospital readmission within 30 days The study found a statistically significant association between people living with diabetes who started insulin post discharge and reduced hospital readmission within 30 days	Specific people living with diabetes population in a single health system which cannot be generalised outside of the health system More people with diabetes may have received diabetes-specific interventions than what is reflected in the study as diabetes consultation could have come from a specialist or a primary care physician instead of inpatient services

(Continues)

TABLE 1 (Continued)

References	Country	Study aim	Study design	Sample characteristics	Data collection method
Bansal et al. ³⁰	USA	To compare the cost-effectiveness of two inpatient diabetes care models; one offered by a SDT versus a primary service team [PST]	Comprehensive retrospective chart review	262 adults with diabetes	Quantitative approach
Marusic et al. ²⁸	Croatia	To evaluate the impact of pharmacotherapeutic education on 30-day post discharge medication adherence and adverse outcomes in people with T2DM	Prospective randomised study	130 adults with type T2D; 65 intervention group, 65 control group	Mixed method approach
Mandel et al. ³¹	USA	To evaluate whether co-managing people with diabetes by an IDMS team reduces length of stay (LOS) and 30-day readmission rates	Retrospective quality improvement cohort study	4654 adults with diabetes	Quantitative approach
Rubin et al. ²⁶	USA	To assess the effectiveness of the DiaTOHC intervention in reducing hospital readmission risk of people with diabetes after 30 days post discharge	RCT	56 hospitalised adults with diabetes; 26 intervention group, 30 usual care group	Quantitative approach
Bhalodkar et al. ¹⁰	USA	To determine if there is a difference in 30- and 365-day readmissions between people with diabetes who received diabetes care on discharge in a standard primary care setting in comparison with those who received their care in a specialised multidisciplinary programme	Randomised controlled prospective study	192 adults with diabetes	Quantitative approach

Main intervention strategy	Comparator(s)	Main findings and outcome	Limitations
SDT diabetes management which included an endocrinologist, diabetes nurse practitioner, diabetes nurse educator and discharge/transition coordinators	Control group received PST diabetes management which included hospitalists, general internal/family medicine, or general surgery physicians	The use of a SDT to manage diabetes in non-critical medical units can result in significant reduction in 30-day readmission rate in comparison with managing diabetes by a PST	Small sample size Study conducted over a limited time frame Retrospective study conducted at a single location
Additional individual pre-discharge pharmacotherapeutic education on discharge prescriptions	Control group received only received usual diabetes education	The study found that the provision of pharmacotherapeutic education to people with T2DM can significantly improve 30-day post discharge medication adherence without a significant reduction in adverse clinical outcomes (readmission, adverse drug reactions, emergency department visits, and death)	Some adverse outcomes potentially undetected due to people with T2DM's forgetfulness and incomplete medical records Community pharmacy and physician counselling to people with T2DM potentially biased study results
Co-management by an IDMS team made up of medical providers including endocrinologists and an inpatient certified diabetes educator	Control group managed under standard care of attending physicians	The study found that co-managing people with diabetes by an IDMS team in a community hospital setting significantly reduces hospital LOS and 30-day readmission rates	Limitations associated with retrospective study design Both study groups exposed to the implementation of hospital-wide glucose policies and educational initiatives Potential selection bias, as providers from the IDMS team were consulted on more complex and sick people with diabetes
DiaTOHC intervention consisting of novel, brief inpatient diabetes education, coordination of care and post discharge support by a nurse practitioner, an A1C-based algorithm to adjust diabetes therapy and weekly calls for 30 days post discharge	Control group received usual care	The study found that the DiaTOHC intervention is associated with non-significant but measurable reductions in readmission risk and A1C	Small sample size attributed to pilot trial study design Conducted at a single location
Specialised multidisciplinary diabetes programme upon discharge from index hospitalisation	Control group received diabetes care in a standard primary medical care programme upon discharge from index hospitalisation	The study found that people with diabetes who are assigned to a specialised multidisciplinary diabetes programme post discharge have significantly reduced hospital readmission rates at 30 and 365 days post discharge	Study conducted at a single location and small sample size Lack of data on readmissions occurring within non-affiliated hospitals Inability of study to identify key specific components of the structured diabetes programme responsible for the reduction in readmissions rates

(Continues)

TABLE 1 (Continued)

References	Country	Study aim	Study design	Sample characteristics	Data collection method
Knee et al. ²⁹	UK	To investigate the effects of introducing a POC ward-based glucose and ketones assessment to trigger a DISN proactive review to the ward, on the LOS, 30-day readmission rate and 30-day mortality rate	Retrospective clinical data analysis study	979 adults with diabetes; 443 pre-intervention, 536 post-intervention	Quantitative approach
Murphy et al. ³²	USA	To determine the difference in 30-day hospital readmission rates for people with diabetes who receive IDPE compared to those who do not	Retrospective, quasi-experimental cohort study	514 adults with diabetes; 364 intervention group, 149 control group	Quantitative approach
Rubin et al. ²⁷	USA	To assess the effectiveness of the DiaTOHC intervention in reducing hospital readmission risk of people with diabetes after 90 days post discharge	RCT	91 hospitalised people with diabetes; 45 intervention group, 46 usual care group	Quantitative approach

3 | RESULTS

3.1 | Study characteristics

The main characteristics of the 12 studies included in the literature review are outlined in Table 1. Most of the studies (92%, $n = 11$) were published between the years 2017 and 2020. A large majority of the studies were conducted in the USA (83%, $n = 10$). One study was conducted in the UK (8%, $n = 1$), and one other study was conducted in Croatia (8%, $n = 1$). A quantitative approach to data collection was the most utilised, having been used in 92% ($n = 11$) of the studies, with a further 8% ($n = 1$) utilising a mixed-method approach and none of the included studies utilised a qualitative approach to data collection. 58% ($n = 7$) of the included studies utilised retrospective study

designs and 42% ($n = 5$) utilised a prospective study design. Most studies (92%, $n = 11$) included people with type 1 and type 2 diabetes within the sample population, with only one study (8%, $n = 1$) limiting the sample population to persons with T2DM. The sample size of the included studies varied from 40 participants to 66,518 participants.

3.2 | Intervention components and skill mix

A total of 14 components of hospital interventions were identified in the literature and grouped into three common categories which are outlined in Table 2. These categories are clinical care, education and protocol development and implementation. Several interventions

Main intervention strategy	Comparator(s)	Main findings and outcome	Limitations
POC-DISN proactive review service consisting of a system which alerts a DISN of all glucose values <4 mmol/L or >27.8 mmol/L and all positive ketones. The DISN reviews all alerts and changes medications and provides educations to patients and ward staff as appropriate	Pre- and post-intervention	The POC-DISN intervention can be effective in reducing 30-day readmission rates for inpatients with diabetes but does not significantly impact average LOS or 30-day mortality rate	Retrospective study conducted in a single hospital Study conducted over a short time frame of 6 months which could introduce seasonal bias to outcomes
Pharmacy-driven IDPE programme provided to diabetes persons which consisted of written materials to persons, discussing general topics on individual person needs and hands on training for blood glucose meter and insulin injection	Control group did not receive IDPE	The study found that there was a significant reduction in 30-day readmission rates among people with diabetes persons who received IDPE from a pharmacist in comparison to people with diabetes who did not receive IDPE but not diabetes-related readmissions	Education sessions likely varied from individual to individual Inability to control for additional diabetes education provided to persons by other health professionals
DiaTOHC intervention consisting of novel, brief inpatient diabetes education, coordination of care and post discharge support by a nurse practitioner, an A1c-based algorithm to adjust diabetes therapy and weekly calls for 30 days post discharge	Control group received usual care	The study found that the DiaTOHC intervention is associated with non-significant but measurable reductions in readmission risk	Small sample size attributed to pilot trial study design Conducted at a single location

utilised a multidisciplinary team consisting of various health professionals as shown in Table 3. Disciplines were classified into five categories consisting of medical, nursing, allied health, diabetes educator and other health professionals. A short description of the interventions of each individual study is provided in Table 1. All the included studies (100%, $n = 12$) utilised clinical care and education as part of their intervention strategy, while only 25% ($n = 3$) of studies influenced the development and implementation of protocols.

3.3 | Outcome measures

A total of 11 outcome measures were identified and grouped into seven categories outlined in Table 4. These

categories included glycated haemoglobin (HbA1c), hospital readmission, hospital LOS, costs, medication adherence, adverse drug reactions and mortality rate. Some variation existed between measurements within outcome categories. Eleven studies utilised an outcome measure of 30-day hospital readmission rates, one utilised an outcome measure of 90-day hospital readmission rates, and one utilised an outcome measure of 30- and 365-day readmission rates.

3.4 | Intervention effects on outcome measures

All 12 studies (100%) provided data related to the primary outcome measure of interest of hospital readmission rates.

TABLE 2 Intervention components

Category	Sub-category	Brumm, Theisen & Falciglia 2016	Drincic, Pfeiffer, Luo & Goldner 2017	Osting et al. 2017	Pembridge 2017	Bansal et al. 2018	Marusic et al. 2018	Mandel et al. 2019	Rubin et al. 2019	Bhalodkar et al. 2020	Knee et al. 2020	Murphy et al. 2020	Rubin et al. 2020	Total
Clinical care	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
	Dietician or Nutritionist Appointments									✓				1
	✓	✓		✓	✓	✓	✓			✓				7
	Certified Diabetes Educator Appointments													
	Insulin therapy			✓				✓			✓			4
	Pharmacological therapy			✓				✓			✓			4
	Post discharge linkages with primary care	✓	✓	✓	✓	✓	✓			✓		✓		8
	Education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
	Staff education	✓	✓				✓	✓			✓	✓		4
	Basic survival Skills education Handouts	✓	✓	✓	✓	✓	✓	✓			✓	✓		7
Video education	✓					✓	✓			✓	✓		3	
Diabetes education for people living with diabetes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12	
Protocols development & implementation	Improved in hospital protocols	✓	✓				✓	✓			✓			3
	Glycaemic management protocol	✓	✓				✓	✓			✓			2
	Diabetes Management Troubleshooting	✓	✓				✓	✓						3
	Discharge transition protocol	✓	✓				✓	✓						2
		✓	✓				✓	✓						1

TABLE 3 Workforce skill mix in each intervention

Skilled worker	Sub-category	Brumm, Theisen & Falciglia 2016	Drincic, Pfeiffer, Luo & Goldner 2017	Osting et al. 2017	Pembridge 2017	Bansal et al. 2018	Marusic et al. 2018	Mandel et al. 2019	Rubin et al. 2019	Bhalodkar et al. 2020	Knee et al. 2020	Murphy et al. 2020	Rubin et al. 2020	Total
Doctors		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	7
	General Physician	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5
	Endocrinologist			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5
Nurses		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
	Ward Nurses	✓					✓							2
	Nurse Practitioner	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	7
	Diabetes Specialist Nurse										✓			1
Allied health		✓								✓	✓	✓	✓	3
	Dietician or Nutritionist									✓	✓	✓	✓	2
	Social Worker	✓								✓	✓	✓	✓	3
	Pharmacist	✓								✓	✓	✓	✓	2
Diabetes educators		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	7
	Diabetes educator	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	7
Other health professionals		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3
	Case Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3

TABLE 4 Intervention primary outcome measures

Category	Sub-category	Brumm, Theisen & Falciglia 2016	Drinic, Pfeffer, Luo & Goldner 2017	Osting et al. 2017	Pembridge 2017	Bansal et al. 2018	Marusic et al. 2018	Mandel et al. 2019	Rubin et al. 2019	Bhalodkar et al. 2020	Knee et al. 2020	Murphy et al. 2020	Rubin et al. 2020	Total
HbA1c		✓						✓					✓	3
	A1c (%)	✓						✓						2
Hospital readmission	A1c (median)												✓	1
	30-day hospital readmission rates	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
	90-day hospital readmission rates	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
	365-day readmission rates									✓			✓	1
Hospital length of stay (LOS)	Inpatient, ED & observation care presentations		✓				✓							2
	Hospital LOS (mean)				✓	✓	✓	✓			✓	✓	✓	3
Costs	Total programme operating costs/ savings in fiscal year				✓	✓								1
					✓									1
Medication adherence	30-day post discharge medication adherence								✓					1
									✓					1
Adverse drug reactions	30-day post discharge adverse drug reactions						✓							1
							✓							1
Mortality rate	30-day mortality rate						✓						✓	2
							✓						✓	2

Among these, three (25%) also reported on hospital LOS, two (17%) reported on HbA1c, two (17%) on mortality rate, one (8%) on costs and one (8%) on medication adherence and adverse drug reactions.

3.5 | Readmission rates

On evaluation of the studies, most (83%, $n = 10$) reported a measurable reduction in hospital readmissions rates, one study (8%) reporting significant reductions in ED representations but not inpatient readmission rates, and only half (50%, $n = 6$) of the studies reported a statistically significant reduction in hospital readmission rates. This is outlined in the result outcomes section of [Table 1](#).

All studies provided some form of diabetes education for people with diabetes, although only four studies (33%) provided staff education. Seven studies (58%) involved doctors in the intervention strategy, nine (75%) involved nurses, seven (58%) involved a diabetes educator, three (25%) involved allied health and three (25%) involved other health professionals. Most studies which reported significant reductions in hospital readmission involved a diabetes educator (83%, $n = 10$), nurse (83%, $n = 10$) or doctor (67%, $n = 8$). All studies which influenced the development and implementation of hospital protocols (25%, $n = 3$), or involved allied health (25%, $n = 3$) resulted in statistically significant reductions in hospital readmission rates for individuals living with diabetes. A quantitative correlational research study by Pembridge²⁴ found that the provision of a diabetes consultation during admission did not significantly reduce hospital readmissions. However, a retrospective study by Ostling et al.⁵ found that the use of a Hyperglycaemic Intensive Insulin or Endocrine Consults consult on admission of people with type 2 diabetes can result in significant reductions in ED representations but not inpatient hospital readmissions.

Most studies that only involved one health profession in the intervention strategy reported non-significant reductions in hospital readmissions. Brumm et al.²⁵ did not find a significant association between the use of a diabetes transition programme conducted solely by a nurse practitioner who was also a nurse educator and significant reductions in hospital readmissions. RCT's conducted by Rubin et al.^{26,27} found that the use of the Diabetes Transition of Hospital Care intervention involving only a nurse practitioner did not significantly reduce hospital readmissions. Marusic et al.²⁸ found that the provision of additional pre-discharge pharmacotherapeutic education by an endocrinologist was not associated with significant reductions in hospital readmissions. A retrospective clinical data analysis study by Knee et al.²⁹ was the only included study which involved a single health profession that reported

significant reductions in hospital readmission. The study found that the use of a Point of Care-Diabetes Inpatient Specialist Nurse service resulted in significant reductions in 30-day readmission rates but not 30-day mortality rate or average LOS.²⁹

Most studies that involved multiple different health professionals in the intervention strategy reported significant reductions in hospital readmissions. Bhalodkar et al.¹⁰ found that the use of a specialised multidisciplinary diabetes programme involving doctors, nurses, allied health and a diabetes educator on discharge resulted in significant reductions in hospital readmissions. Bansal et al.³⁰ found that the use of a specialised diabetes team management involving an endocrinologist, diabetes nurse practitioner, diabetes nurse educator, and discharge/transition coordinators was associated with significant reductions in 30-day readmission rates to medical services but not surgical services. Mandel et al.³¹ found that the co-management of individuals living with diabetes by an Inpatient Diabetes Management Services team consisting of endocrinologists and an inpatient-certified diabetes educator resulted in significant reductions in hospital LOS and 30-day readmission rates. Murphy et al.³² found that the use of a pharmacy-driven Inpatient Diabetes Patient Education programme involving allied health significantly reduced 30-day readmission rates but not diabetes-related readmissions. Drincic et al.⁴ found that the use of an inpatient diabetes care model involving the role expansion of diabetes educators and the use of a Diabetes Resource Nurse programme involving doctors, nurses and allied health was associated with significant reductions in readmission risk.

4 | DISCUSSION

This scoping review aimed to identify interventions that hospitals can implement to reduce preventable hospital readmissions of people with type 2 diabetes. The primary outcome measure was hospital readmission inclusive of within 30, 90, or 365 days of participating in an intervention. The findings from this review demonstrate that interventions started at index admission for people diagnosed with type 2 diabetes can result in reductions in hospital readmissions. The six studies among the selected 12 studies which reported significant reductions in hospital readmissions were comprised of several different intervention components; although, it was unclear which specific components or if all intervention components were associated with statistically significant changes in outcomes.

Common strategies which attributed to the success of interventions in reducing hospital readmissions of T2DM individuals included a multidisciplinary team (MDT)

approach, a dedicated care team, certified diabetes educator appointments, basic survival skills education and influence hospital protocol development and implementation. Common characteristics in workforce skills mix of studies which reported significant reductions in hospital readmission of people with type 2 diabetes included the involvement of more than one health profession in the intervention strategy, diabetes educators, nurses, doctors and allied health. In studies which did not report any significant reductions in hospital readmission of people with type 2 diabetes, common intervention components included insulin therapy and pharmacological therapy. The main differences between studies that did not show any significant reductions in hospital readmissions and studies which did appear to be the application of intervention components associated with the development and implementation of hospital protocols, the involvement of a diabetes educator, the involvement of allied health and the involvement of more than one health profession in the intervention strategy.

This scoping review has exposed a variety of critical knowledge gaps in current literature. Firstly, there is a lack of interventions that addressed the psycho-social factors of individuals living with diabetes. This is the case despite it being well known that individuals with diabetes are at an increased risk of suffering from mental health problems including anxiety, depression and eating disorders which can lead to poor disease management and reduced compliance with diabetes treatment.^{33,34} Secondly, there were no studies undertaken in Australia, despite the growing prevalence of diabetes in Australia and the excessive level of burden diabetes places on the Australian health-care system.^{13,35} Thirdly, there is a lack of studies involving diabetes-specific interventions specifically targeted at reducing diabetes-specific readmissions rather than overall readmissions. Only three of the 12 included studies differentiated the primary readmission reason rather than overall hospital readmission.^{5,26,32} Lastly, there is a lack of studies involving Indigenous populations despite there being an increased prevalence and disproportionate level of burden from complications associated with diabetes.³⁶

4.1 | Strengths

This scoping review is an attempt at exploring and synthesising current research on interventions that hospitals can implement to reduce preventable hospital readmissions of people with type 2 diabetes. Interventions were evaluated mainly to determine their effectiveness at reducing hospital readmissions. Promisingly, most study interventions (83%, $n = 10$) reported a measurable and potentially

clinically meaningful reduction in hospital readmissions rates, and half (50%, $n = 6$) of all studies reported a statistically significant reduction in hospital readmission rates.

4.2 | Limitations

Several of the studies that were included in this literature review utilised a multitude of different intervention components and reported on a variety of outcome measures with limited crossover between studies. The variation in studies could have potentially weakened the evidence base for the impact of the individual intervention components making it difficult to estimate the effectiveness of intervention components in relation to hospital readmissions. Studies of more than a 5-year timeframe would have been more helpful to a clinician. Several of the included studies did not differentiate Type 1 and Type 2 diabetes in the sample group making it impossible to determine the difference in the effectiveness of interventions between Type 1 and Type 2 diabetes. Additionally, variations in study design, measurement, methodology quality, sample size and timeframe among studies makes it difficult to determine a clear conclusion in relation to the primary outcome measure.

5 | CONCLUSION

The hospitalisation of people with T2DM allows for the prospect of providing diabetes support to people with T2DM both within the hospital and post discharge with the aim of reducing preventable hospital readmissions, although further research is needed. The results of this literature review suggest that interventions which include a MDT approach, a dedicated care team, certified diabetes educator appointments, basic survival skills education, influence hospital protocol development and implementation, and involve more than one health professional are likely to significantly reduce hospital readmission rates. In addition, it is essential that more rigorous studies are conducted globally addressing psycho-social factors of people with T2DM to address gaps in current literature.

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CONFLICT OF INTEREST

The authors have no conflicts of interest.

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