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Profiling risk factors of patients diagnosed with type 2 diabetes awaiting outpatient diabetes specialist consultant appointment, a narrative review

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ABSTRACT

Background: Entry to seek health care services in Australia is based on a person's acuity rating as stipulated in legislation, standards and policy. In the context of diabetes Specialist Outpatient Departments, access involves a referral that is triaged by a clinician into a categorised waitlist. However, within categories, access to health care is queue based only, which omits patient centric factors determining the order of appointment allocation.

Aim: The purpose of the literature review undertaken June to December 2019 was to identify which patient centric factors influence the risk of deterioration in a type 2 diabetes population waiting for an appointment.

Methods: Databases searched included CINAHL, Medline and Scopus from 2011 to 2019. The first search focussed on key words, the second search focussed on a revised expression of key words emerging from the first search. The third search identified articles sourced from reference lists. Joanna Briggs Institute (JBI) and Critical Appraisal Skills Programme (CASP) critical appraisal tools were used to appraise the rigour of the studies.

Findings: Four key themes emerged from 29 selected articles. Duration of diabetes, comorbidity, age of patient and prescribed medication therapy significantly influenced the level of risk associated with deterioration.

Discussion: Further research is needed to evidence if duration of type 2 diabetes, comorbidities, age of patient and medication therapy influence the risk of deterioration in an Australian cohort.

Conclusion: The aim of this review was to discover which patient centric factors influence the risk of deterioration in a type 2 diabetes population.

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Summary of relevance

Problem
Little is known about the impact of patient centric factors influencing risk of deterioration for patients with type 2 diabetes awaiting specialist advice.

What is already known
Patients are categorised from 1 to 3 by health clinicians estimating the risk of requiring emergency services. This categorisation is based upon their medical condition and investigations.

What this paper adds
This paper demonstrates that patient centric factors which are not routinely considered when identifying the category of acuity for waitlist management are now essential when determining waiting timeframes to access specialist care for patients with type 2 diabetes.

Introduction

The World Health Organisation (2018) highlighted between years 1980 and 2014 a global increased trend of all types of diabetes diagnosis rates from 108 million to 422 million occurred. Current statistics from the Australian Institute of Health and Welfare (2019) highlight one million Australian adults were diagnosed with type 2 diabetes in 2017-2018. The incidence of type 2 diabetes is growing at an alarming rate not just in Australia, but globally (Chen et al., 2015; Cox et al., 2014; Li et al., 2018; Venuraju et al., 2019).

Type 2 diabetes is characterised by the body's inability to produce the volume of insulin needed to meet blood glucose demand, leading to increased morbidity and/or mortality (Dunning & Sinclair, 2020) and is a chronic progressive condition characterised by suboptimal blood glucose ranges (International Diabetes Federation, 2019). Risk factors such as obesity (Dietrich et al., 2017; Rastogi & Ferrucci, 2014; Svensson et al., 2016; Tuligenga et al., 2014) and hypertension (Azizi-Soleiman et al., 2015; Norhammar & Schenck-Gustafsson, 2013; Willey et al., 2014) were heavily featured in the literature in the context of type 2 diabetes predictive risk of secondary complications (Dunkler et al., 2016; Laiteerapong et al., 2019; Monami et al., 2013).

The purpose of the literature review was to identify patient centric factors defined as lifestyle/ psychosocial influenced such as smoking, BMI, psychological, mental health, cognitive conditions that influence the risk of deterioration in a type 2 diabetes population while waiting for an appointment. The clinical environment where a patient referral waits is the Specialist Outpatient Department defined as a clinical setting where patients are placed onto a waitlist or registry with the goal to seek health related services (QueenslandHealth, 2017). In the context of this research, deterioration was defined as prehospital risk of patient's physiological reserve including number and extent of organ dysfunctions and premorbid functional status. A patient and/or population, intervention, comparison and outcomes (PICO) framework was used to form the question before undertaking the narrative review (The Clinical Knowledge Network, 2017). A PRISMA Diagram was used to report the process of identifying articles (PRISMA Checklist, 2015). Two critical appraisal frameworks were used to guide analyses of each article. The overall process of undertaking this narrative literature review was guided by the Primsa Checklist (PRISMA Checklist, 2015). The aim of the narrative literature review was to determine if there are common factors in those who deteriorate in order to inform doctoral research.

Methods

All articles includedin this review were listed and sourced through the James Cook University Library One Search portal after relevant abstracts were identified through use of the following databases: CINAHL, Medline and Scopus. Each of the three databases were methodically searched using defined criteria for inclusion and exclusion. Inclusion criteria for the first search centred around both type 1 and type 2 diabetes cohorts with N=314,629 articles captured. A decision to limit the search to studies with a predominantly type 2 diabetes cohort was enacted on the secondary search of all three databases. An exception aligns to articles where both a type 1 and type 2 diabetes cohort were reported, as these were separated during statistical analysis. English was the sole language inclusion option, age range parameters were applied from 16 years of age and older with a publication date range set from 2011 to 2019.

Rationale for the age parametre centres upon eligibility criteria to access health services in an Australian adult Specialist Outpatients Department (Children's Health Queensland Hospital and Health Service, 2019). The publication date range was considered to align with the introduction of the Hospital and Health Boards Act 2011. This piece of legislation directs the Hospital and Health Services of Queensland to ensure access to health services is based upon an acuity rating which is defined as emergency and/or critical care medicine requirement for the severity of a hospitalised patient's illness and the level of attention or service he or she will need from professional staff (State of Queensland, 2018). The exclusion criteria focused on removing other associated cohorts as the type 2 diabetes condition features differences in diagnosis criteria, treatment pathways and/or clinical outcomes over time (International Diabetes Federation, 2019). Peer review articles featured heavily in the accepted cohort undertaking critical review. Types of studies featuring in this narrative review include cohort, cross-sectional, case-control studies and systematic reviews. grey literature, opinion pieces and dissertations were removed once identified.

The search strategy focused on three phases to find literature related to patient centric factors influencing the risk of deterioration for patients with type 2 diabetes in the outpatient environment. Between June and July 2019 the first search was undertaken in CINAHL, Medline and Scopus databases. The first search focused on identifying titles with key words and/or search terms. Key terms included Diabetes, Risk factors and/or Clinical Deterioration. Once a quantity of suitable titles was identified, the abstracts were then reviewed. The abstract review focused on identifying a defined 'Type 2 Diabetes Mellitus' cohort, patient centric factor/s, element of risk, quantitative methodology and the healthcare environment from which the sample was extracted and/or recruited. From the selected abstracts, the introduction and conclusion were then reviewed to clarify if the cohort, environment, patient centric factor/s, element of risk and/or study design were acceptable to transition into the critical appraisal stage of the screening process.

A second search of CINAHL, Medline and Scopus was undertaken after the completion of the first search. The second search concentrated on adding the additional key words and/or search terms that had emerged in the first search. Key words and/or search terms emerged from use of MeSH and/or the database associated synonym filters were applied in order to collect articles worthy of inclusion. To maintain the methodological flow of the first and second search, separate folders in the Endnote software were used to hold articles throughout the review process. The second search undertaken between August and September 2019 followed the above original search format of title, abstract, introduction and conclusion then critical appraisal process.

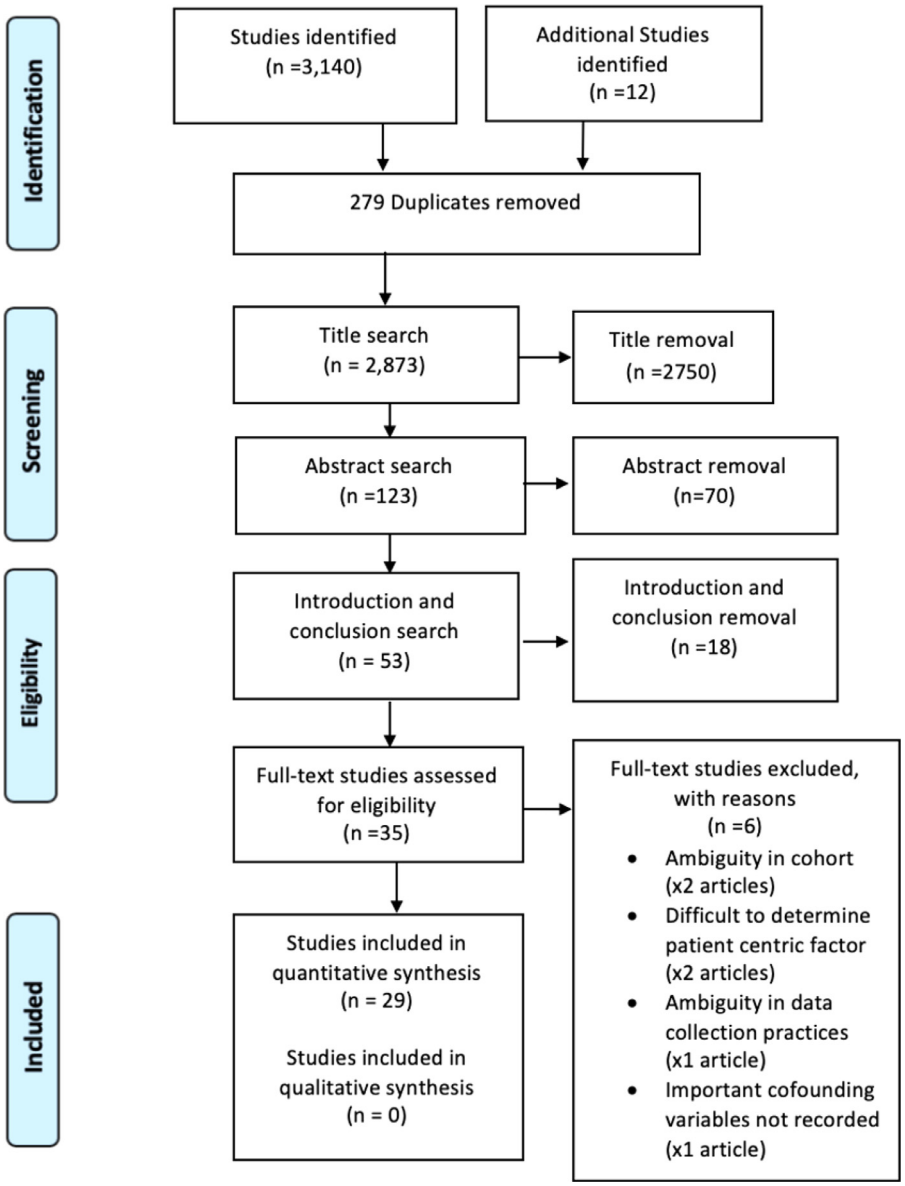

Fig. 1. Prisma flow diagra m.

A third search undertaken between October and November 2019 was conducted in order to identify further studies worthy of inclusion. The third search focused on identifying literature located in the reference lists of the dataset that resulted from the first two searches. The same inclusion and exclusion criteria were applied in the third search to identify studies suitable for critical appraisal. Joanna Briggs Institute (JBI) and Critical Appraisal Skills Programme (CASP) critical appraisal tools were used to facilitate a structured approach. Systematic literature reviews underwent the CASP systematic review appraisal whereas all other studies were matched with the relevant JBI tool. Records were maintained of all search results including citations for both excluded and included studies. Critical Appraisal tools were scrutinized by the primary advisor. Endnote citation management system was used to store this information.

The PRISMA Diagram Fig. 1 displays the summarised number of articles identified at each stage of the 3 separate searches. In summary, 29 articles from a total of 3,152 were identified to outline which patient centric factors influence the risk of deterioration in a type 2 diabetes population while waiting for specialist outpatient consultation.

From 29 articles (n = 6) originated from America, (n = 3) each originated from the United Kingdom, Taiwan and Germany, with others originating from Iran, Italy, China, India and Scotland. The mean age of the cohorts was 40 to 60 years, and there was an equal number of studies with separate and/or combined male and female cohorts. From 29 articles accepted into the review, 20.7% (n = 6) systematic integrated reviews were featured, with each identifying age as a primary influencer of deterioration. These articles are summarised in Table 1 along with the articles' sample size and aspects of data analysis.

A summary of the accepted cohort, cross-sectional and case-control studies features in Table 2. Overall, 48.2% (n = 14) are cohort studies, 20.7% (n = 6) are cross-sectional studies and 10.4% (n = 3) are case control studies. Four themes became evident during the narrative literature review, with duration of type 2 diabetes, comorbidity, medication therapy and age of patient identified as influential. A working matrix table was created to extract key elements of each study, such as size and type of sample, ge-

Table 1
Summary of included systematic reviews

Author (Year)	Design	Sample	Topics	Results
Abdelhafiz, A., et al., (2015).	Systematic integrative review (both qualitative and quantitative).	Type 2 DM cohort-based articles. Number of publications reviewed was not stated.	Physical dysfunction, cognitive dysfunction, increased mortality, hypoglycaemia and frailty.	Older cohort has higher risk of adverse consequences of hypoglycaemia due to polypharmacy, prevalence of multiple comorbidities, under nutrition compared with younger cohort.
Dietrich, I., et al., (2017).	Systematic review with quantitative studies only.	Both Type 1 and Type 2 DM cohorts. Articles discussed Type 2 DM cohort separately. Number of publications reviewed not stated.	Metabolic Disorders, Neuropathy, Cardiovascular events, Renal Function, Impairment, Chronic Inflammation inclusive of Impaired wound healing and infection.	Established comorbidity (Sensory Neuropathy) is the primary cause of 60%-foot ulceration with Type 2 DM patients. Acute complication/s (hyperglycaemia and inflammatory status) and adiposity (condition of severe overweight) plays major role in axon injury.
Jafari, B., et al., (2015).	Systematic integrative review (both qualitative and quantitative).	Both Type 1 and Type 2 DM cohorts. Articles discussed Type 2 DM cohort separately. Number of publications reviewed not stated.	Frequency and prevalence of hypoglycaemia, hypoglycaemia unawareness and hypoglycaemia-associated autonomic failure, risk factors, consequences of hypoglycaemia, prevention of hypoglycaemia and medications.	Age (elderly) associated with prevalence of comorbidities and polypharmacy. Age related changes cause increased risk of hypoglycaemia. Medication therapy increases risk of Hypoglycaemic event.
Norhammar, A., et al., (2012).	Systematic integrative review (both qualitative and quantitative).	Type 1 and Type 2 DM cohorts. Articles discussed Type 2 DM cohort separately though did mention Gestational DM. Number of publications reviewed not stated.	Diabetes and Cardiovascular Disease (CVD), glucose a risk factor for CVD, sex-specific conditions in women, Acute Coronary Syndromes in women and DM.	Gender (female) and age is predicted for poorer outcomes after coronary episode in Type 2 DM patients. Risk factors include previous Gestational Diabetes causing increased risk of Type 2 Diabetes development as dispositions patient with increased risk of complications and or comorbidity.
Sinclair, A., et al., (2015).	Systematic integrative review (both qualitative and quantitative).	Both Type 1 and Type 2 cohorts. Articles discussed Type 2 DM cohort separately. 1232 Publications reviewed.	Nature of DM and old age, pathophysiology and diagnosis, complications, frailty and disability, emerging areas (falls and medications) and hypoglycaemia.	Aim for older Type 2 DM patients is to prolong life and avoid acute complication/s. Type 2 DM patients associated with increased risk of incident vascular dementia. Long duration of Type 2 DM patients and comorbidity (macroalbuminuria) is associated with high risk of severe hypoglycaemia.
Wong, C. (2015)	Systematic integrative review (both qualitative and quantitative).	Both Type 1 and Type 2 DM cohorts. Articles discussed Type 2 DM cohort separately. Number of publications reviewed not stated.	Elderly people are at risk of hypoglycaemia, co-morbidities and polypharmacy, Impact of hypoglycaemia and management of hypoglycaemia.	Advanced age, medication therapy and morbidities are contributing factors of severe hypoglycaemia. Metformin drug was associated with low risk of hypoglycaemic episode.

Body Mass Index (BMI), Dependant Variable (DV), Diabetes Mellitus (DM), Diabetes and Cardiovascular Disease (CVD), Haemoglobin A1c (HbA1c).

ographic location, data collection and data analysis methods, key findings, strengths and limitations, etc. Each of these elements was inserted in a working version of the matrix, and reviewed by SS, KW and MC as the matrix iteratively developed. A more succinct version of the matrix is presented as a summary of studies in Tables 1 and 2.

A table was used to list the key themes outlined in the data set of the final 29 studies. Table 3 titled Theme Table clearly highlights 4 reoccurring contributory factors leading to deterioration in the chosen cohort.

Themes were synthesised from the key findings of selected studies, each of which was reported in the prose of the Findings section.

Findings

3.1 Duration of diabetes

The association between duration of type 2 diabetes and increased risk in the development of comorbidities is found in the Progression of Coronary Atherosclerosis in Asymptomatic Diabetes Subjects (PROCEED) study. The PROCEED study found the duration of type 2 diabetes and hypertension increased the risk of coronary artery disease (Heller, 2009). In a different cohort study of 32,545 patients, those patients with type 2 diabetes of >5 years duration were significantly associated with increased prevalence of hypoglycaemia (Kostev et al., 2014). Hypoglycaemia is defined as an acute complication with blood glucose level reduced to <3.9mmol/L

Table 2
Summary of the accepted cohort, cross-sectional and case-control studies

Author (Year)	Study design	Sample/Country	Measures	Results
Azizi-Soleiman, F., et al., (2015).	Cross-Sectional study.	1,782 patients with Type 2 DM. Mean age of 50.3 years. Follow up: not stated Iran.	(IV) Duration of DM, HbA1c, systolic blood pressure and proteinuria. (DV) Diabetic Retinopathy.	Predictors of Diabetic Retinopathy included age, duration of DM (5-10 years) and hypertension. Lower BMI and higher education decrease risk.
Berkowitz, S., et al., (2014).	Cross-Sectional study.	14,357 patients with Type 2 DM. Mean age of 58 years. Follow up: 1 year. America.	(IV) High income earners (>$65K), low income earners (<$15K) and level of education. (DV) Hypoglycaemia events.	Lower income earners experience greater frequency of acute complications (hypoglycaemia (16%)) compared with higher income earners (8.9%).
Bramlage, P., Et al., (2012).	Case Control study.	3,810 patients with Type 2 DM. Aged over 40 years. Follow up: 1 year. Germany.	(IV) Age, duration of DM and medication therapy. (DV) Hypoglycaemia events.	Multiple comorbidities, older age associated with polypharmacy and insulin use which are risk factors for hypoglycaemic events.
Colayco, D., Et al., (2011).	Case Control study.	44,628 patients with Type 2 DM. Mean age of 65.5 years. Follow up: 3 years. America.	(IV) Age, gender and HbA1c. (DV) Cardiovascular event/s.	HbA1c <6% in Type 2 DM patients were 20% more likely to experience comorbidity (cardiovascular event).
Collier, A., et al., (2014).	Cohort study.	15,351 Sample. Type 1 and Type 2 DM patients. Type 2 DM cohort separated by gender. Follow up: not stated. Scotland.	(IV) Body Mass Index (BMI)= >30kg/m2, gender and hypertension. (DV) Comorbidity.	Type 2 DM men identified with higher rates of comorbidity (ischaemic heart disease, stroke, peripheral vascular disease) compared with women who had higher rates of hypertension and increased BMI.
Darivemula, S., Et al., (2019).	Cross-Sectional study.	336 patients with Type 2 DM. Males mean age of 52 years. Females mean age of 50.8 years. Follow up: 2 months. India.	(IV) Age, gender, HbA1c, duration of DM and hypertension. (DV) Diabetic Peripheral Neuropathy.	Type 2 DM duration (50 years) had significantly higher rates of comorbidity (Peripheral Neuropathy.)
He, B., et al., (2015).	Cross-Sectional study.	1,997 patients with Type 2 DM. Mean age of 59.67 years. Follow up period not stated. China.	(IV) Co-morbidities through macrovascular and microvascular complications. (DV) Anaemia (Hb level <13g/dL males and <12g/dL females).	Anaemic patients identified higher rates of comorbidity (microvascular complications (62.7%) cohort). Macro and micro vascular complications were identified in patients with longer duration of Type 2 DM, older age and established hypertension.
Hu, W., et al., (2018).	Cohort study.	84,450 patients with Type 2 DM patients. Mean age of 57.2 years. Follow up: 11 years. Taiwan.	(IV) Age, gender, hypertension and number of pre-existing comorbidities. (DV) Acute Coronary Syndrome, Ischemic Stroke and mortality.	Secondary complications identified as most significant factor to increase risk of comorbidity and/or mortality (acute coronary syndrome and ischemic stroke).
Huang, E., Et al., (2014).	Cohort study.	72,310 patients with Type 2 DM. Ages between 60 and 80 years. Follow up: 5 years. America.	(IV) Duration of DM and age. (DV) Microvascular and macrovascular complications, and mortality.	Longer duration of Type 2 DM is associated with hypoglycaemia CVD and microvascular complications.
Kastelan, S., et al., (2013).	Cross-Sectional study.	545 patients with Type 2 DM. Type of medication. Mean age of 68.28 years. Follow up period not stated. Europe	(IV) BMI. (DV) Retinopathy.	Significant deterioration in HbA1c associated with progression of comorbidity (Retinopathy). Duration of Type 2 DM patients increased risk of incidents of retinopathy.
Kostev, K., et al., (2013).	Cohort study.	32,545 patients with Type 2 DM. Mean age 70 years. Follow up: 1 year. Germany	(IV) Age, gender, medication therapy and comorbidity. (DV) Hypoglycaemia events.	Patient with mental health conditions showed increased odds of having acute complication/s (hypoglycaemia). Increased duration of disease (>5 years) increased prevalence of acute complication (hypoglycaemia). Comorbidity (renal failure and autonomic neuropathy) independently associated with hypoglycaemia events.
Laiteerapong, N., et al., (2019).	Cohort Study.	34,737 patients with Type 2 DM. Mean age of diagnosis 56.8 years. Follow up: 13 years. America.	(IV) HbA1c and duration of DM. (DV) Microvascular and macrovascular complications.	Longer duration of early exposure to >8% A1c linked with increased future risk of comorbidity (microvascular events) and mortality.
Li, T., et al., (2018).	Cohort study.	32,653 patients with Type 2 DM. Mean age of 61.09 years. Follow up: 2 years. Taiwan	(IV) Duration of DM, smoking, alcohol consumption and BMI. (DV) Morality and hospitalisation.	Significant factors leading to Type 2 DM patients hospitalised included duration of condition and medication therapy prescribed (insulin).
Lipska, K., et al., (2013).	Cross-Sectional study.	9,094 patients with Type 2 DM. Mean age 59.5 years. Follow up: 1 year. America.	(IV) HbA1c, age, duration of DM and medication therapy. (DV) Severe hypoglycaemia events.	Patient with HbA1c of <6% or >9% identified as higher risk of hypoglycaemia. Patients with duration of DM >10 year more likely to report hypoglycaemia.
Mayeda, E., et al., (2014).	Cohort study.	22,171 patients with Type 2 DM. Over 60 years of age. Follow up: 6.7 years. America.	(IV) Race/ethnicity, age, gender, duration of DM and level of education. (DV) Dementia risk.	Type 2 DM patients who were followed for 10 years had a 40-60% greater risk of acute/secondary complication (dementia) in patients who identified as African American and Native Americans.

(*continued on next page*)

Table 2 (*continued*)

Monami, M., et al., (2013).	Case Control study.	4,140 patients with Type 2 DM. Mean age of 63.4 years. Follow up: 3.5 years. Italy.	(IV) HbA1c, duration of DM, comorbidity and medication therapy. (DV) Mortality.	Medication therapy treatment (insulin and/or glucose medication/s) was associated with longer duration. HbA1c >8.5% associated with increased mortality regardless of insulin use.
Prinz, N., et al., (2015).	Cohort study.	215,932 patients with Type 2 DM included in study. Aged over 40 years n=6,181. Follow up period not identified. Germany.	(IV) Age, gender and duration of DM. (DV) Dementia diagnosis.	Type 2 DM n=6770 equals 3.1% of total cohort reported Dementia. 82.1% of the Type 2 DM cohort n=5560 reported vascular dementia. 10.3% of the Type 2 DM cohort n=695 reported Alzheimer's disease. Hypoglycaemia and diabetes related complications were reported higher in patients with Type 2 DM and a diagnosis of dementia.
Shih, C., et al., (2015).	Cohort study.	120,000 patients with Type 2 DM. Mean age of 66.3 years. Follow up: 4.2 years. Taiwan.	(IV) Hypoglycaemia events (DV) Chronic Kidney disease	Longer duration, age of patient and identified with higher number of comorbidity (Heart, Renal and/or liver) influenced rates of hypoglycaemic events
Tuligenga, R., et al., (2014).	Cohort study.	5,653 patients with Type 2 DM. Mean age of 54.4 years. Follow up: 10 years. United Kingdom.	(IV) DM type, glycaemic control and age. (DV) Level of cognitive decline defined as decline in memory, reasoning and global cognitive score.	T2DM patients showed greater acute and/or secondary complication (45% faster decline in memory, 29% faster decline in reasoning, 24% faster decline in global cognitive score) compared with normoglycemia patients. 1%-point increment in HbA1c associated with significantly faster decline in memory in patients with Type 2DM.
Venuraju, S., et al., (2019).	Cohort study.	259 patients with Type 2 DM. Mean age of 62.0 years. Follow up: 22 months. United Kingdom.	(IV) Duration of DM and systolic blood pressure. (DV) Coronary Stenosis.	Duration of Type 2 DM >10.5 years predicted significant comorbidity (Coronary Artery Disease).
Wannamethee, et al., (2011).	Cohort study.	4,045 patients with Type 2 DM men aged between 40 to 59 years. Follow up: 9 years. United Kingdom.	(IV) Age and gender. (DV) Cardiovascular disease.	>8 years of Type 2 DM duration showed significantly increased risk of comorbidity CVD.
Zakkerkish, M., et al., (2013).	Cross-Sectional study.	350 patients with Type 2 DM. Mean age of 54.0. years. Follow up: 3 months. Iran.	(IV) Height and Weight, blood pressure, HbA1c and duration of DM. (DV) Albuminuria levels.	Women who had abnormal albumin excretion had longer duration (p=0.001). Average duration was 5 years for the prevalence of microalbuminuria (20.6%).

Body Mass Index (BMI), Dependent Variable (DV), Diabetes Mellitus (DM), Diabetes and Cardiovascular Disease (CVD), Haemoglobin A1c (HbA1c), Independent Variable (IV).

Table 3
Theme table

Author (Year)	Duration of Diabetes	Comorbidities	Prescribed Medication Therapy	Age of Patient
Abdelhafiz, A., et al., (2015).		√		√
Azizi-Soleiman, F., et al., (2015).	√	√		√
Bramlage, P., et al., (2012).	√	√	√	√
Colayco, D., et al., (2011).		√		√
Collier, A., et al., (2014).		√		
Darivemula, S., et al., (2019).	√	√		√
Dietrich, I., et al., (2017).		√		
He, B., et al., (2015).	√	√		√
Hu, W., et al., (2018).		√		√
Huang, E., et al., (2014).	√	√		√
Jafari, B., et al., (2015).		√	√	√
Kastelan, S., et al., (2013).	√	√		
Kostev, K., et al., (2013).	√	√	√	
Laiteerapong, N., et al., (2019).	√	√		
Li, T., et al., (2018).	√		√	
Lipska, K., et al., (2013).	√		√	
Mayeda, E., et al., (2014).	√			
Monami, M., et al., (2013).	√	√	√	√
Norhammar, A., et al., (2012).		√		√
Prinz, N., et al., (2015).	√	√		√
Shih, C., et al., (2015).	√	√		√
Sinclair, A., et al., (2015).	√	√	√	√
Tuligenga, R., et al., (2014).		√		√
Venuraju, S., et al., (2019).	√	√		
Wannamethee, et al., (2011).	√	√		√
Wong, C. (2015).		√	√	√
Zakkerkish, M., et al., (2013).	√	√		

and/or a person is symptomatic (Dunning & Sinclair, 2020). Duration of type 2 diabetes was linked with an increased risk of hypoglycaemic events in two other studies (Huang et al., 2011; Wong, 2015). This finding is again evidenced in a cross-sectional study of 9,094 patients with type 2 diabetes, who experienced an increased risk of hypoglycaemia if their HbA1c range was <6% (42mmol/mol) and/or >9% (75mmol/mol) (Lipska et al., 2013). Haemoglobin A1C (HbA1c) is the blood pathology investigation identifying the number of glucose molecules attached with red blood cells which indicates the average blood glucose range over a period of 3-4 months (Dunning & Sinclair, 2020). From this same cohort it was identified patients with longer duration, defined as >10 years, were more likely to report the hypoglycaemic event (Lipska et al., 2013).

Various length durations of type 2 diabetes were associated with different severities of deterioration. In a cross-sectional study of 350 participants with type 2 diabetes, 20.6% of the cohort recorded a diagnosis of microalbuminuria after five years (Zakkerkish et al., 2013). In comparison, 5 to 10 years was identified as the longest duration of disease span for the development of Diabetic Retinopathy (Azizi-Soleiman et al., 2015). In Mannamethee, et al., (2011) a cohort study reported >8 years duration of type 2 diabetes increased the risk of future comorbidity. Li et al., (2018) created a predictive scoring tool to determine what patient-centric factors in a type 2 diabetes cohort attracted the highest risk of hospitalisation. It was determined a duration of 20 years with type 2 diabetes attracted the highest level of risk for hospitalisation (Li et al., 2018).

3.2 Comorbidities

Pre-existing Diabetic Retinopathy (Azizi-Soleiman et al., 2015), Cardiovascular Disease (Dietrich et al., 2017), Diabetic Neuropathy (Darivemula et al., 2019) and Diabetic Renal Disease (Shih et al., 2015; Zakkerkish et al., 2013) were identified as predictive factors of risk for further deterioration in a type 2 diabetes population (Li et al., 2018; Prinz et al., 2016) due to the long term exposure of suboptimal blood glucose ranges (Laiteerapong et al., 2019). In a cohort study by Hu & Lin, (2018), of 84,450 patients with type 2 diabetes, it was evidenced that secondary complications were the most significant factor to increase the risk of comorbidity and/or mortality.

The relationship between comorbidities influencing the risk of further deterioration in patients with pre-existing type 2 diabetes (Azizi-Soleiman et al., 2015; Zakkerkish et al., 2013) is rationalised through long term suboptimal blood glucose ranges (Dietrich et al., 2017; Lipska et al., 2013). This relationship between optimal blood glucose ranges reducing the incidence of comorbidity is supported by longitudinal clinical trials. For example, the 20 year United Kingdom Diabetes Prospective study found a reduction in microvascular complications was directly related to improving the glycaemic ranges of its type 2 diabetes cohort (Bailey & Grant, 1998). In a case control study of 44,628 patients with type 2 diabetes, it was shown patients with HbA1c levels of <6% (42mmol/mol), were 20% more likely to experience comorbidity and/or mortality via a cardiovascular event (Colayco et al., 2011).

3.3. Prescribed medication therapy

In 92% of cases in adults aged 40 years and over with pre-existing type 2 diabetes, treatment includes the use of insulin therapy (Australian Institute of Health and Welfare, 2019). Insulin therapy is a patient-centric factor which is evidenced to increase the risk of mortality through the associated risk of a hypoglycaemic event (Li et al., 2018; Wong, 2015). Glucose lowering medication/s in the context of Oral Hypoglycaemic Agents (OHAs) are also evidenced to increase the risk of an adverse outcome in the form of hypoglycaemic event/s (Sinclair et al., 2015; Wong, 2015). The Action to Control Cardiovascular Risk in Diabetes (ACCORD) study aimed to achieve a target range HbA1c of 6.5% (48mmol/mol) through active use of OHAs and/or insulin in a type 2 diabetes cohort. The study reported a high rate of death estimated at 3 in every 1000 participants per year that led to the ethical decision to cease the clinical trial 18 months before its original completion date (Heller, 2009).

Literature acknowledges the relationship between hypoglycaemia causing fatal mortality in the elderly type 2 diabetes population (Monami et al., 2013; Wong, 2015). Prescribed medication therapy in the form of glucose lowering medication/s attracted the highest risk of deterioration for the type 2 diabetes population (Li et al., 2018; Monami et al., 2013). Polypharmacy is recognised as a leading cause of adverse outcomes in the form of severe hypoglycaemia (Sinclair et al., 2015; Wong, 2015). In contrast Monami et al., (2013) identified in a case control study of 4,140 patients with type 2 diabetes that insulin has no independent significance for increased risk of mortality if a patient's HbA1c is >8.5% (69mmol/mol). The risk of deterioration in patients with type 2 diabetes seen through the use of glucose lowering medication/s is also heightened if the individual is defined as elderly (Abdelhafiz et al., 2015; Bramlage et al., 2012; Wong, 2015).

3.4. Age of patient

The patient-centric factor of age is highlighted as being statistically significant in the association of deterioration in the type 2 diabetes population (He et al., 2015; Jafari & Britton, 2015). Explanation for the association is varied with authors alluding to insulin resistance (Monami et al., 2013; Sinclair et al., 2015) and the reduction of insulin secretion over the life span of the individual (Sinclair et al., 2015; Wong, 2015). A secondary outcome of insulin resistance was the link of muscle protein degradation causing muscle mass decline in the elderly (Sinclair et al., 2015). Muscle mass decline in the elderly then in turn causes barriers with achieving optimal glucose ranges (Abdelhafiz et al., 2015) leading to the requirement of glucose lowering medication/s for acute complication management, for example hyperglycaemic events (Sinclair et al., 2015).

Emerging evidence links severe episodes of hypoglycaemia inducing cognitive decline (Jafari & Britton, 2015). Strong evidence from a retrospective study suggests 82 percent (n=5560) of the type 2 diabetes cohort over the age of 40 identified with a recorded case of Vascular Dementia (Prinz et al., 2016). In a cohort study of 5,653 patients it was identified in the type 2 diabetes cohort, that a 1%-point increment in HbA1c was associated with a significantly faster decline in memory, in comparison with the normoglycemic cohort (Tuligenga et al., 2014). Sinclair et al., (2015) identified age increased the risk of an asymptomatic hypoglycaemic event, thus influencing a cognitive decline.

From the 29 articles presented in the findings section above, 48% (n = 14) evidenced patient-centric factors that influenced the risk of deterioration in a type 2 diabetes population. Duration of type 2 diabetes was heavily portrayed in the literature as contributing to the emerging development of secondary complications (Azizi-Soleiman et al., 2015; Darivemula et al., 2019; Wannamethee et al., 2011; Zakkerkish et al., 2013). Targeted end stage organ failure over the duration of the type 2 diabetes (Azizi-Soleiman et al., 2015; Wannamethee et al., 2011) through hypoglycaemic (Jafari & Britton, 2015; Sinclair et al., 2015) and hyperglycaemic exposure (Dietrich et al., 2017) was the repeated association identified.

Discussion

The purpose of the literature review was to identify patient centric factors that influence the risk of deterioration in a type 2 diabetes population while waiting for an appointment. The results indicate four key themes emerged from 29 selected articles. Duration of diabetes, comorbidity, age of patient and prescribed medication therapy significantly influenced the level of risk associated with deterioration. Significantly, it is evident that the length of duration of type 2 diabetes influences the risk of deterioration (Huang et al., 2011; Wong, 2015). Comorbidities were linked directly to patients who experienced suboptimal blood glucose ranges over a lengthy disease duration (Hu & Lin, 2018). A long duration of suboptimal blood glucose ranges was connected to a higher number of prescribed glucose lowering medications (Lipska et al., 2013). The higher number of prescribed therapies was linked to an elevated risk of deterioration in patients with type 2 diabetes, especially in the elderly cohort (Abdelhafiz et al., 2015; Bramlage et al., 2012; Wong, 2015).

Patient-centric factors identified to increase the risk of deterioration in this literature review (Abdelhafiz et al., 2015; Kostev et al., 2014; Mayeda et al., 2014) can be contextualised against the American Society of Anaesthesiologists (ASA) Physical Status Classification System used to assist in predicting perioperative risks based upon patient-centric factors (American Society of Anesthesiologists, 2019). The Physical Status Classification System outlines a scale of risk based upon the severity of conditions held by the patient. For example, ASA-1 is linked to a healthy patient who identifies as a non-smoker and/or consumes minimal to no alcohol (QueenslandHealth, 2017). In comparison ASA-III is linked to a patient with severe systematic disease, for example poorly managed diabetes or hypertension (QueenslandHealth, 2017). In a retrospective cohort study the validity of the classification system was demonstrated with the outcome of the study endorsing the framework for use in contemporary clinical practice (Sankar et al., 2014).

The findings of this narrative literature review indicate that there are distinctive attributes that are shared by those patients at higher risk of deterioration, enabling more precise risk stratification for outpatient scheduling. Risk stratification has been used successfully in the healthcare setting of New South Wales (NSW) Health (NSW Government Health, 2018). For instance, the risk stratification method is used in primary practice to predict an individual's probability of requiring assistance from the emergency department in a futuristic 12 month period (Khanna et al., 2019). The benefit of implementing the futuristic predictive tool allows clinicians to tailor supportive care for the patient to reduce the risk of requiring future emergency services (National Academies Press, 2011; NSW Government Health, 2018).

Throughout Australian inpatient wards, the risk stratification method is used through the Modified Early Warning Score (MEWS) to identify and flag clinical risk (Mizrahi et al., 2019). The CHADS Score, is another patient-centric risk stratification calculation, indicating risk for a stroke event (Heart Foundation, 2019). A diabetes centric example includes the AUSDRISK tool where age, gender, ethnicity and patient-centric clinical factors influence the collective score identifying risk for the individual to develop type 2 diabetes (The Department of Health, 2016).

Future research informs policy and practice change and to embed change education is vital. The findings from this narrative literature review highlight key recommendations for the clinical environment. Recommendations for policy include altering both government and facility processes, to incorporate patient-centric factors into the determination of acuity rating. There is opportunity to then leverage this change into future research endeavours. Future research has the potential to implement a risk stratification method based on identifying patient-centric factors in a cohort of type 2 diabetes. Further research is required to evidence if these four factors of duration of type 2 diabetes, comorbidities, medication therapy and age of patient also influence the risk of deterioration in an Australian-only population. This is further demonstrated by a cross-sectional study held in Denmark which evidenced the benefits of using stratification level categorisation for newly referred type 2 diabetes patients seeking Endocrinologist Specialist advice (Munch et al., 2016).

A recommendation for clinical practice includes educating clinicians to enact change of evidenced based processes and frameworks into routine practice. While numerous alternative models of care for clinicians to consider and enact into clinical practice are available to trial, all proposed pathways are not suitable to everyone's needs National Associated of Diabetes Centres, (2019); Ugenthiri, FitzGerald, Dulhunty & Rosemann, (2017). Clinicians should be educated to consider the practical benefits of including predictive factors in their categorisation clinical decision. This benefit can be achieved by incorporating patient-centric information to refine determination of acuity in referral and waitlist management, prior to appointment booking. Refining the potential risk of deterioration in other cohorts will allow health practitioners to create tailored models of care. The downstream effect of the research is the ability to build integrated models of care to further reduce waiting periods and increase access to healthcare for a growing population.

Strengths of this narrative literature review include an international and contemporary data set which highlights a patient's anticipated disease trajectory based upon their own centric factors. Initially the PubMed data base was utilised for inclusion in the first search. Duplication featured in results and led to no additional articles of value being added to the cohort for further review. Therefore, no additional searching in the PubMed data base occurred. Other limitations of this review include the lack of qualitative articles to assist the reader in understanding the patient experience. There was a paucity of Australian-specific studies concentrating on identifying patient-centric factors which influenced deterioration in a type 2 diabetes cohort.

Conclusion

Patient-centric factors which influence risk of deterioration in a type 2 diabetes cohort are recognised through the narrative literature review as having a longer duration of their type 2 diabetes, the presence of comorbidities, the use of medication therapy and increased age of the patient.

Authorship contribution statement

Shannon Sheehan: Conceptualisation, Methodology, Data Curation, Writing-Original Draft, Visualisation, Project Administration, Funding Acquisition. **Kristin Wicking:** Methodology, Validation, Writing-Review & Editing, Supervision, Funding Acquisition. **Maude Chapman:** Validation, Writing-Review & Editing, Supervision, Funding Acquisition. Melanie Birks: Writing-Review & Editing, Supervision, Funding Acquisition.

Ethical Statement

Not applicable, as no human or animal participants were involved.

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Conflict of interest

No ethical clearance was obtained before conducting the narrative literature review as the review focused on public accessible articles. There is no conflict of interest registered with the authors listed on the paper.

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