Co-design of school-based strategies and supports for Aboriginal and Torres Strait Islander youth living with type 2 diabetes: A qualitative study

Stefanie Puszka,[1,2]* Angela Titmuss,[1,3] Emma Weaver,[1] Natasha Freeman,[1] Marylin Carino,[1] Jade Morris,[1] Peggy Tom,[1] Shiree Mack,[1] Sumaria Corpus,[8] Deanne Minniecon,[4] Peter Azzopardi,[5,6] James Dowler,[7] Louise Maple-Brown,[1,8] Renae Kirkham[1]

[1]Menzies School of Health Research, Charles Darwin University, Casuarina, NT, Australia
[2]School of Medicine and Psychology, College of Science and Medicine, The Australian National University, Canberra, ACT, Australia
[3]Department of Paediatrics, Division of Women, Children and Youth, Royal Darwin Hospital, Casuarina, NT, Australia
[4]Diabetes Australia, Canberra, ACT, Australia
[5]Adolescent Health and Wellbeing Program, Telethon Kids Institute, Adelaide, SA, Australia
[6]Centre for Adolescent Health, Murdoch Children's Research Institute, Royal Children's Hospital, Parkville, VIC, Australia
[7]Department of Paediatrics, Alice Springs Hospital, Alice Springs, NT, Australia
[8]Department of Endocrinology, Division of Medicine, Royal Darwin and Palmerston Hospitals, NT, Australia

Submitted: 8 October 2024; Revision requested: 5 June 2025; Accepted: 8 July 2025

Abstract

Objective: Youth-onset type 2 diabetes is an emerging condition impacting Indigenous populations worldwide. Schools have an important role in supporting students to manage their health.

Methods: We undertook a qualitative study to (i) explore the lived experience of type 2 diabetes, diabetes management and support in school environments and (ii) co-design recommendations for age-appropriate, culturally safe school-based strategies and supports. Interviews and focus groups were undertaken with Aboriginal and Torres Strait Islander youth, caregivers, health professionals and school-based staff. Aboriginal and Torres Strait Islander youth were involved in determining the research topic.

Results: We found a need for school-based measures to address diabetes stigma, medication management, privacy and confidentiality, healthy eating and social and emotional wellbeing and identified further needs for staff training.

Conclusions: In many cases, schools are providing extensive support to students, but without adequate resources, supportive systems and policies or staff training, current approaches are insufficient.

Implications for public health: Recommendations include whole-of-school responses to address diabetes stigma and to generate sensitive approaches to nutrition, school-based management plans for students with T2D and adoption of Aboriginal and Torres Strait Islander-driven approaches.

Key words: youth, schools, type 2 diabetes, stigma, Aboriginal and Torres Strait Islander peoples, co-design

Introduction

Youth-onset type 2 diabetes (T2D), defined as diabetes diagnosed before the age of 25, is an emerging issue impacting young people's wellbeing and development. While type 1 diabetes (T1D) has long been recognised as a condition affecting school-aged youth,[1] the prevalence of youth-onset T2D is increasing rapidly worldwide, particularly in Indigenous populations.[2] Compared to T1D, less is known about school-based needs for youth with T2D and models of care for youth-onset T2D remain under-developed.[3]We respectfully refer to Indigenous people in Australia as Aboriginal and Torres Strait Islander people and reserve the term Indigenous to refer to international populations.

*Correspondence to: Stefanie Puszka, The Australian National University Canberra ACT 2600 Australia;
e-mail: Stefanie.Puszka@anu.edu.au.

Aust NZ J Public Health. 2025; Online; https://doi.org/10.1016/j.anzjph.2025.100265

Like T1D, T2D may impact on educational outcomes, long-term health and quality of life.[4,5] In some situations, hypoglycaemia or hyperglycaemia can be life threatening, requiring an immediate response.[4,5] Youth-onset T2D is also associated with increased and earlier complications, such as renal disease, dyslipidaemia, hepatic dysfunction and visual impairment[6] compared to later-onset T2D. Achieving optimal glycaemia is therefore imperative. T2D is also interconnected with psychological distress and depression.[7,8] Comorbid mental health conditions can impact on diabetes management[9–11] and can be exacerbated by sub-optimal glycaemia. It is therefore critical to address T2D management and social support needs of youth through multi-faceted approaches, including within-school settings.

Growing rates of T2D among Aboriginal and Torres Strait Islander youth necessitate specific culturally safe, age-appropriate responses. The prevalence of T2D among Aboriginal and Torres Strait Islander youth across Northern Australia (comprising the regions of the Top End, Central Australia, the Kimberley and Far North Queensland) is the highest reported in any population of youth internationally over the last 25 years.[12] While Aboriginal and Torres Strait Islander youth may draw strength from extended kinship networks, family caregiving and positive cultural identities, social stressors and inequities can impact on management.[13,14] Many health services poorly engage youth with T2D, yet youth have described a need for more assistance with diabetes management and social support.[13,14] We have illustrated in our previous research a need for holistic approaches to care, including in non-clinical environments familiar to young people, such as schools.[13] School support systems have previously been developed in Australia for T1D, funded by the Australian Government.[15] There is a need to develop school support systems for T2D.

This study is nested within the Diabetes Across the Lifecourse: Northern Australian Partnership, a collaboration between research institutes, health services, policymakers and communities. Specifically, this study sits within a larger project co-designing enhanced models of care for youth-onset T2D in Aboriginal and Torres Strait Islander communities across Northern Australia. Investigators comprise Aboriginal and Torres Strait Islander and non-Indigenous researchers, health professionals and health service managers. The project is funded by the Australian Government Department of Health. This work was preceded by a formative study of youth T2D experiences in the NT(13) and has sustained employment of Aboriginal and Torres Strait Islander young people as peer researchers. Here, we report on a sub-study that aimed to (i) explore the lived experience of T2D and T2D management and support in school environments among Aboriginal and Torres Strait Islander youth, their caregivers, health professionals and school staff and (ii) co-design recommendations for culturally safe school-based strategies and supports.

Methods

This study was informed by principles of co-design, centring sustained partnerships and valuing lived experience in processes of co-creation.[16,17] We undertook five non-linear phases of co-design, comprising engagement and relationship-building; collecting information and identifying issues; reaching consensus over approaches to develop; design work and implementation. This involved convening co-design groups across the study sites comprising Aboriginal and Torres Strait Islander youth, including participants diagnosed with T2D, and separate health professional working groups comprising clinicians involved in the management of youth T2D. Our co-design process is further described elsewhere.[18]

Initially, interviews and focus groups with youth, caregivers and health professionals across all sites, as well as co-design group workshops, explored experiences of managing youth T2D. Through this process, a need for systemic approaches and increased support for T2D management in schools emerged. Initial findings from analysis of this data were presented to co-design groups comprised of Aboriginal and Torres Strait Islander youth with T2D. One of the Top End co-design groups of youth subsequently reached a consensus to prioritise this issue. Participants' support needs at school were further discussed in focus groups. Additional interviews were also undertaken with school staff in the Top End and Central Australia to explore T2D management within schools. Initial data analysis informed draft recommendations compiled by the research team, subsequently reviewed by the co-design group, other youth participants, Health Professional Working Groups convened by the project in each region and other stakeholders. Two peer researchers (Aboriginal or Torres Strait Islander youth with lived experience of T2D) were engaged as employed members of the research team.

Participant recruitment

Across study sites, participants included Aboriginal and Torres Strait Islander youth aged 10–25 years diagnosed with T2D, the family caregivers of youth participants, health professionals providing care to Aboriginal and Torres Strait Islander youth with T2D and school staff involved in supporting Aboriginal and Torres Strait Islander students with T2D. This latter group included school nurses, teachers, support staff, boarding staff and staff of external organisations. The co-design groups comprised Aboriginal and Torres Strait Islander youth diagnosed with T2D. The contributions of youth and their caregivers were recognised through a $25 gift voucher provided for a session less than one hour duration and $50 for over an hour.

Recruitment of youth and their caregivers occurred via referral by participating health services and through the networks of the research team. Health professionals and school staff were recruited through health services participating in the wider project, direct approaches and existing networks.

Data collection

Interviews and focus groups were undertaken with 15 Aboriginal and Torres Strait Islander youth, 5 caregivers, 50 health professionals and 9 school staff members. For youth and caregivers, these occurred at locations nominated by participants. Health professionals and school staff were interviewed at their places of employment. Initial interviews with youth were generally unstructured, while those with other participant cohorts were semi-structured. Interview duration ranged 20 to 120 minutes.

The Top End co-design group involved in developing responses to T2D in schools comprised four youth, all of whom participated in five workshops, of approximately four hours each. Workshops encompassed focus group discussions using yarning techniques and art-based methods such as drawing and photoyarn, methods designed to reflect Aboriginal and Torres Strait Islander norms and

traditions.[19,20] Discussions were audio-recorded. The co-design group was facilitated by two non-Indigenous project staff (see Appendix 1). Additionally, health professional working groups, each comprising approximately 10 health professionals, were facilitated by Aboriginal and Torres Strait Islander and non-Indigenous project staff, including clinician-researchers. Working group data were recorded in meeting minutes and documents. All focus group discussions were audio-recorded and transcribed verbatim. Participants retain ownership of data, which is managed by Menzies School of Health Research.

Analysis

Rapid summative analyses of co-design workshop data (comprising transcripts of focus group discussion and narratives of art-based data) were undertaken after each workshop. Emerging findings were presented at subsequent workshops for review and further interpretation by participants. Emerging findings also informed the development of recommendations. In-depth thematic analysis of workshop data occurred following the conclusion of the co-design process to identify key themes in youth's experiences of school policies, practices and supports regarding T2D. To weight the analysis towards the perspectives of youth, these transcripts were initially reviewed using an inductive approach by SP to identify codes representing patterns of T2D experience in schools, which were subsequently organised into key themes.[21] Syntheses of each theme were compiled and reviewed by other authors. These initial themes were used in a subsequent deductive approach to guide analysis of interview and focus group data from caregivers, health professionals, school staff and other youth not involved in the workshops. This data was subsequently synthesised with the workshop data using a meta-synthesis approach.[22] We maintained analytic rigour through member checks of emergent themes and the involvement of multiple research team members in eliciting key themes.

Results

Summaries of narratives from the Top End co-design group were compiled to accompany creative outputs from art-based methods (see Supplementary material) and synthesised with interview and focus-group data. Findings related to stigmatisation and misinformation; experiences of taking medications; experiences of food policies and practices; interactions between social and emotional wellbeing and diabetes management; and approaches to diabetes management by school staff and community workers (Table 1). Subsequent synthesis of data from participants across all regions led to an additional theme of T2D knowledge and skills among school staff.

Stigmatisation

Youth with T2D described experiences of diabetes-related social stigma in schools, reporting feelings of being "embarrassed", "shamed" and "disrespected" when other students discovered their diagnosis. In several cases, this led to judgement and heightened surveillance of their food intake by peers, school staff and community workers.

Participants discussed concealing their diagnosis from friends due to fears of judgement and ostracisation. While caregivers and health professionals also identified stigma as an issue, some school staff members were unaware of students with T2D experiencing exclusion or judgement.

Youth suggested that exposure to lived experience of T2D could help staff and other students gain more understanding of their conditions, potentially occurring via guest speakers, workshops, videos and posters in schools, and by embedding T2D content in school curricula. Several health professionals also advocated for the inclusion of T2D content in curricula, in addition to formal training for school staff about diabetes to improve support and reduce stigma.

Experiences of taking medications

Medication procedures adopted by some schools led to breaches of students' privacy and confidentiality. Several youth described being reminded by teachers in front of peers to take medications, and some described having medications labelled with their names stored in shared refrigerators or being required to inject insulin in student bathrooms. Furthermore, medication support arrangements often did not address excursions and camps, and several participants described breaches of privacy and confidentiality during these activities. School staff noted that administering medications and ensuring blood glucose monitoring was performed were challenging and highly resource-intensive tasks.

Youth participants articulated a need for increased support and appropriate, private facilities to take and store medications. Effective measures used at some schools included reminder strategies, confidential storage facilities and private spaces for taking insulin and other medicines. Training and support of key school staff is also important, as well as clear and regular communication with health services, including written plans.

Experiences of food policies and practices

Youth participants described school strategies to address their nutritional needs as limited to reminders about restricting carbohydrate- or sugar-dense foods and meal portion sizes, often in front of peers. Youth participants described experiencing feelings of guilt, frustration and ostracisation as a result of these prompts, sometimes leading them to rebel against advice and skip meals.

School staff reported adopting general health guidelines to regulate catering. Although some schools undertook annual menu reviews by dieticians, staff identified a need for further improvement in the nutritional quality of food served. Some school staff commented that catering at their school did not reflect the foods and eating practices of many Aboriginal and Torres Strait Islander cultures or other culturally and linguistically diverse students.

One caregiver saw policies allowing products such as large-sized juices to be sold at school canteens as an impediment to young people's diabetes management. However, most school staff raised reservations regarding imposing food restrictions on young people with diabetes compared to other students. The strategies of school staff generally foregrounded the education of students about food choices, focussing on restrictions and portion sizes.

Youth recommended that support from school staff around nutrition be provided in sensitive ways that expanded their existing knowledge and preserved autonomy over food choices. Youth described a need for practical information on cooking healthy meals and strategies for avoiding stress-eating.

Table 1: Identified themes, needs and solutions regarding T2D management in schools.

Theme	Identified needs	Identified solutions	Illustrative evidence
Stigmatisation	Addressing stigma when diagnosis revealed to peers and staff	Confidentiality measures, exposure to lived experience of T2D, embedding T2D content in school curricula	*I did not want them to know about me being diabetic because I did not want to be judged* (youth participant).
Experiences of taking medications	Lack of confidentiality in medication processes Resource-intensive processes	Private storage facilities and locations to take medications Arrangements for excursions and camps Training of school staff	*And my teacher she wasn't being mindful I guess…She was like, "remember don't forget your diabetes medication". "Thanks, thanks." Embarrassing, and everybody was like they broke their neck like looking at me and they were, "Diabetes medication. Diabetes, you have diabetes?" "Yep I have diabetes". And honest I couldn't look at anybody that night* (youth participant).
Experiences of food policies and practices	Insensitive, public reminders about food Focus on food restriction	School-wide reduction in access to sugar-sweetened beverages School-wide promotion of healthy nutrition Dietitian review of catering to ensure consistent with guidelines Reconsider use of food as reward	*I didn't belong because of how they were telling us what to eat and that we needed to slow down eating* (youth participant). *you can't say you can't buy that… when other kids can* (school staff participant).
Interactions between wellbeing and diabetes management	Distress at diagnosis and in conversations about T2D complications Experiences of trauma and loss Distress impacting on diabetes management	School management plans for T2D encompassing mental health support Sensitive approach to conversations about T2D complications	*I think we all have our highs and lows when it comes to diabetes. Like, whether they be… a high when you're feeling really good taking our meds and all that, but also if we're feeling low, that's when we spiral out of control with our sugars. Like, the food that we eat, to not taking the medications and wanting to be lazy, you know* (youth participant).
School approaches to diabetes management	Tension between fulfilling school responsibilities and building capacity of students to take on a greater role. Youth perceptions of surveillance	Formal collaborations between schools and health services to increase support to schools and allow opportunity for healthcare in non-clinic settings Sensitive, empathetic and collaborative approaches by school staff to supporting students	*if you die under my watch, it'll be my fault* (youth participant recalling comment from teacher). *I think we go above and beyond... but we have a duty of care* (school staff participant). *let them know that if you don't look after yourself, you're going to end up having dialysis* (school staff participant).
T2D knowledge and skills among school staff	Misinformation and confusion	Structured and standardised training and support of school staff for T2D	*staff judging the students on their behaviours without understanding the primary cause* (school staff participant).

T2D = type 2 diabetes.

Many health professionals highlighted the need for school-wide nutrition policies, such as reducing access to sugar-sweetened beverages, rather than targeted measures for youth with diabetes. Other suggested strategies included reconsidering the use of food as a reward and reviews of school catering to ensure consistency with recommended nutritional guidelines.

Interactions between social and emotional wellbeing and diabetes management

Many youth described the experience of initial diagnosis as highly distressing, with some initially believing that their condition was fatal. Some described the diagnosis as leading them to feel "sad", "down", or "depressed". Other life events, both interconnected and separate from T2D, could also result in feelings of distress, including family histories of T2D and social vulnerability. All members of the youth co-design group had experienced the death of a parent due to diabetes-related complications, and some were also caregivers to family members with diabetes-related complications. Distressing events and fluctuating mental health could cause the capacity of youth to manage T2D to fluctuate over time.

In contrast, one school staff member described reinforcing the risk of diabetes complications to youth as an approach to improving students' diabetes management. Health professionals and other school staff, however, described challenges in communicating these risks to students without inducing distress or exacerbating shame.

Youth, families, health professionals and school staff all articulated a need for school-based approaches to diabetes management that encompass students' mental health. The development of holistic and flexible T2D management plans in collaboration with students was described by youth as one mechanism to begin to address these support needs. All school staff reported that students had access to counsellors and psychologists on site or via referral; however, few reported strategies to address the specific social and emotional wellbeing of students with T2D. Clear communication between health services and school staff may allow for early identification of mental health concerns and may enhance the capacity of staff to support the mental health of students.

Approaches to diabetes management adopted by school staff and community workers

Youth described varying approaches to T2D management among school staff. One recalled a teacher commenting that medication reminders were "not my responsibility". Others described experiencing support from teachers as intense surveillance that heightened their own distress. School staff described a tension between fulfilling their responsibilities for medication management and building the capacity of students to take on a greater role in their diabetes management. Some staff members articulated a need for "open doors and consistency" and a "delicate" approach to conversations about difficulties with diabetes self-management.

Some youth recounted examples of positive relationships with school staff who expressed empathy, addressed emotional distress and provided practical support such as advice on what to do when they had missed medications. Youth and school-based staff emphasised the importance of collaborative approaches to T2D management grounded in respectful, trusting relationships.

Type 2 diabetes knowledge and skills among school staff

Most schools had internal procedures for sharing information and determining responsibilities for students' T2D management. However, a need to build the knowledge and skills of staff in providing appropriate T2D care and education to students was identified, particularly as medication administration was often the responsibility of non-clinical school staff, not school nurses. Some staff reported instances of misinformation and confusion within school communities further contributing to stigmatisation and judgement of students with T2D. This included limited understanding of hypoglycaemia management and the social and intergenerational determinants of youth T2D. Concerningly, staff-reported capacity and resource issues led some schools to consider refusing enrolment to young people with T2D diagnoses.

All participant groups highlighted a need for staff training.

Discussion

The World Health Organization and United Nations Health-Promoting Schools Framework[23] describes six key characteristics of health-promoting schools: healthy school policies, healthy physical school environments, healthy school social environments, health skills and education, links with parents and the school community and access to school health services. While youth T2D is an emerging condition across Aboriginal and Torres Strait Islander communities in Northern Australia and systems to support schools in fulfilling their duty of care to students are still being developed, we have illustrated a need for school-wide responses that attend to all of these domains. In particular, school-based responses to youth T2D that address social environments, policies, health skills and community linkages need further development. While some of these needs could be addressed by expanding school-based interventions developed for T1D, such as management plans for students with diabetes and training for school staff, youth participating in our research described additional support needs and demonstrated how current school policies and practices were not supporting them in ways that are not addressed by these measures. These differences may potentially reflect the social stigma of T2D and intersectional experiences of Aboriginal and Torres Strait Islander status and diabetes. The new knowledge of young peoples' experiences of T2D in schools generated by our study elicits a deeper understanding of these needs and how they may be addressed (Table 2).

To complement school-wide measures, the specific care needs of individual students with T2D require the development of personalised management plans by health services in collaboration with schools. This is currently the recommended practice for students with T1D in Australia and internationally[3,4,15,29] and should be extended to students with T2D. These plans should specify roles, responsibilities and emergency measures and should be developed and implemented through collaborative approaches that gradually build students' capacity (see Table 2, Recommendations 4 and 6). It is also important to prevent misinformation and enhance youth-T2D–specific knowledge among school staff. Management plans should integrate social and emotional wellbeing support and include measures to maintain young people's privacy and confidentiality.

Our research suggests that diabetes stigma is a common experience among youth and illustrates a need to foster healthy social environments in schools around T2D. Diabetes stigma has the potential to compound other stressors and mental health conditions and negatively impact diabetes management. This is consistent with our formative work regarding the lived experience of Aboriginal and Torres Strait Islander youth with T2D[13,14] and with studies of T2D among young people internationally.[24,25] While some school staff members have developed sensitive approaches to supporting students' diabetes management, many students feel marginalised at school through perceived judgemental language and privacy breaches, particularly through discussions regarding medications and food in front of their peers.

Some youth used the Aboriginal English term "shame" to describe these experiences, which does not entirely correspond with the standard English usage of feeling "ashamed". In Aboriginal English, being "shamed" may not necessarily refer to personal wrongdoing, and can denote feelings of extreme unease, particularly in situations and settings characterised by social norms of the dominant population, such as formal meetings in workplaces.[26,27] Experiences of diabetes stigma in schools may thus intersect with some Aboriginal and Torres Strait Islander young people's experiences of structural marginalisation and racial discrimination, potentially magnifying distress. The presence of diabetes stigma illustrates a need to address intersectional experiences of diabetes and discrimination, and misconceptions of diabetes in school environments through education for students and school staff. This includes, at a local level, developing and using culturally safe, non-stigmatising language to talk about diabetes. These dynamics also suggest a need for trauma-informed approaches that recognise that talking about diabetes and aspects of diabetes management may be triggering for youth, particularly where there is a family history of diabetes-related complications (see Table 2, Recommendations 1, 2, 6 and 7).

There is a need to develop nutritional approaches within schools that attend to the social environments in which food is consumed. We have illustrated the importance of considering students' food security and the availability of healthy foods while remaining sensitive to food-related stigma and culturally informed food choices and eating practices. Current Australian nutritional guidelines for schools already provide a holistic, whole-of-school approach to healthy nutrition and recommend reducing access to sugar-sweetened beverages.[28] However, many schools impose few restrictions on foods that increase the risk of T2D and high blood glucose levels, instead requiring students with T2D to adopt different diets to their peers and to have their food choices regulated by school staff in public. These were largely reported by school staff to be ineffective and described by youth as stigmatising. Evidence suggests that health interventions based on weight can have adverse physiological and mental health impacts on youth, contributing to a "shadow epidemic" of weight stigma associated with poor body image, depression, low self-esteem, low physical activity, disordered eating, avoidance of healthcare and bullying in schools.[24] There is a need for support for schools to implement the Australian Government's nutritional guidelines in order to enable a whole-of-school approach. Sensitive approaches and confidentiality are also critical to conversations with individual students regarding their food choices (see Table 2, Recommendations1, 3 and 6).

Many school-based staff members report inadequate knowledge, skills or resources to support students' T2D management. Training

Table 2: Co-designed recommendations.

Recommendation	Actions and approaches
1. Aboriginal and Torres Strait Islander leadership	• Aboriginal and Torres Strait Islander people and organisations' leadership of implementation, evaluation and refinement of strategies and supports, grounding of responses in Aboriginal and Torres Strait Islander worldviews, social determinants of health, and decision-making structures
2. T2D stigma	• Student workshops with clinical experts, school counsellors, psychologists, Aboriginal Health Practitioners, Aboriginal Health workers and young people living with T2D to share evidence-based information and lived experiences of T2D • Workshops framed around healthy living rather than T2D • T2D education incorporated into health and wellbeing curricula alongside T1D • Educational resources we have developed could be drawn on[30]
3. Nutritional guidelines	• Support for schools in both public and private sectors from education departments to implement the Australian Government's guidelines for school canteens and adapt guidelines to culturally diverse cuisines
4. School support plans for students with T2D	• Conversations about T2D, food, medications and support plans conducted confidentially by school-based staff • Support plans developed through discussion and recognition of how students are already managing their own health, their existing knowledge of T2D, and the specific support students need and want • Development of shared goals around T2D management • Parents/family caregivers, teachers, school counsellors, nurses, Aboriginal Liaison Officers, administrative staff, support program staff and others involved as needed. Roles and responsibilities specified. Ideally, staff members with the primary responsibility for overseeing students' T2D support plans have the same gender identity as the student • Flexibility for greater support from school-based staff when needed • Procedures to respond to hypoglycaemia/hyperglycaemia • Measures to continue to protect privacy and confidentiality in different situations such as during school camps and excursions • Consider local adaptation of the T2D action and management plan template recently developed for use within Victoria[31]
5. Integration of primary health services	• Formal partnerships between schools and local primary health services for managing T2D, particularly Aboriginal Community controlled Health Services where present • Systems for information-sharing between school nurses, local primary health services and local/visiting specialist services developed by health and education departments for schools in both public and private sectors • Health services consider outreach services in schools
6. T2D Staff knowledge and skill	• Funding provided to develop, implement and evaluate a training package to build the capacity of schools to fulfil their duty of care to students with T2D. This could potentially be integrated with existing T1D training for school staff • Training in general support and guidance, and specific training for relevant staff in developing and implementing young people's support plans in collaboration with youth and health services; trauma-informed conversations about T2D; implementing nutrition guidelines; sensitive conversations about food and eating; supporting young people's social and emotional wellbeing and culturally safe T2D practice and language
7. Safe spaces for medications and glucose monitoring	• Private, secure areas provided by schools for students to store and take medications and measure blood glucose levels without being observed by peers • Students with T2D given the option of having a responsible friend or classmate accompany them when taking medications to feel less isolated

T1D = type 1 diabetes; T2D = type 2 diabetes.

should include management of emergency situations (e.g. hypoglycaemia), school management plans, medications, nutrition and safe management of physical activity using culturally safe approaches. Training is needed for all school staff to enhance their understanding of youth T2D and to address misinformation. Higher-level training is also required for staff who will interact with the young person, including emergency treatments and medication administration. Training in T2D management could potentially be integrated into existing Australian-wide training modules and structures available for schools supporting students with T1D (see Table 2, Recommendation 6).

While some schools involved in our research have already developed informal relationships with local health services to embed management plans and staff skills in school systems, there is also a need for formal partnerships between health services and schools. As many young people have limited engagement with health services beyond their school experiences, school environments provide an opportunity for integrated health care and early diagnosis in a trusted space. In particular, schools should develop partnerships with local Aboriginal Community-Controlled Health Services where present. We also acknowledge the need for national and state partnerships between Aboriginal and Torres Strait Islander representative bodies and governments, recognising that government is a key player in addressing youth T2D (see Table 2, Recommendations 1 and 4–7).

Strengths and limitations

Our co-design approach facilitated deep and sustained engagement with Aboriginal and Torres Strait Islander youth living with T2D, family caregivers, health professionals and school staff. Youth participants had overwhelmingly positive feedback about the co-design process, commenting on their appreciation for the opportunity to share experiences with others with a diagnosis. This process enabled Aboriginal and Torres Strait Islander youth with T2D, who may experience social marginalisation,[13,14] to be involved in determining the priorities and objectives of the project and facilitated triangulation of multiple data sources and the development of robust, practical recommendations for action.

The facilitation of the co-design group by non-Indigenous team members is a limitation of the study. However, both team members have previous experience working with Indigenous people, are aware of local protocols of behaviour and express their respect for Aboriginal and Torres Strait Islander sovereignty; one of them has been collaborating with Aboriginal and Torres Strait Islander people in the Northern Territory for over 16 years. While the research team strove to develop a safe and welcoming environment, it is possible that the positionality of facilitators could have impacted responses.

All school staff members participating in the study were engaged at boarding schools, which have a greater duty of care to students than other schools; however, the perspectives of school staff were

triangulated with the experiences of youth involved in the project, none of whom attended boarding schools, in addition to those of other participants. We strongly encourage schools and other stakeholders to adapt our recommendations to guide the development of local place-based responses.

Conclusions and implications for public health

Adolescence and school environments provide critical intervention points in developing and implementing comprehensive, culturally safe approaches to T2D management in order to minimise the risk of diabetes complications and improve wellbeing. In many cases, schools are already providing extensive assistance to students with T2D but without adequate resources, supportive systems and policies or staff training. We have illustrated a need for school-wide measures that address diabetes stigma and nutrition, as well as targeted support for the clinical management of T2D at school. The involvement of Aboriginal and Torres Strait Islander youth in determining the research topic illustrates that school-based strategies and supports are a priority for young people. It also shows the capacity for youth to participate in the development of interventions. We recommend the ongoing involvement of Aboriginal and Torres Strait Islander youth, organisations and communities through collaborative methods in the implementation and evaluation of school-based measures going forward.

Conflicts of interest

The authors have no conflicts of interest to declare.

Funding

This work was supported by the Australian Government Department of Health (Activity ID 4-BRAG719). LMB was supported by an NHMRC Investigator Grant (#1194698). The funders had no role in developing the study design; in the collection, analysis and interpretation of data; in the writing of the manuscript and in the decision to submit the manuscript for publication.

Ethics

The project was approved by the Northern Territory Human Research Ethics Committee (#2020 – 3764), Western Australian Aboriginal Health Ethics Committee (#HREC 1093), Western Australian Country Health Service Human Research Ethics Committee (#RGS-5821) and Far North Queensland Human Research Ethics Committee (#HREC/2021/QCH/70454). All participants provided written informed consent, and consent was also obtained from caregivers/guardians for youth under the legal age of consent.

Author contributions

SP contributed to conceptualisation, data curation, methodology development, project administration and analysis; was involved in the co-design process and wrote the manuscript. EW and NF were involved in conceptualisation, data curation, methodology development, project administration, analysis and manuscript editing. MC contributed to data curation, methodology development, project administration, analysis and manuscript editing and was involved in the co-design process. AT contributed to analysis and manuscript editing. JM and PT are Aboriginal and Torres Strait Islander young people employed as peer researchers who provided their lived experiences perspectives within the research team, contributed to interpretation and analysis of data and were involved in the co-design process. DM and PA assisted with manuscript editing. LMB and RK co-led the funding acquisition, conceptualisation, and project implementation and contributed to analysis, methodology development and manuscript editing.

Acknowledgements

We express our gratitude to all of the participants in our research for their contributions to this study. We acknowledge and thank the Diabetes Across the Lifecourse: Northern Australian Partnership's Aboriginal and Torres Strait Islander Advisory Group and the following investigators who contributed to the conceptual and methodological development of the broader models of care project: Vicki O'Donnell, John Boffa, Elna Ellis, Sian Graham, Lydia Scott, Ashim K Sinha, Christine Connors, Jonathan Shaw, Elizabeth Davis and Brandy Wicklow. We would also like to thank the following project staff for their contributions to stakeholder engagement, participant recruitment and data collection: Kim Martin and Anthony Gunther.

Author ORCIDs

Stefanie Puszka https://orcid.org/0000-0002-5008-8122
Marylin Carino https://orcid.org/0000-0001-8122-2075
James Dowler https://orcid.org/0000-0003-2320-1473

References

1. Wilson V. Managing type 1 diabetes in children and young people: challenges and solutions. *Nurs Child Young People* 2023;**35**(5):35–42.
2. Perng W, Conway R, Mayer-Davis E, Dabelea D. Youth-onset type 2 diabetes: the epidemiology of an awakening epidemic. *Diabetes Care* 2023;**46**(3):490–9.
3. Smith L, Terry A, Bollepalli S, Rechenberg K. School-based management of pediatric type 1 diabetes: recommendations, advances, and gaps in knowledge. *Curr Diabetes Rep* 2019;**19**(37).
4. Lawrence S, Cummings E, Pacaud D, Lynk A, Metzger D. Managing type 1 diabetes in school: recommendations for policy and practice. *Paediatr Child Health* 2015;**20**(2):35–9.
5. Geijselaers SLC, Sep SJS, Claessens D, Schram MT, van Boxtel MPJ, Henry RMA, et al. The role of hyperglycemia, insulin resistance, and blood pressure in diabetes-associated differences in cognitive performance—the maastricht. *Stud Diabet Care* 2017;**40**(11):1537–47.
6. TODAY Study Group, Drews KL, Caprio S, Gubitosi-Klug R, Nathan DM, Tesfaldet B, et al. Long-term complications in youth-onset type 2 diabetes. *N Engl J Med* 2021;**385**(5):416–26.
7. Ke C, Lau E, Shah BR, Stukel TR, Ma RC, So W, et al. Excess burden of mental illness and hospitalization in young-onset type 2 diabetes: a population-based cohort study. *Ann Intern Med* 2019;**180**(3):145–54.
8. Sellers EAC, McLeod L, Prior HJ, Dragan R, Wicklow BA, Ruth C. Mental health comorbidity is common in children with type 2 diabetes. *Pediatr Diabetes* 2022;**23**(7):991–8.
9. Gonzalez JS, Peyrot M, McCarl LA, Collins EM, Serpa L, Mimiaga MJ, et al. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care* 2008;**31**(12):2398–403.
10. Schmitz N, Gariepy G, Smith KJ, Clyde M, Malla A, Boyer R, et al. Recurrent subthreshold depression in type 2 diabetes: an important risk factor for poor health outcomes. *Diabetes Care* 2014;**37**(4):970–8.
11. Renn BN, Feliciano L, Segal DL. The bidirectional relationship of depression and diabetes: a systematic review. *Clin Psychol Rev* 2011;**31**(8):1239–46.
12. Titmuss A, Davis LA, O'Donnell V, Wenitong M, Maple-Brown LJ, Haynes A, et al. Youth-onset type 2 diabetes among First Nations young people in northern Australia: a retrospective, cross-sectional study. *Lancet Diabetes Endocrinol* 2022;**10**(1):11–3.
13. Weaver E, Freeman N, Mack S, Titmuss A, Dowler J, Corpus S, et al. "I don't really know what diabetes is": a qualitative study exploring the experiences of aboriginal and Torres Strait Islander young people aged 10 to 25 Years living with type 2 diabetes in northern and Central Australia. *Can J Diabetes* 2022;**46**(7):722–9.
14. Carman R, Towell-Barnard A, Shah M, Davis E, Maple-Brown L, Pearson G, et al. "Sometimes our mob don't really take it serious until it's serious": the

experiences of western Australian aboriginal adolescents living with type 2 diabetes, their parents, and their family members. *Can J Diabetes* 2023;**47**(5):420–7.
15. National Diabetes Services Scheme. *Diabetes in schools brisbane: diabetes Australia*. 2023 [Available from: https://www.diabetesinschools.com.au.
16. Goodyear-Smith F, Jackson C, Greenhalgh T. Co-design and implementation research: challenges and solutions for ethics committees. *BMC Med Ethics* 2015;**16**(78).
17. Palmer VJ, Weavell W, Callander R, Piper D, Richard L, Maher L, et al. The Participatory Zeitgeist: an explanatory theoretical model of change in an era of coproduction and codesign in healthcare improvement. *Med Humanit* 2019;**45**:247–57.
18. Kirkham R, Puszka S, Titmuss A, Freeman N, Weaver E, Mack S, et al. Codesigning enhanced models of care for Northern Australian Aboriginal and Torres Strait Islander youth with type 2 diabetes: study protocol. *BMJ Open* 2024;**14**(e080328).
19. Bessarab D, Ng'andu B. Yarning about yarning as a legitimate method in indigenous research. *Int J Crit Indig Stud* 2010;**3**(1):37–50.
20. Rogers J. Photoyarn: Aboriginal and Maori girls' researching contemporary boarding school experiences. *Aust Aborig Stud* 2017;**2017**(1):3–13.
21. Braun V, Clark V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;**3**(2):77–101.
22. Noblit G, Hare D. *Meta-ethnography: synthesizing qualitative studies*. Newbury Park: Sage Publications; 1988.
23. WHO, UNESCO. *Making every school a health-promoting school: global standards and indicators*. 2021. Geneva.
24. Cameron E, O'Reilly C. Type 2 diabetes in youth. *Biochem Cell Biol* 2015;**93**:430–7.
25. Wicklow B, Dart A, McKee J, Griffiths A, Malik S, Quoquat S, et al. Experiences of First Nations adolescents living with type 2 diabetes: a focus group study. *Can Med Assoc J* 2021;**193**(12):e403–9.
26. Kwok N. Shame and the embodiment of boundaries. *Oceania* 2012;**82**(1):28–44.
27. Harkins J. Linguistic and cultural differences in concepts of shame. In: Parker D, Dalziell R, Wright I, editors. *Shame and the modern self*. Melbourne: Australian Scholarly Publishing; 1996. p. 84–96.
28. Australian Government. *National healthy school canteens resource collection*. Canberra: Australian Government; 2023 [Available from: https://www.health.gov.au/resources/collections/national-healthy-school-canteens-resource-collection.
29. Kise S, Hopkins A, Burke S. Improving school experiences for adolescents with type 1 diabetes. *J Sch Health* 2017;**87**(5):363–75.
30. Diabetes Across the Lifecourse: Northern Australian Partnership. *Youth diabetes: youth resources Darwin*. Menzies School of Health Research; 2023 [Available from: https://diabeteslifecourse.org.au/youth-diabetes/youth-diabetes-youth-resources/.
31. Diabetes Victoria. *Diabetes action and management plans: diabetes victoria*. 2023 [Available from: https://www.diabetesvic.org.au/how-we-help-detail?tags=Left-Mega-Nav%2FSchools&content_id=a1R0o00000JvVy8EAF&ocmsLang=ar.

Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anzjph.2025.100265.