How do healthcare providers support people with prediabetes to eat well?

An in-depth, mixed-methods case study of provider practices

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Background and objective
Guidelines recommend people with prediabetes receive diet and lifestyle support to avoid type 2 diabetes, yet it is unclear whether this care is provided in practice. The aim of this article is to explore the perspectives and nutrition care practices of healthcare providers (HCPs) for patients with prediabetes.

Methods
This was a mixed-methods case study of an urban practice comprising a retrospective chart review and semi-structured interviews. Charts of adult patients with prediabetes were reviewed and informed a protocol used to interview HCPs. Interviews were thematically analysed.

Results
Charts of 47 patients, representing 1096 consultations, were reviewed. The majority (74.5%) of patients had 'diet' noted in their chart, yet this accounted for only 8.1% of consultations. Only 19.1% of patients were referred to a dietitian. Interviews provided HCP explanations of the quantitative findings.

Discussion
HCPs value nutrition care, yet are limited by the healthcare system to provide comprehensive care to people with prediabetes.

PREDIABETES is becoming an internationally recognised term to categorise people at high risk of type 2 diabetes (T2D).[1] Also referred to as 'impaired fasting glucose' or 'impaired glucose tolerance', prediabetes presents a growing public health concern, with one in 13 people living with the condition worldwide.[2] Along with increased risk of developing T2D,[1,3] prediabetes increases the risk of kidney and cardiovascular disease.[4] The global financial burden of both T2D and prediabetes was estimated to be US$760 billion in 2019.[2] However, when individuals with prediabetes engage in healthy diet, exercise and weight loss behaviours, they greatly reduce the risk of developing T2D.[5] Individualised medical nutrition therapy has been shown to be effective in lowering glycated haemoglobin (HbA1c), fasting blood glucose and weight among people with prediabetes.[6,7] This evidence informed a recent position statement from national governing bodies in Australia, which supports proactive prediabetes management with diet and lifestyle interventions.[8]

Primary care is an ideal setting for providing professional nutrition care to people with prediabetes.[9] However, this review of international studies found lifestyle interventions are not always provided in primary care, despite patients and healthcare providers (HCPs) preferring this treatment approach.[10] Similarly, in the Australian Registrar Clinical Encounters in Training (ReCEnT) study, only 21% of individuals with prediabetes or T2D received a referral to a dietitian/nutritionist from general practice registrars.[11] In the 3D Study of a nationally representative sample of Australian adults with newly diagnosed T2D, fewer than half the participants reported being told they had prediabetes prior to a diagnosis of T2D.[12] There were few associations between patient characteristics and the likelihood of their prediabetes being identified, suggesting non-patient factors may be more predictive of prediabetes identification and management.[12]

A key non–patient related factor associated with prediabetes management may include how general practitioners (GPs) identify and manage prediabetes. When surveyed, GPs note the importance of nutrition in the chronic disease management of patients.[13,14] However, patients report receiving limited nutrition care for prediabetes,[12,15] making it unclear to what extent nutrition care is actually provided in practice. The views and attitudes of HCPs who provide this support must be considered when developing effective strategies. Therefore, the aim of this study was to explore, in depth, a sample of HCP perspectives and nutrition care practices for prediabetes.

Methods

Study design

This study was a mixed-methods case study with an explanatory sequential design to investigate prediabetes practices and practitioner views.[16] A case study involves an in-depth exploration of a particular phenomenon; in this study, a single practice involving a sample of patients and providers.[17] A retrospective chart review (RCR) and qualitative semi-structured interviews were conducted. Ethical clearance was obtained from the Griffith University Human Research Ethics Committee (2019/340). The Good Reporting of A Mixed Methods Study (GRAMMS) tool was used to guide the reporting of this mixed-methods study, while the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) and Standards for Reporting Qualitative Research (SRQR) tools were used to guide the reporting of the quantitative and qualitative study components, respectively.

Practice setting

The study took place between May 2019 and January 2020 in a large, urban general practice in Australia, servicing approximately 10,000 patients. The practice serves a socioeconomically disadvantaged area and has a relatively high proportion of people from refugee or migrant backgrounds.[18] T2D and prediabetes are highly prevalent in this population.[19] At the time of the study, the practice employed nine full-time equivalent GPs and five nurses (three of whom are registered), with co-located, private allied health service providers, including dietitians. The practice bulk bills (ie provides services at the same cost as the rebate provided by Medicare, so no cost is incurred to the patient) the majority of GP services, while allied health providers bulk bill where possible, based on the Medicare Benefits Schedule (MBS).

Retrospective chart review

Guidelines from Vassar and Holzmann informed the design and execution of the RCR. Decisions about the research involved input from all authors, including the lead GP, practice manager and primary care researcher, and three researchers with extensive nutrition research experience.[20] The practice required written informed consent from patients before their chart could be included in the RCR.

Inclusion criteria

Screening was conducted to identify eligible participants: 1) active patients (at least three visits in the past two years); 2) aged 18 years and older; and 3) with prediabetes (HbA1c 5.7–6.4%). Patients were excluded if they had a comorbid condition inhibiting their ability to provide informed consent, were unable to communicate in English or had previously been diagnosed with T2D (Appendix 1, available online only).

Screening for eligibility

A time frame of 2015 to current day (2019) was chosen because 2015 was the year HbA1c was included in the MBS as a funded method of diagnosing and screening for T2D,[21] and was recent enough to reflect current practice.
A screening protocol was developed by the academic researchers based on the inclusion criteria, with clinical guidance from two practice employees. The electronic medical record (EMR) system was accessed by a practice employee and author to systematically identify eligible patients from the potential pool of 9557 individuals. Ten randomly selected charts were pilot tested by extracting relevant data using a systematic approach to ensure accuracy of the screening method. The protocol was then used to identify a final list of eligible participants for recruitment.

Participant recruitment and consent

Recruitment occurred between June and October 2019. To preserve patient privacy, a staff member of the practice, who was familiar to patients, was trained to recruit participants. The staff telephoned eligible participants (n = 204), provided a verbal briefing of study requirements and sought consent to send a participant information and consent form (PICF) to them. A maximum of three approach attempts were made to eligible participants, after which a final list of participants who agreed to receive a PICF was given to the research team. PICFs were mailed to interested patients. If, by three weeks after mailing, signed consent was not returned, the lead researcher contacted the patient by telephone. A maximum of three telephone contact attempts were made before excluding the participant. Returned, signed PICFs were digitally stored by the research team on a password-protected server.

Data extraction

The charts of participants who provided written informed consent were accessed through the practice EMR system (Best Practice Software) by the lead researcher (MS) between October and December 2019. Participants were allocated a unique study identifier by MS, who was unfamiliar with participants. Identifying information was then deleted. A data abstraction form was developed based on a set of pre-identified data points. Data were manually extracted from the EMR system, entered into the electronic abstraction form and stored on a secure research server. Date of prediabetes detection and corresponding blood glucose value were identified to check eligibility and to determine the data extraction range. Textual data were extracted from charts by filtering for six months prior to six months after prediabetes detection date for consultations with an HCP. A consultation included any documented visit where an HCP was listed as the provider and visit notes were recorded.

Patient data extracted included age, weight, waist circumference and body mass index (BMI) at time of prediabetes detection, ethnicity, sex, smoking status and alcohol intake and medication usage. Demographic and anthropometric data not available within the time frame were recorded as missing. Extracted consultation data included date of visit, name and role of practitioner and any corresponding visit notes. Visit notes were filtered for words related to 'diet' and 'weight'. This included any mention of diet advice, nutrition, food intake, weight management, recorded weight in kilograms and diet or weight referral. Each diet and weight-related notation was documented and summarised for

each patient and presented as 'diet or weight recorded'. When a referral for diet support was declined by a patient, this was recorded as 'declined referral'. Patients with an active General Practitioner Management Plan (GPMP) at the time of prediabetes detection were identified, and the document was extracted and analysed.[22] Patients with no GPMP or with a GPMP date beyond one month of prediabetes detection were noted as 'no GPMP'. Following extraction, raw data were cleaned and checked for accuracy by a second researcher.

Data analysis

Participant demographic, anthropometric and visit note data were analysed using descriptive statistics. Mean and standard deviation were reported for continuous variables where the data were normally distributed, while median and interquartile range (IQR) were used to report non-normally distributed data. BMI and waist circumference were categorised based on risk level. Missing anthropometric data were recorded and noted in the analysis. Categorical variables were descriptively analysed and reported as number and percentage.

Interviews with practice-based HCPs

Interview protocol

A qualitative description approach guided the qualitative research component of this mixed-methods study.[23] This approach is commonly used in mixed-methods research, where the aim is to explore a phenomenon of interest that is informed by existing knowledge, focusing on a more detailed understanding of the phenomenon.[23] Qualitative description requires the researchers to remain close to the data during the analysis process and to describe the resulting themes in language used by participants.[23] Health services research often employs a qualitative description approach to inform intervention design. This methodology informed the development and application of a semi-structured interview protocol, with questions based on findings from the RCR (Appendix 2, available online only). This follows a sequential explanatory design, where quantitative data are further explained with qualitative data.[16] Interview questions were pilot tested with one GP from the practice who met inclusion criteria. Two authors with significant qualitative research experience provided feedback on the pilot test to ensure the protocol was effective in obtaining valuable responses. The final authenticated protocol was used for data collection.

Participants and recruitment

All nurses and GPs who provided care to patients at the practice were eligible to participate and were recruited through an in-person announcement and internal email request by the lead author. Interested practitioners responded directly to the invitation and were contacted to arrange an interview.

Qualitative data collection

Telephone interviews were conducted between November 2019 and January 2020 by the lead researcher, who is a dietitian with qualitative research experience. Participants received and read a PICF prior to the interview. Verbal consent was obtained at the start of the interview, which was audio-recorded. Field notes were taken during the interviews to provide further context to the analysis. Participant demographic data were collected at the end of each interview. All participants received a $20 gift voucher as compensation for their time.

Data analysis

Interviews were transcribed verbatim and analysed simultaneously with data collection. Due to a damaged audio file, one interview could not be transcribed verbatim, so field notes were used in the analysis. The six-step approach to content analysis, as described by Miles and colleagues, was used to identify common themes.[24] The research team met to discuss codes and themes as they were identified in the data until consensus was reached. Transcripts were returned with comments to the participants for review to enhance the trustworthiness of the data. Transcripts were manually coded independently by two researchers using descriptive analysis and categorised into themes and sub-themes.

Synthesis of quantitative and qualitative data

The RCR was conducted prior to interviews, and findings informed the interview protocol development. Qualitative findings provided further explanation of the quantitative results. After an in-depth review of all findings, a synthesis table was developed to report the RCR results and corresponding interview themes.

Results

Retrospective chart review

Seventy-eight of 204 eligible patients consented to have their chart reviewed (38.2% response rate). Of these, 31 were excluded due to a previous diagnosis of T2D, and 47 (n = 32 females) were included in the RCR. Participating patients' demographic and health characteristics are reported in Table 1. Six participants had no weight recorded, and 20 participants (42.5%) had no waist circumference measurement recorded at the time of prediabetes detection.

The 47 participants had a total of 1096 documented consultations with 36 different HCPs at the practice over the 12-month study period, with a median (IQR) of 22 (12–31) consultations per participant. Extracted consultation data are summarised in Table 2. The majority of consultations where diet was recorded were conducted by a GP (74.2%), followed by a dietitian (13.48%) and nurse (12.4%). The majority of weight consultations were conducted by a GP (52.7%), followed by a nurse (42.7%), exercise physiologist (2.7%) and dietitian (2.0%). A referral to a dietitian was noted for only nine participants (19.2%) in 14 consultations (1.3%). In two (14.3%) of these consultations, the referral was declined by the patient. Of the 47 participants, 29 (61.7%) had an active GPMP, in addition to usual consultation notes, at the time of prediabetes detection. 'Diet' was recorded in all 29 GPMPs, 22 of which included a referral for further diet support (15 to a practice nurse, three to a dietitian, one to both a dietitian and practice nurse and three not specified). Twenty-five patients with a GPMP were noted as either currently receiving or had previously received dietitian support.

Three GPMPs reported a declined visit to a dietitian, and three reported declining any allied health input. Seventeen GPMPs had weight recorded.

Interviews

Six GPs and two practice nurses (n = 7 females) were interviewed, and the interviews lasted 20–40 minutes (Appendix 3, available online only). Content analysis revealed four themes: 1) HCPs report lifestyle modification as key to managing prediabetes; 2) the frequency and intensity of nutrition care for prediabetes depend on consultation length and competing priorities; 3) referrals for individual diet support rely on funding and patient factors; and 4) HCPs want a healthcare system that enables proactive prediabetes management. Corresponding participant quotes for each theme are shown in Table 3.

Table 1. Demographic and anthropometric details of patients at time of prediabetes detection (n = 47)*

Variable	n (%)
Sex	
Male	15 (31.9)
Female	32 (68.1)
Age (years)	
Mean (SD)	59.62 (15.72)
Age category (years)	
≤18–34	6 (12.8)
35–49	5 (10.6)
50–64	17 (36.2)
65–79	15 (31.9)
≥80	4 (8.5)
Self-reported ethnicity/cultural background	
Australian	33 (70.2)
Aboriginal or Torres Strait Islander	1 (2.1)
Asian	7 (14.9)
Sub-Saharan African	1 (2.1)
European	5 (10.6)
Weight (kg)†	
Mean (SD)	88.86 (20.28)
Body mass index (kg/m²)†	
Mean (SD)	32.0 (6.28)
Body mass index category (kg/m²)†	
Underweight (<18.5)	0 (0.0)
Healthy weight (18.5–24.9)	3 (7.3)
Overweight (25.0–29.9)	15 (36.6)
Obese 1 (30.0–34.9)	11 (26.8)
Obese 2 (35.0–39.9)	6 (14.6)
Obese 3 (≥40.0)	6 (14.6)
Waist circumference (cm)‡	
Mean (SD)	107.92 (12.12)
Waist circumference category (cm)‡	
Healthy	1 (3.7)
Increased risk	3 (11.1)
Greatly increased risk	23 (85.2)
Smoking status	
Non-smoker	23 (48.9)
Current smoker	6 (12.8)
Ex-smoker	18 (38.3)
Alcohol status	
Non-drinker	20 (42.6)
Light drinker	26 (55.3)
Moderate drinker	0 (0.0)
Heavy drinker	1 (2.1)
Taking diabetes medication	
Yes	0 (0.00)
No	47 (100.0)

**Reported as n (%) unless indicated otherwise*
†Missing weight data (n = 6)
‡Missing waist circumference data (n = 20)
SD, standard deviation

Data synthesis

Themes from the qualitative data further explained the quantitative findings in the context of the study practice (Table 4). While providers attempted diet discussions with patients with prediabetes at least once, several barriers to nutrition care were found, with only 8.1% of all consultations having 'diet' recorded. The low recorded referral rate to dietitians in usual consultations were explained by qualitative reports that patients frequently decline dietitian support due to limited time, high cost or little perceived usefulness. GPMPs may allow access to more comprehensive nutrition care, but prediabetes alone does not qualify a patient for a GPMP. HCPs suggested ways the current system could change to enhance multidisciplinary care for people with prediabetes.

Discussion

This case study investigated HCP practice behaviours and views towards managing patients with prediabetes within a busy, urban practice. The mixed-methods case study design allowed for a rich understanding of the data in a specific context. HCPs recognised diet as the first-line treatment approach for prediabetes, which was reflected in the chart data, with no patients taking diabetes medication. However, HCPs reported significant barriers to providing nutrition care. While most patients had 'diet' noted at least once, the overall percentage of consultations with 'diet' reported was low (8.1%), and only 1.3% indicated a referral to a dietitian. This implies that diet is raised initially following prediabetes detection, but not regularly. These practice behaviours contradict the recommendations of recently published national practice guidelines, which suggest that GPs provide individual lifestyle support and dietitian referrals to patients at risk of T2D.[25] Patients have previously reported receiving limited, 'vague' or inconsistent dietary advice following a prediabetes diagnosis.[12] The current study shed light on why this might be, with HCPs stating that competing priorities and limited time made it difficult to

discuss diet at every appointment. Time constraints in GP visits are frequently cited as barriers to providing nutrition care.[26-28]

GPMPs provide an opportunity to increase access to nutrition care,[22] and were viewed favourably by HCPs. While the current arrangement only provides five allied health visits, this care plan could be enhanced to provide more intensive lifestyle interventions, similar to those employed in large-scale, randomised controlled trials, which effectively delayed T2D in 58% of participants with prediabetes.[5] The majority of patients were on a GPMP, and all of these had diet noted. Most patients with a GPMP had a current or past interaction with a dietitian, suggesting GPMPs do increase access to nutrition services. However, prediabetes alone does not qualify for GPMP funding, which suggests that many patients with prediabetes already have other comorbidities, such as obesity, as reflected in the RCR, with 92.7% of people classified as being overweight or obese. Perhaps, counterproductively, under the current MBS, T2D and cardiovascular disease qualify a patient for a GPMP,[22] but these are ultimately consequences of poorly managed prediabetes.[1,3,4] HCPs who would like more lifestyle support for their patients during prediabetes articulated concerns over this reactive systems approach.

Possible reasons for declined dietitian referrals were reported in a survey of 699 patients with type 1 diabetes and T2D in the Netherlands.[29] The 51 non-attendees quoted little perceived usefulness (n = 6) and ability to independently maintain a stable weight (n = 22) as the top reasons for declining a dietitian visit.[29] However, focus groups with patients in Israel identified that physician attitudes towards dietitians influenced whether patients would attend dietitian appointments in the long term.[30] Recent studies exploring patients' experiences of prediabetes diagnosis and management in Australia and New Zealand found them to report to be highly motivated to make changes following prediabetes, but require HCP support.[12,31] In Australia, individuals may pay $50–$196 for a standard one-hour dietitian consultation.[32] Although Medicare Benefits Schedule–funded consultations represent the lower end of this range ($50–$150), the high costs associated with seeing a dietitian could be a significant barrier to accessing care.[32] Populations with increased chronic disease prevalence and/or socioeconomic disadvantage experience increased barriers to individualised nutrition care, which was especially true for the practice in this study.[18,19] A cross-sectional audit of 90,000 patient records from a national database in Israel found frequency of dietitian visits to be positively associated with being female, middle aged and higher socioeconomic status,[33] differing significantly from the study population in the present study. Nutrition care provided by a dietitian can be effective in improving weight outcomes and reducing blood glucose levels among people with prediabetes.[34,35] Clearly, The Royal Australian College of General Practitioners (RACGP) guideline recommendations for providing nutrition support to people with prediabetes are warranted, yet inconsistently followed,[25] as demonstrated in the present study. Although patients at risk of chronic disease, such as those in the current study population, would benefit from improved nutrition care, efforts to increase access to nutrition services for these patients are needed.

This study advances understanding of HCP practices for patients with prediabetes in one large Australian practice in a socially disadvantaged area. The mixed-methods, case study design was a strength of this study, allowing for a comprehensive understanding of HCP practices within the context of contemporary practice. The sample size (n = 8) and mixed nature of HCP roles (two nurses, six GPs) of interviewees may be viewed as a limitation of this study. However, within this case study of one large practice, HCP perspectives were viewed together due to their collaborative nature and similar governing mandates. Furthermore, the qualitative data explained the quantitative findings, indicating integrity of both datasets. However, a limitation of a case study design is that the data may not be generalisable, as it explores one specific setting in great detail, rather than a diverse sample.[17] Therefore, the findings from the present study may not be generalisable to other practices, particularly those of a different demography, such as more affluent or rural areas.[19] Relying on correct data entry in patient charts is a limitation of this study. Misclassification of patients as having prediabetes and

Table 2. Consultation data, including diet, weight and referrals recorded across the prediabetes detection period, for 47 patients receiving 1096 consultations

Variable	Patients n (%) (n = 47)	GPMP patients n (%) (n = 29)	Consultations n (%) (n = 1096)
Diet recorded			
Yes	35 (74.5)	29 (100.0)	89 (8.1)
No	12 (25.5)	0 (0.0)	1007 (91.9)
Weight recorded			
Yes	40 (85.1)	17 (58.6)	150 (13.7)
No	7 (14.9)	12 (41.4)	946 (86.3)
Dietitian referral recorded			
Yes	9 (19.1)	22 (75.9)	14 (1.3)
No	38 (80.9)	7 (24.1)	1082 (98.7)

GPMP, general practitioner management plan

Table 3. Qualitative theme descriptions and corresponding quotes from healthcare providers (HCPs)

Theme description	Representative quote(s)
Theme 1. HCPs report lifestyle modification as key to managing prediabetes	
While not all practitioners used the same terminology to describe prediabetes, they described taking similar initial approaches to prediabetes management. Interviewees spoke about prediabetes being an opportunity for patients to take action and avoid future health complications. Participants discussed diet and lifestyle as being the mainstay for tackling prediabetes, while medication was viewed as inappropriate for prediabetes management. It was clear that participants felt diet and lifestyle support should be the main focus of prediabetes treatment; however, providing this care was not always possible.	'Usually I would put impaired glucose tolerance in the diagnosis.' (P03) 'It would depend on the diagnosis … prediabetes. I don't use the diagnosis very often. In Australia, there's still some conjecture on the term prediabetes.' (P06) 'I'm not aware of any recommendations to use medication straight away if they have a diagnosis of prediabetes, but are not diabetic, in which case lifestyle is my go to.' (P01) 'What we need to do for people with prediabetes is alter lifestyle change. It's diet, exercise and weight loss.' (P06) 'I might consider medication in PCOS, polycystic ovary syndrome, but otherwise not.' (P07)
Theme 2. The frequency and intensity of nutrition care for prediabetes depend on consultation length and competing priorities	
Participants identified barriers in consistently providing nutrition support. While participants stated it would be unlikely if diet was not discussed at least once following a prediabetes diagnosis, barriers, such as consultation length and competing patient priorities, were acknowledged. Participants reported that certain appointment types allowed for longer consultations, alleviating time barriers. Where appropriate, a GPMP enables patients to be seen more frequently and have longer appointments, and decreases barriers to accessing allied health support by providing publicly funded visits. Despite the opportunity for enhanced care through a GPMP, prediabetes alone does not qualify patients for this funding. Furthermore, nurses stated that they could only see patients with prediabetes if they were also on a GPMP, due to the funding model. Participants discussed certain patient characteristics that influenced how aggressively they managed prediabetes. They stated they would treat younger or overweight patients more intensely.	'Well, I would have hoped I would have talked about it [diet] with everyone at some point during when they've been diagnosed with prediabetes.' (P03) 'It depends on the situation, usually there's a whole lot of other stuff going on.' (P06) 'It [GPMP] means someone is talking to them about diet and exercise every six months and they have access to allied support as well.' (P03) 'I don't think they would be eligible for a [GPMP] plan just because they've got prediabetes as a problem. They'd have to have another medical condition.' (P05) 'If someone has an HbA1c of 6.3% at [age] 70 [years], I'm not going to be that concerned, but if you've got an HbA1c of 6.3% and you're 100 kilos at 30, you're going to have more problems.' (P07)
Theme 3. Referrals for individual diet support rely on funding and patient factors	
Unless on a GPMP, patients in Australia pay directly for dietitian services, which may be partially covered if they have private health insurance. Patients with a GPMP can attend five Medicare-funded allied health visits. However, HCP participants stated many of their patients with prediabetes opt out of seeing a dietitian to prioritise treatment for comorbidities by other allied health providers. Other reasons for patients' low uptake in dietitian referrals, as perceived by HCPs, included low motivation or interest to attend a dietitian visit, little perceived benefit and time constraints. One participant felt this was particularly true for their younger patients who might find it difficult to take time off work.	'Under a GPMP, not many of my patients can afford to pay privately, so it depends on what their other medical needs are and priorities for those other five sessions.' (P03) 'They [patients] say "No, I'd really rather see a physio for my sore back or a podiatrist for my feet" … and it's only five visits a year divided up, and their feet and their sore back always out-wins the dietitian.' (P04) 'They'll [patients] say "I've seen a dietitian in the past, I know what to do, I don't want to see them again or it wasn't helpful". So I just find it hard to get people to see dietitians.' (P01) 'For the young people who are prediabetic, if they're working, getting time off work … they lose money so the financial implication is there, but then … the financial implication of if you go on to develop diabetes … yeah that's a bigger issue.' (P05)
Theme 4. HCPs want a healthcare system that enables proactive prediabetes management	
The current healthcare funding model raises inherent barriers for patients when trying to access individualised, consistent and comprehensive nutrition care following a prediabetes diagnosis. Participants talked about needing a system change to optimise prediabetes care, with a focus on diet and lifestyle. Extending the MBS coverage of allied health and chronic disease nurse services for patients with prediabetes were suggested. A multidisciplinary, patient-centred approach was proposed. Participants want to support patients with prediabetes, but restrictions within the current primary healthcare system make it challenging.	'If you can actually get patients involved in a team environment and everyone is talking together, it does make a difference.'(P03) '… frequency of visits depending on what they [patients] want, not as what is funded by Medicare. It would be regular support from exercise physiology, dietitian and probably psychology to help patients understand and support them.' (P04)

GPMP, general practitioner management plan; HbA1c, glycated haemoglobin; MBS, Medicare Benefits Scheme; P, participant

missed or incorrect data entry is possible. However, this was mitigated by including patients from all HCPs at the practice and by conducting interviews with HCPs to understand their practice and reporting behaviours. To ensure patient confidentiality and transparency of the research, written consent was needed before accessing patient data, meaning the charts of some eligible patients were not analysed. This was evidenced by a low response rate of 38.2% and was a limitation of the present study. However, the quantitative data from the 47 included patients provided insight into HCP practice behaviours needed to inform the qualitative interview questions, which explored these behaviours more broadly for all patients of the practice. While researchers took steps to remove themselves from the HCP participants, some were known to the research team. This pre-existing relationship may have led to greater social desirability bias. Despite this affiliation, the HCP participants were unaware of the specific research aims of the study prior to interview.

HCP participants agreed that, in current practice, individuals with prediabetes receive nutrition care that is limited and varies between individuals, as a result of patient, provider and system-related factors. Better access to nutrition support for individuals with prediabetes should include system-level changes, as well as increased advocacy for the role of the dietitian in the multidisciplinary team in the primary care setting. Opportunities to enhance patient care through GPMPs and alternative, cost-effective health services, such as digital health tools, should be explored. Further research should investigate how patients would prefer to receive nutrition care within the existing healthcare system.

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Table 4. Synthesis of qualitative and quantitative findings

Quantitative finding	Qualitative finding	Synthesised finding
1. Diabetes medication not prescribed 2. Diet recorded once or more in visit notes for 74.5% of patients	(Theme 1) HCPs report lifestyle modification as key to managing prediabetes	Diet recognised as key in managing prediabetes and preventing T2D; attempts made to provide nutrition care at prediabetes detection
3. Diet recorded in only 8.1% of consultations 4. Patients were mostly overweight or obese (92.7%) 5. Weight recorded in only 13.7% of consultations	(Theme 2) The frequency and intensity of nutrition care for prediabetes depend on consultation length and competing priorities	Barriers to providing consistent and frequent nutrition care to all patients Providers want to provide more intensive care to younger, overweight patients, but this is not always possible
6. Dietitian referrals made for one in five patients, but only 1.3% of total consultations 7. Patients with a GPMP (61.7%) all had diet recorded and most (86.2%) had seen a dietitian 8. Patients refused a dietitian or allied health referral in 20.6% of GPMPs	(Theme 3) Referrals for individual diet support rely on funding and patient factors (Theme 4) HCPs want a healthcare system that enables proactive prediabetes management	Having a GPMP increases the likelihood of receiving nutrition care and accessing dietitian support Qualifying for a GPMP depends on Medicare funding; GPMP patients not guaranteed to see a dietitian; depends on patient motivation and time Providers recognise the need for system change to manage prediabetes with diet and lifestyle support effectively

GPMP, general practitioner management plan; HCP, healthcare providers; T2D, type 2 diabetes

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