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Development of the D-stress care pathway for adults with type 1 diabetes: adapting interventions for implementation in UK NHS diabetes services

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ABSTRACT

Objectives Diabetes distress is common among adults with type 1 diabetes and can adversely affect diabetes self-management and psychosocial outcomes. This study aimed to describe the development and adaptation of the D-stress care pathway for adults with type 1 diabetes for use in routine UK National Health Service (NHS) diabetes services. The pathway combines Enhanced Usual Care (EUC), which supports healthcare professionals to identify and respond to diabetes distress during routine consultations, with REDUCE, a group-based psychological intervention for adults experiencing elevated diabetes distress.

Design Intervention development study informed by the Medical Research Council framework for complex interventions and ADAPT guidance. Evidence synthesis, realist programme theory, stakeholder involvement and iterative intervention refinement were integrated throughout development. The Double Diamond framework and Acceptance and Commitment Therapy principles guided the adaptation of REDUCE.

Setting Routine UK NHS diabetes services.

Participants Stakeholders included 12 adults with lived experience of type 1 diabetes participating through the D-stress Patient Forum, healthcare professionals including diabetes psychologists, consultFants and a diabetes specialist nurse, and a 10-member independent Expert Reference Group comprising people with lived experience, healthcare professionals, academics and methodological experts. Academic and clinical collaborators from the D-stress Programme Management Group also contributed to development.

Interventions The D-stress care pathway was developed by adapting two complementary interventions. Enhanced Usual Care (EUC) was adapted to support healthcare professionals to identify, assess and respond to diabetes distress during routine consultations, incorporating the Type 1 Diabetes Distress Assessment System. REDUCE was adapted from previously evaluated diabetes distress interventions from the US and Denmark.
Results Two rapid realist reviews identified initial programme theories for how EUC and REDUCE work which informed adaptation. Stakeholder involvement led to iterative refinement of intervention content, language, consultation resources, delivery approaches and implementation materials. The final D-stress pathway combines EUC, delivered through routine consultations supported by healthcare professional eLearning, with referral to REDUCE for adults with elevated diabetes distress. REDUCE comprises six 90-minute online group sessions incorporating emotional awareness, reflection, peer support, psychological flexibility and values-based coping. Core theoretical mechanisms of the source interventions were retained while components were adapted or removed to improve relevance, accessibility and feasibility within UK NHS services.
Conclusions D-stress provides a structured care pathway integrating routine identification and management of diabetes distress with access to group-based psychological support for adults with elevated distress. The development process demonstrates how international interventions can be systematically adapted to a new healthcare context through realist theory, established adaptation frameworks and sustained stakeholder involvement. Feasibility, implementation and effectiveness will be evaluated in subsequent research.

Strengths and limitations of this study

- The development process integrated international evidence, rapid realist reviews, established adaptation frameworks and stakeholder involvement.
- PPI was embedded throughout intervention development and adaptation, with sustained involvement of people with lived experience of type 1 diabetes.
- Realist programme theories informed decisions about which intervention components to retain, adapt or remove.
- Stakeholder feedback informed iterative refinement of intervention content, accessibility and delivery.
- The Patient Forum may not fully represent the diversity of people living with type 1 diabetes in the UK.

- The programme theories have not yet been empirically tested within the D-stress pathway.

What are the new findings?

- The D-stress care pathway was developed by adapting two complementary interventions for UK NHS diabetes services.
- Rapid realist reviews generated programme theories that informed intervention adaptation.
- Stakeholder involvement informed iterative refinement of intervention content, accessibility and delivery.
- The final pathway integrates Enhanced Usual Care with online group-based REDUCE for adults with elevated diabetes distress.

How might it impact on clinical practice or future research?

- D-stress provides a structured approach to identifying and managing diabetes distress within routine NHS care.
- The development process demonstrates how existing interventions can be adapted to a new healthcare context while retaining core theoretical mechanisms.
- Future research will evaluate the feasibility, implementation and effectiveness of the pathway.
- Research should also examine its applicability across diverse populations and healthcare settings.

Keywords Type 1 diabetes; diabetes distress; intervention development; co-design; patient and public involvement; psychological care

1. Introduction

Type 1 diabetes is a lifelong condition requiring continuous and complex self-management, including insulin administration, glucose monitoring, dietary management, and physical activity (1). The daily demands of managing type 1 diabetes can place a substantial burden on individuals and are associated with poorer clinical and psychosocial outcomes when support needs are unmet (1,2). Recognising and addressing these psychosocial needs is therefore an important component of comprehensive type 1 diabetes care (2).

Diabetes distress (DD) is the emotional burden associated with living with and managing diabetes and is distinct from clinical depression or broader quality of life challenges (3,4). Unlike depression, DD is not a psychiatric condition but a normal negative emotional response to living with type 1 diabetes (3,4). DD is commonly assessed using validated diabetes-specific measures, including the Diabetes Distress Scale (DDS), originally developed by Polonsky et al. (2005) (5). For adults with TYPE 1 DIABETES, subsequent measures have been developed to capture diabetes-specific sources of distress, including the T1-DDS and the brief T1-DDS-7 (6.7). Approximately 40% of adults with TYPE 1 DIABETES experience elevated DD at any given time (8,9). Higher levels of DD are associated with suboptimal diabetes self-management, hyperglycaemia and an increased risk of diabetes-related complications (4,8). Routine assessment provides healthcare professionals (HCPs) with an opportunity to identify elevated DD and provide timely, appropriate support (2,8). However, gaps in healthcare professional training in the psychological and emotional aspects of diabetes may limit the capacity to recognise and manage these needs effectively (10).When unrecognised or unmanaged, DD may contribute to diabetes burnout, characterised by emotional exhaustion and disengagement from diabetes self-management (2,8). Reductions in DD have been associated with improvements in glycaemic outcomes, quality of life and engagement with healthcare, with potential benefits for healthcare utilisation and costs (4,11,12).

Clinical guidelines for DD recommend routine assessment of DD using validated measures, appropriate follow-up, and access to structured psychological or psychoeducational interventions according to clinical need (12,13). Current guidance supports person-centred approaches to identifying and managing DD within routine diabetes care, with referral to appropriately trained HCPs when additional support is required (2, 11,14). Structured interventions targeting DD have been developed and evaluated internationally and have demonstrated improvements in DD and, in some studies, glycaemic outcomes (11,12). These include the TunedIn intervention, evaluated in the EMBARK trial (11), and the Danish REDUCE programme (12). TunedIn was an online group-based psychological intervention that used psychological strategies to address DD. It demonstrated reductions in DD and improvements in glycaemic outcomes in the EMBARK trial (11). Danish REDUCE was an in-person group-based intervention for adults with type 1 diabetes and elevated DD that focused on emotional support, reflection and peer discussion. It demonstrated reductions in

DD and improvements in psychosocial outcomes (12). However, NHS diabetes services currently lack a structured pathway for routinely identifying and managing DD. Psychological support may also be constrained by gaps in HCP training and confidence in recognising and responding to the psychological and emotional aspects of diabetes, alongside practical barriers to providing psychosocial care (10,14-15). There is therefore a clear need for an evidence-based care pathway capable of identifying and managing DD within routine UK diabetes services. The D-stress care pathway comprises two complementary interventions: Enhanced Usual Care (EUC), which supports HCPs to routinely identify, assess and discuss DD using the Type 1 Diabetes Distress Assessment System (T1-DDAS) (16), and REDUCE, a group-based online psychological intervention for adults with elevated DD.

The intervention adaptation process comprised two complementary workstreams. The EUC workstream was informed by the Australian diabetes distress eLearning programme and associated *Life with Diabetes* consultation resources, which had undergone structured development and provided a foundation for supporting HCPs in recognising, assessing and discussing DD during routine consultations (17-120).The REDUCE workstream drew on both TunedIn and the Danish REDUCE programme (11-12).

This study aimed to describe the theory- and evidence-informed adaptation of the D-stress care pathway for adults with type 1 diabetes, including the adaptation of EUC and the co-adaptation of the REDUCE group intervention for implementation within routine UK NHS diabetes services.

2. Methods

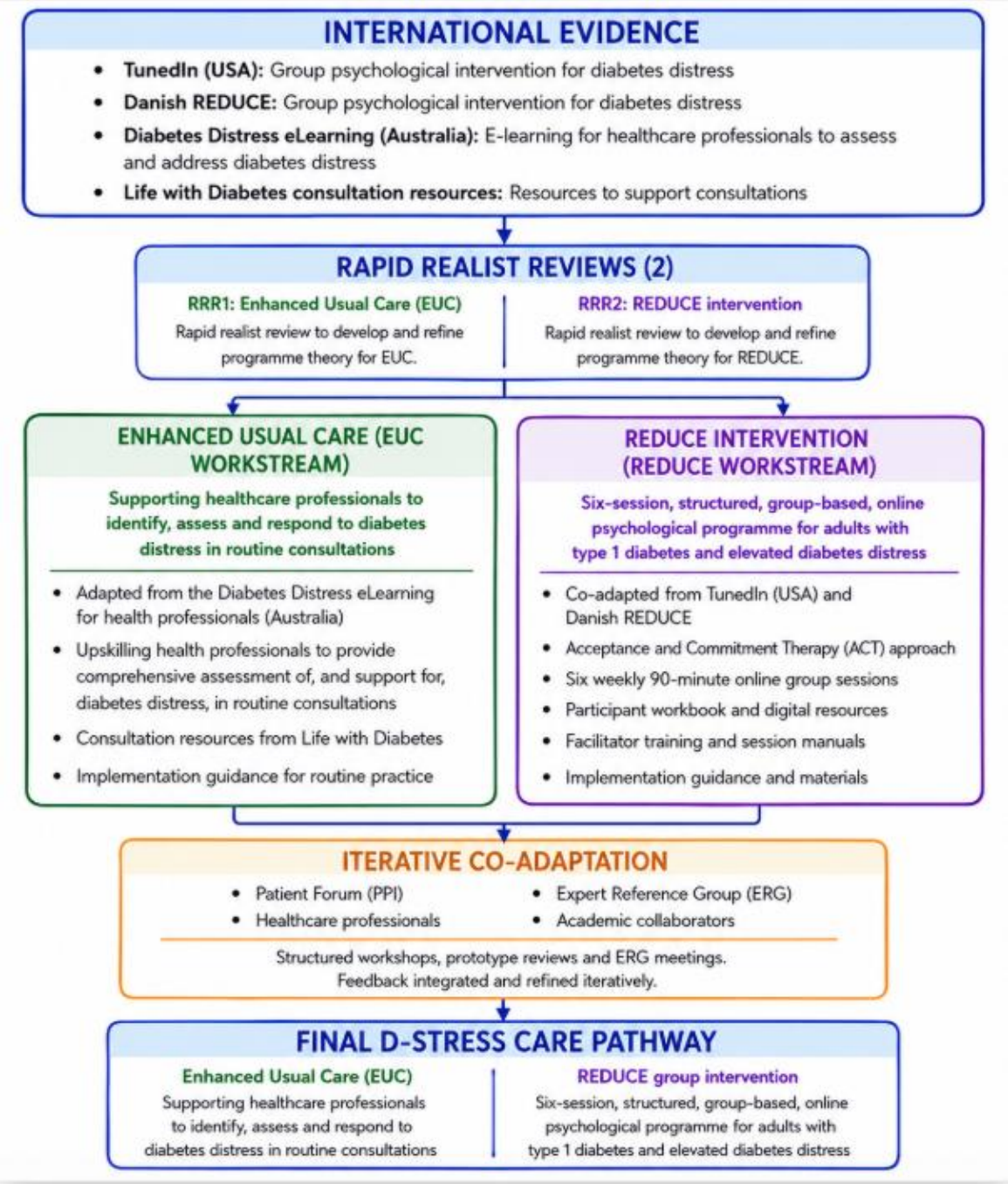
This study represents the intervention development phase of a five-year research programme aiming to evaluate the feasibility, implementation and cost-effectiveness of D-stress, a care pathway designed to support NHS diabetes services to routinely identify and manage diabetes distress among adults with type 1 diabetes.

The sequencing of intervention adaptation activities described in this paper was informed by the Medical Research Council (MRC) framework for complex interventions (21). Evidence synthesis, theory development, stakeholder involvement and iterative intervention refinement were integrated throughout the development process. Consistent with the ADAPT guidance

for adapting interventions to new contexts, the adaptation process accounted for differences in healthcare organisation, care pathways and available resources while retaining the interventions' core functions and mechanisms of action (22).

EUC used expert-led contextual adaptation, with stakeholder feedback informing iterative refinement of intervention content and delivery, while REDUCE used participatory co-adaptation structured around the Double Diamond model, comprising four phases: Discover, Define, Develop and Deliver (Design Council, 2019) (23). An overview of the intervention adaptation process is presented in Figure 1. Patient and Public Involvement (PPI) was embedded throughout the adaptation of both interventions and was guided by the UK Standards for Public Involvement (24). Equality, diversity, and inclusion (EDI) considerations were incorporated throughout the development process. The final intervention components are reported in accordance with the TIDieR checklist (25) (Supplementary 1) to support transparency and reproducibility. PPI is reported in line with the GRIPP2 short form reporting checklist (26) (Supplementary 2). The intervention development process is reported in accordance with the GUIDED reporting guidance (27) (Supplementary 3).

Figure 1: Intervention adaptation process



2.1 Stakeholder involvement

Stakeholders (i.e. public and patient contributors, clinicians, academics) were involved through a series of structured workshops, prototype review activities and Expert Reference Group (ERG) meetings. PPI was undertaken through the D-stress Patient Forum, the dedicated PPI group established for the programme. The D-stress Patient Forum comprised twelve adults with lived experience of type 1 diabetes including one family member with caregiving experience. The group chose to refer to themselves as the *Patient Forum*. All

Patient Forum members who expressed an interest in contributing to this phase of the project participated. Eight was the maximum number required at each meeting, and attendance was rotated across the 12 members according to their availability. The Patient Forum's role was to ensure that the interventions reflected the priorities, experiences and preferences of people living with type 1 diabetes by providing feedback on intervention content, accessibility, acceptability and delivery.

HCPs were identified through existing clinical collaborations and professional networks. HCPs included diabetes psychologists (n=2), diabetes consultants (n=2), and a diabetes specialist nurse (DSN) (n=1), Their role was to advise on clinical feasibility, implementation within routine NHS diabetes services, and alignment with existing diabetes care pathways. The ERG comprised 10 independent national and international members who were not part of the core D-stress investigator team. Membership included a person and close family member living with type 1 diabetes (n=1), clinical HCPs (n=4; two diabetes psychotherapists, one diabetes consultant, and one DSN), leading academics in DD (n=3), and methodological experts in realist evaluation and co-design (n=2). The ERG provided independent advice on interpretation of the evidence, theoretical alignment, and retention of core intervention mechanisms throughout the adaptation process.

Academic and clinical collaborators comprised 15 members of the D-stress Programme Management Group, including the Chief Investigator, co-investigators, and the research team. The group included expertise in DD, health and clinical psychology, behavioural science, intervention development, diabetes care, and implementation research. Their role was to lead evidence synthesis, coordinate intervention development, integrate stakeholder feedback, and oversee iterative refinement of the interventions.

2.1.1 Patient and Public Involvement

Patient and Public Involvement (PPI) was embedded throughout the intervention development and adaptation process and was guided by the UK Standards for Public Involvement. The D-stress Patient Forum comprised 12 adults with lived experience of type 1 diabetes, including one family member with caregiving experience. Members contributed to workshops, review meetings and prototype development across the EUC and REDUCE workstreams, providing feedback on intervention content, accessibility, acceptability and delivery. Their feedback informed iterative adaptations to intervention materials, language,

session content and delivery approaches. Three members of the Patient Forum are named co-authors of this manuscript and have contributed to its development and reporting. Members of the Patient Forum also continue to contribute to dissemination activities.

2.2 Rapid realist reviews

Two rapid realist reviews (RRRs) were conducted to synthesise evidence from international diabetes distress interventions and to identify relevant context–mechanism–outcome (CMO) configurations [27,28]. One review informed the development of the EUC workstream by examining interventions that support HCPs to recognise, assess, and respond to DD in routine diabetes care, while the second informed the REDUCE workstream by examining psychosocial interventions for adults with type 1 diabetes experiencing elevated DD. The reviews drew on evidence from interventions including EMBARK (TunedIn) [10], Danish REDUCE [11], and other related DD literature to identify programme theories that informed adaptation decisions. Programme theories, core components, and materials from TunedIn and Danish REDUCE were introduced during the development activities and explored throughout the adaptation process, with stakeholders contributing to decisions regarding which elements should be retained, adapted, or removed for the UK NHS context.

2.3 EUC workstream

The EUC workstream involved adapting an intervention involving training health professionals to identify and discuss diabetes distress in routine clinic consultations, based on an Australian eLearning for health professionals (18,19). The Australian eLearning was developed as an extension of the National Diabetes Services Scheme (NDSS) *Diabetes and Emotional Health: A Practical Guide for Health Professionals Supporting Adults with Type 1 and Type 2 Diabetes* and its accompanying toolkit (17, 30). The eLearning was developed using an intervention mapping approach and demonstrated feasibility and acceptability in improving healthcare professionals' knowledge, skills and confidence in recognising and responding to diabetes distress (18,19). The EUC workstream was also informed by the *Life with Diabetes* tool, which provided a structured approach to discussing emotional wellbeing and DD (20).

The EUC workgroup comprised people with expertise in diabetes psychology, healthcare training, intervention development, and experience of eLearning platforms. Adaptation activities focused on ensuring relevance for implementation within UK NHS diabetes

services and preparing a training and consultation support package to facilitate the identification, comprehensive assessment and follow-up of diabetes distress during routine diabetes consultations. Adaptation activities included modifying language, clinical pathways, consultation resources and case examples; incorporating the Type 1 Diabetes Distress Assessment System (T1-DDAS) into consultation resources (16); developing UK-specific eLearning content; and refining materials for implementation within the feasibility study.

The consultation resources and supporting eLearning programme were presented to the Patient Forum during a dedicated review meeting. Discussion focused on the clarity of the content, usability within routine diabetes consultations and acceptability to people living with type 1 diabetes. People with lived experience also shared their experiences of DD through discussion, interviews or written reflections, which informed refinement of the consultation resources, language and training materials. HCPs reviewed successive iterations of the consultation resources and eLearning materials, providing input on clinical workflow, consultation length, referral pathways, terminology and implementation within UK NHS diabetes services.

2.4 REDUCE workstream

The REDUCE workstream drew on TunedIn and the Danish REDUCE programme, which use Acceptance and Commitment Therapy (ACT) approaches (31).

The REDUCE co-adaptation group included researchers with expertise in DD, health psychology, behavioural science, intervention development, co-design, and implementation research. Adaptation activities involved people living with type 1 diabetes and HCPs, who contributed to refining intervention content, session structure, facilitation approaches, participant materials, and delivery processes for implementation within UK NHS diabetes services. Adaptations aimed to retain the core theoretical mechanisms of the source interventions.

Stakeholder workshops informed iterative refinement of intervention content, materials and delivery, as detailed in Table 1.

Table 1. Overview of REDUCE development activities across the Double Diamond phase

REDUCE Double Diamond Phase	**Purpose**	**REDUCE Activities**
Discover (Sessions 1–2)	Understand needs and priorities	Explored lived experiences of DD and reviewed international interventions (TunedIn and Danish REDUCE). Stakeholders highlighted the importance of emotional support, person-centred care, and peer connection.
Define (Sessions 3–5)	Identify priorities for intervention development	Reviewed and adapted prototype materials derived from TunedIn and Danish REDUCE and explored preferences relating to programme structure, content, and facilitation.
Develop (between sessions)	Develop and refine intervention materials	Refined group session content, facilitation approaches, and delivery structure through workshop feedback and prototype review.
Deliver (Session 6)	Prepare interventions for implementation	Prototype-tested group-session materials and facilitation approaches, using feedback to inform final refinements before implementation.

Across both workstreams, intervention materials underwent iterative cycles of review and refinement informed by evidence synthesis, stakeholder feedback and expert consultation. Feedback from the Patient Forum, HCPs, academic collaborators and the ERG was incorporated into successive refinements of the interventions.

2.5 Data Handling and Integration of Feedback

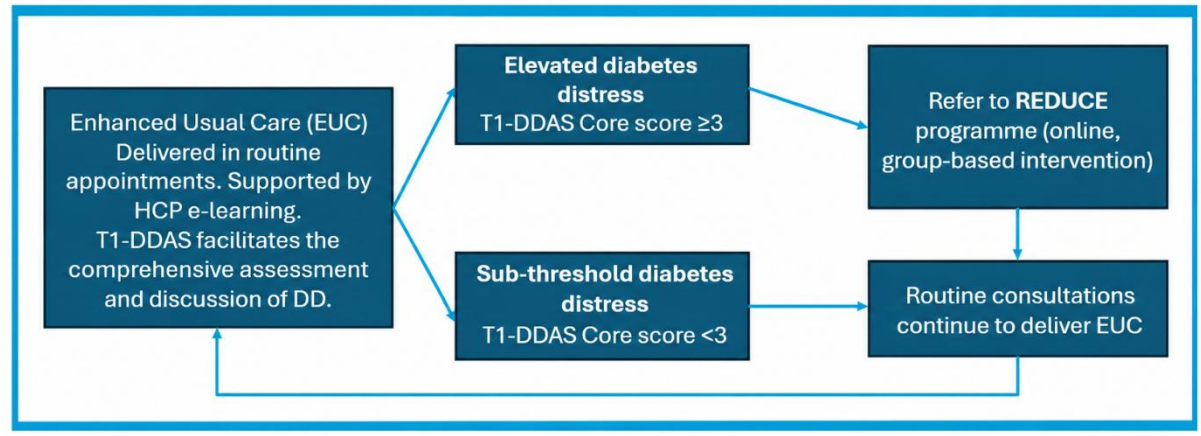
Data generated during development activities included facilitator notes from workshops and review meetings, written feedback on draft materials, and reflections arising from prototype review and testing activities. This information was collected to support the ongoing refinement of the intervention, with particular attention to contextual fit within UK NHS diabetes services, accessibility, usability and emotional acceptability.

Feedback was reviewed iteratively by the research team within the relevant workstream. Facilitator notes and written comments were synthesised following each activity to identify areas requiring clarification, modification or further development. Proposed adaptations were discussed within the EUC or REDUCE workstreams, as appropriate, while cross-cutting issues affecting the overall D-stress care pathway were reviewed by the wider investigator team and, where relevant, discussed with the ERG to support evidence-informed decision-making. Agreed modifications were incorporated into subsequent versions of the intervention materials and revisited during later workshops or review meetings where further refinement was required.

3. Results

Together, EUC and REDUCE provide an integrated model of care that embeds comprehensive assessment and discussion of DD within routine consultations, alongside referral to structured group-based psychological support for adults with elevated DD (Figure 2). The results are presented in two parts. First, we describe the stakeholder feedback and adaptation decisions that informed intervention development. We then describe the final EUC and REDUCE interventions.

Figure 2: D-stress care pathway



3.1 Stakeholder Feedback and Adaptation Decisions for EUC and REDUCE

Stakeholder feedback identified several practical considerations for implementation within routine diabetes services, including accessible language, flexible delivery, attention to emotional burden, and materials that reflected the realities of living with type 1 diabetes. These informed refinements to intervention materials, facilitator guidance and delivery approaches across both workstreams (Table 2), with the key adaptation decisions and their rationales summarised in Table 3. For EUC, adaptations focused on clarity, usability within routine consultations and integration with NHS care pathways. For REDUCE, adaptations focused on reducing overly didactic psychoeducation, strengthening opportunities for reflection and peer discussion, and improving accessibility and flexibility. For example, Patient Forum feedback led to the removal of case studies and participant narratives from the source TunedIn intervention because these were considered to have limited relevance across the diverse lived experiences of people with type 1 diabetes. This feedback informed adaptation of the intervention to use content that was more inclusive and relevant to participants' experiences.

[TABLE 2]

Table 3. Summary of key adaptation decisions informing development of the D-stress pathway

Source intervention	Component from source intervention	Decision for D-stress	Rationale for decision
TunedIn	ACT emotional regulation activities	Retained and adapted	Retained due to strong support from the realist review and stakeholder feedback.
TunedIn	Case studies and participant narratives	Removed	Removed following PPI feedback regarding limited relevance across diverse lived experiences.
TunedIn	Psychoeducational content	Reduced and adapted	Adapted to increase opportunities for discussion, reflection, and emotional processing.
Danish REDUCE	Structured six-session group format	Retained	Retained due to perceived feasibility and value for peer support and shared learning.
Danish REDUCE	Peer discussion and shared reflection	Retained	Retained to support validation, peer connection, and shared understanding.
Danish REDUCE	Facilitator-led delivery model	Adapted	Adapted to support delivery within NHS services while maintaining a person-centred approach.

Danish REDUCE	Session content and examples	Adapted	Adapted to improve relevance to UK healthcare services and practice.
Australian diabetes distress eLearning programme	Structured training in recognising, assessing, and responding to diabetes distress using the 7 A's model	Retained and adapted	Adapted to inform the EUC training programme and consultation resources.
Life with Diabetes tool	Structured emotional wellbeing conversations	Retained and adapted	Integrated to support structured discussions about emotional wellbeing and diabetes distress.
All source interventions	Language and terminology	Adapted	Adapted to improve accessibility, clarity, and relevance to NHS practice.

3.2 Final Outputs: Enhanced Usual Care (EUC)

3.2.1 The EUC intervention

The EUC intervention provides a structured approach to assessing and discussing DD within routine diabetes consultations. Central to EUC is the T1-DDAS, a self-report assessment designed to support structured, person-centred conversations about the emotional impact of living with type 1 diabetes [15]. Rather than functioning solely as a screening tool, the T1-DDAS helps identify specific sources of distress and guides discussion of individual support needs. HCPs complete the D-stress eLearning programme, via the accompanying D-stress eLearning to equip them with the knowledge, communication skills and consultation resources they need to integrate these conversations into routine care. The EUC intervention does not prescribe a standardised consultation script; instead, HCPs are encouraged to apply the principles and communication strategies according to the individual needs of the person with diabetes and the clinical context.

3.2.2 The EUC health professional training programme

To support delivery of EUC within routine NHS diabetes services, HCPs will complete the D-stress eLearning programme. The programme comprises five modules delivered across eight interactive lessons designed to develop knowledge, communication skills and confidence in recognising, assessing, and responding to DD, which includes sub-threshold distress and opportunities for prevention. Content included evidence-based guidance, consultation scenarios, role-play demonstrations, reflective activities and peer learning. One module focusses specifically on the T1-DDAS, providing guidance on introducing the tool, interpreting responses and using it to support structured conversations about DD prevention and/or management. The programme also includes an online community area where HCPs can share reflections, questions and experiences with colleagues and the D-stress study team. The programme is designed to be accessible across professional roles and to support the implementation of EUC within routine NHS diabetes services. The programme is designed to be accessible across professional roles and to support the implementation of EUC within routine NHS diabetes services (Table 4).

Table 4. Structure of the D-stress EUC eLearning programme

eLearning Programme Module Structure	
Module 0	Introduction to the D-stress Study eLearning Programme
Module 1	Part 1: Being 'Aware' of Diabetes Distress Part 2: About The D-stress study
Module 2	How to 'Ask', 'Assess' and 'Advise' about Diabetes Distress
Module 3	Providing Support for Diabetes Distress: How to 'Assist, Assign and Arrange'
Module 4	Useful Skills for Diabetes Distress
Module 5	Enhancing Care in Practice

3.3 Final Outputs: REDUCE Group Intervention

3.3.1 The REDUCE intervention

REDUCE is a structured, online psychological group intervention designed for adults with type 1 diabetes experiencing elevated DD. The intervention provides a psychologically safe and supportive environment in which participants reflect on emotional experiences associated with living with type 1 diabetes, develop coping strategies, and engage in supportive peer discussion. Grounded in ACT, REDUCE promotes emotional validation, peer connection, self-compassion, psychological flexibility, and values-based coping within the context of everyday diabetes management. It also aims to normalise emotional experiences associated with type 1 diabetes and reduce feelings of isolation through opportunities for shared reflection with peers. The structure and key components of REDUCE are summarised in Table 5.

Table 5. Structure and key components of the REDUCE intervention

Component	**Description**
Format	Six 90-minute group sessions delivered online
Target population	Adults with elevated diabetes distress (referral-based)
Theoretical basis	Acceptance and Commitment Therapy (ACT)
Facilitation	Delivered by trained facilitators using a person-centred, non-judgemental, and emotionally supportive approach. Sessions are co-facilitated by two or three people, enabling technical and personal support.
Facilitator training	Structured facilitator training in diabetes distress, ACT-informed delivery, group facilitation and emotional safety (see 3.3.3 'The REDUCE facilitator training programme).
Group process	Optional sharing; integration of individual and group-based reflective activities, with a focus on peer support.

Section 3.3.2 Programme structure

The final REDUCE programme progressed from emotional awareness and regulation towards behaviour change and future-oriented coping. These elements were introduced progressively and overlapped across sessions, rather than constituting discrete phases.

Peer support is integrated throughout the intervention, with participants encouraged, but not required, to share experiences within a non-judgemental group environment. REDUCE combines facilitated discussion, reflective exercises, experiential activities, and practical coping strategies to encourage emotional processing and sustained engagement. Facilitator guidance emphasises a person-centred and non-directive approach, positioning participants as experts in their own lived experience rather than passive recipients of advice. The facilitation approach is designed to maintain flexibility and responsiveness to participants' emotional experiences and group dynamics.

Table 6 maps the adapted REDUCE content to ACT processes and the programme theories identified through the RRR, including emotional regulation, peer learning and support, motivation for action, and empowerment and self-management.

Table 6. Mapping of REDUCE content, ACT processes, and underlying RRR theories

REDUCE Content	**ACT Process**	**Aligned RRR Programme Theories[1]**	**Relevant Sessions**
Recognising diabetes distress			
Identifying personal sources, events, and circumstances that trigger distress (e.g., daily management burden, social support, healthcare interactions, financial strain, fear of complications)	**Acceptance**[1]	**Emotional Regulation; Peer Learning and Support**	1–2
Exploring emotional and behavioural patterns ("DD Cycle")			
Understanding how distress manifests emotionally (fear, shame, frustration), cognitively (thoughts), and behaviourally (avoidance, withdrawal), and how these interact	**Acceptance, Cognitive Defusion**[2]	**Emotional Regulation; Peer Learning and Support**	2–3
Practicing distancing			
Stepping back to notice the difference between events and the narratives created around them	**Cognitive Defusion, Self as Context**[3]	**Emotional Regulation;**	3–5
Identifying control			
Distinguishing between what is within one's control and what is not	**Acceptance**[1]	**Emotional Regulation**	2, 5
Developing a compassionate perspective			
Revisiting personal stories with empathy and self-compassion	**Acceptance, Cognitive Defusion, Self as Context**[123]	**Emotional Regulation; Peer Learning and Support;** empowerment and self-management	4–5
Exploring new possibilities			
Considering alternative, value-based choices and actions and setting future goals	**Values Clarification, Committed Action**[4]	**Motivation for Action;** empowerment and self-management	5–6

[1] Additional mechanisms identified through the RRR, reflected in the group-based delivery process as a whole, included: Regular Assessment and Follow-Up (Ongoing inquiry into diabetes distress); Changing Facilitator–Participant Dynamics (Facilitators operate as partners, not experts); and Peer Learning.

3.3.3. The REDUCE facilitator training programme

REDUCE is designed to be delivered by a specifically appointed team of facilitators with appropriate professional registration and/or experience in diabetes care, psychological support, and group facilitation. The facilitator training was therefore developed to build intervention-specific competencies rather than provide foundational clinical or psychological training. Detailed facilitator eligibility criteria are described in the D-stress feasibility protocol (32).

A facilitator training programme was developed comprising five sessions (16 hours in total). The sessions covered orientation to DD, the D-stress study, the underlying principles of ACT, and the programme mechanisms identified through the RRRs. They also covered the content and flow of each REDUCE session, as well as the co-facilitation approach and associated facilitation skills. The training emphasised a person-centred and collaborative facilitation approach, with facilitators positioned as partners in shared exploration rather than directive experts. Each training session included opportunities to practise delivering components of REDUCE, with structured peer feedback. In the final session, facilitators tested delivery of a REDUCE session with members of the Patient Forum who had contributed to programme development.

4. Discussion

4.1 Principal Findings

This study describes the systematic development of the D-stress care pathway. To our knowledge, D-stress is the first UK care pathway specifically designed to integrate routine identification and management of diabetes distress with access to structured psychological support for adults with type 1 diabetes.

The D-stress care pathway reflects recommendations that diabetes distress should be addressed across different levels of care intensity, combining routine assessment and discussion with access to structured psychological support when required (12). Existing approaches often rely on referral to specialist psychological services despite diabetes distress being common within routine diabetes care. D-stress was therefore designed to support healthcare professionals to identify and respond to diabetes distress during routine

consultations while providing a structured pathway to more intensive and scalable psychological support when required.

4.2 What the D-stress pathway represents

Rather than constituting a single intervention, D-stress represents a coordinated care pathway designed to integrate psychosocial support into routine diabetes care. The pathway was designed to address current NHS service constraints, including limited access to specialist psychology services, workforce pressures and variability in HCP confidence in addressing emotional wellbeing [3,4]. By embedding assessment and support within routine diabetes consultations, D-stress aims to improve access to evidence-based psychosocial care within routine diabetes services.

4.3 Contribution of the adaptation process and guiding frameworks

This study contributes a transparent description of how international evidence was adapted for implementation within UK NHS diabetes services, while illustrating a process that may be relevant to other healthcare systems seeking to adapt evidence-based interventions to local contexts. The process demonstrates how adaptation approaches can differ according to the nature of the intervention, with expert-led contextual adaptation used for EUC and participatory co-adaptation for REDUCE. The RRRs identified initial programme theories associated with interventions designed to reduce DD and provided a theoretical basis for decisions about which components to retain, adapt or remove. Rather than developing entirely new interventions, D-Stress adapted existing evidence-based programmes while seeking to retain their core theoretical mechanisms. This highlights the potential value of theoretically informed adaptation as an approach for translating international evidence across healthcare settings while maintaining fidelity to the mechanisms through which interventions are expected to work.

4.4 Positioning within the wider literature

Although structured interventions can reduce DD, their integration into routine diabetes services remains challenging because of workforce limitations, access to specialist psychological support, and variable HCP confidence in recognising and responding to DD [3,4]. Unlike many previously evaluated DD interventions, which have focused on stand-alone psychological or psychoeducational programmes [12,13], D-stress integrates routine identification and comprehensive assessment of DD, clinician training and support through

EUC, and referral to an evidence-based psychological group intervention within a coordinated care pathway. This approach aligns with recent European recommendations advocating routine assessment, follow-up and access to structured support for DD [13], while addressing the practical implementation challenges that have limited adoption of psychosocial interventions within routine diabetes services [3,4].

4.5 Strengths and limitations of the development process

One main strength of this study was the integration of multiple sources of evidence throughout intervention development. International evidence, RRRs, stakeholder input and established development frameworks were combined to inform adaptation decisions. A further strength was the extensive and structured PPI approach, with sustained involvement of people with lived experience throughout intervention development and adaptation. The approach demonstrates how PPI can move beyond consultation to contribute meaningfully to intervention adaptation and refinement.

Several limitations should be acknowledged. Although efforts were made to support inclusive involvement, the Patient Forum may not fully represent the diversity of adults living with type 1 diabetes in the UK. Perspectives from people with lower digital access or confidence, limited English proficiency, or other groups underrepresented in diabetes research may not have been fully captured. Although online activities enabled participation across a wide geographical area, they may also have created barriers for some contributors.

A further limitation relates to the evidence underpinning the intervention development process. The RRRs identified initial programme theories that informed adaptation decisions (28, 29). However, these theories have not yet been empirically tested within the D-stress pathway. Their contribution to implementation and outcomes will therefore need to be examined during subsequent feasibility and implementation studies.

4.6 Implications for practice, policy, and research

The D-stress pathway provides a structured, theoretically informed model for integrating psychosocial care into routine diabetes services. For practice and policy, it offers a pragmatic approach to operationalising guideline recommendations for DD within existing NHS infrastructure. The next stage will evaluate the feasibility, implementation and clinical effectiveness of the D-stress care pathway within routine NHS diabetes services (32). Future

research should also examine how the pathway can be implemented, and where necessary adapted, across diverse populations and healthcare settings while maintaining fidelity to its core mechanisms

5. Conclusions

This study describes the development of the D-stress care pathway, combining EUC with a co-adapted REDUCE group intervention to support the routine identification and management of DD in adults with type 1 diabetes. The pathway integrates international evidence, realist programme theories and extensive stakeholder involvement to support adaptation to routine NHS diabetes services. The development process demonstrates how international interventions can be systematically adapted through structured stakeholder involvement while retaining their core theoretical principles. The feasibility, effectiveness and economic implications of the pathway will be evaluated in subsequent research.

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Ethics Approval

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Competing interests

JS, RHa and RIGH declare competing interests. All other authors declare no competing interests. All authors have completed the ICMJE disclosure form.

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6. References

1. Association of Diabetes Care and Education Specialists, Kolb L. An effective model of diabetes care and education: the ADCES7 Self-Care Behavior. Sci Diabetes Self Manag Care. 2021;47(1):30-53. doi:10.1177/0145721720978154.
2. Sturt J, Dennick K, Due-Christensen M, McCarthy K. The detection and management of diabetes distress in people with type 1 diabetes. *Curr Diab Rep.* 2015;15:101.
3. Snoek FJ, Bremmer MA, Hermanns N. Constructs of depression and distress in diabetes: time for an appraisal. *Lancet Diabetes Endocrinol.* 2015;3(6):450–60.
4. Fisher L, Mullan JT, Arean P, Glasgow RE, Hessler D, Masharani U. Diabetes Distress but Not Clinical Depression or Depressive Symptoms Is Associated With Glycemic Control in Both Cross-Sectional and Longitudinal Analyses. Diabetes care. 2010;33(1):23-28. doi:10.2337/dc09-1238
5. Polonsky WH, Fisher L, Earles J, Dudl RJ, Lees J, Mullan J, Jackson RA. *Assessing psychosocial distress in diabetes: development of the Diabetes Distress Scale.* Diabetes Care. 2005;28:626–31.

6. Fisher L, Polonsky WH, Hessler DM, Masharani U, Blumer I, Peters AL, Strycker LA, Bowyer V. Understanding the sources of diabetes distress in adults with type 1 diabetes. *J Diabetes Complications.* 2015;29(4):572-577. doi:10.1016/j.jdiacomp.2015.01.012.
7. Nygaard M, Willaing I, Joensen LE, Lindgreen P, Stenov V, Hessler D, Nørgaard K, Pedersen-Bjergaard U, Olesen K. A short-form measure of diabetes distress among adults with type 1 diabetes for use in clinical practice: development and validation of the T1-DDS-7. *Diabetes Care.* 2023;46(9):1619-1625. doi:10.2337/dc23-0460.
8. Fisher L, Hessler DM, Polonsky WH, Strycker LA, Masharani U, Peters AL. Diabetes distress in adults with type 1 diabetes: prevalence, incidence and change over time. J Diabetes Complications. 2016;30(6):1123-8.
9. Fisher L, Hessler DM, Polonsky WH, Mullan JT, Glasgow RE, Masharani U, et al. *When is diabetes distress clinically meaningful? Establishing cut points for the Diabetes Distress Scale.* Diabetes Care. 2012;35:259–64.
10. Byrne JL, Davies MJ, Willaing I, Holt RIG, Carey ME, Daly H, et al**.** Deficiencies in postgraduate training for healthcare professionals who provide diabetes education and support: results from the Diabetes Attitudes, Wishes and Needs (DAWN2) study. *Diabet Med.* 2017;34(8):1074–83
11. Hessler DM, Fisher L, Guzman S, et al. *EMBARK: A randomized controlled trial comparing three approaches to reducing diabetes distress and improving HbA1c in adults with type 1 diabetes.* Diabetes Care. 2024;47:1370–8.
12. Stenov V, Due-Christensen M, Cleal BR, Tapager IW. Significant reduction in diabetes distress and improvements in psychosocial outcomes: a pilot test of an intervention to reduce diabetes distress in adults with type 1 diabetes and moderate-to-severe diabetes distress (REDUCE). *Diabet Med.* 2023;40(10):e15187.
13. Holt RIG, DeVries JH, Hess-Fischl A, Hirsch IB, Kirkman MS, Klupa T, et al. The management of type 1 diabetes in adults. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care.* 2021;44(11):2589–625.
14. American Diabetes Association. Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes: Standards of Care in Diabetes—2025. *Diabetes Care.* 2025;48(Suppl 1):S86–S127.

15. Mosely K, Aslam A, Speight J. Overcoming barriers to diabetes care: perceived communication issues of healthcare professionals attending a pilot Diabetes UK training programme. *Diabetes Res Clin Pract.* 2010;87(2):e11–4.
16. Fisher L, Polonsky WH, Naranjo D, Strycker L, Hessler DM. A novel approach to understanding and assessing the emotional side of type 1 diabetes: The Type 1-Diabetes Distress Assessment System. *Diabet Med.* 2024;41(7):e15282.
17. Halliday JA, Speight J, Bennet A, Beeney LJ, Hendrieckx C. The Diabetes and Emotional Health Handbook and Toolkit for Health Professionals Supporting Adults With Type 1 and Type 2 Diabetes: formative evaluation. *JMIR Form Res.* 2020;4(2):e15007.
18. Halliday JA, Speight J, Russell-Green S, O E, Hagger V, Morris A, et al. Developing a novel diabetes distress eLearning program for diabetes educators: an intervention mapping approach. *Transl Behav Med.* 2021;11(6):1264–73.
19. Halliday JA, Russell-Green S, Hagger V, O E, Morris A, Sturt J, et al. Feasibility and acceptability of eLearning to upskill diabetes educators in supporting people experiencing diabetes distress: a pilot randomised controlled trial. *BMC Med Educ.* 2022;22:768.
20. Due-Christensen M, Joensen LE, Sarre S, Romanczuk E, Wad JL, Forde R, Robert G, Willaing I, Forbes A. A co-design study to develop supportive interventions to improve psychological and social adaptation among adults with new-onset type 1 diabetes in Denmark and the UK. *BMJ Open.* 2021;11:e051430. doi:10.1136/bmjopen-2021-051430.
21. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, et al. *A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance.* BMJ. 2021;374:n2061.
22. Moore G, Campbell M, Copeland L, Craig P, Movsisyan A, Hoddinott P, et al. Adapting interventions to new contexts—the ADAPT guidance. *BMJ.* 2021;374:n1679. doi:10.1136/bmj.n1679.
23. Design Council. The Double Diamond: a universally accepted depiction of the design process [Internet]. London: Design Council; 2019 [cited 2026 Aug 24]. Available from: https://www.designcouncil.org.uk/resources/the-double-diamond/
24. UK Public Involvement Standards Development Partnership. UK Standards for Public Involvement. London: National Institute for Health Research; 2019. Available from: https://sites.google.com/nihr.ac.uk/pi-standards/home

25. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, Altman DG, Barbour V, Macdonald H, Johnston M, Lamb SE, Dixon-Woods M, McCulloch P, Wyatt JC, Chan AW, Michie S. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ.* 2014;348:g1687.
26. Staniszewska S, Brett J, Simera I, Seers K, Mockford C, Goodlad S, Altman DG, Moher D, Barber R, Denegri S, Entwistle A, Littlejohns P, Morris C, Suleman R, Thomas V, Tysall C. GRIPP2 reporting checklists: tools to improve reporting of patient and public involvement in research. *BMJ.* 2017;358:j3453.
27. Duncan E, O'Cathain A, Rousseau N, Croot L, Sworn K, Turner KM, Yardley L, Hoddinott P. Guidance for reporting intervention development studies in health research (GUIDED): an evidence-based consensus study. *BMJ Open*. 2020;10:e033516. doi:10.1136/bmjopen-2019-033516.
28. Sims S, Stenov V, Due-Christensen M, Fisher L, Fabian-Therond C, Peck M, et al. Group-based interventions to reduce diabetes distress in adults with type 1 diabetes: a rapid realist review of the REDUCE and TunedIn interventions. *Diabet Med.* 2026:e70242. doi:10.1111/dme.70242.
29. Harris R, Sims S, Due-Christensen M, Stenov V, Abrams R, Fabian-Therond C, et al. Introducing diabetes emotional wellbeing into routine consultations with adults with type 1 diabetes: a rapid realist review. *Metabologia.2026,* 2(10).
30. Hendrieckx C, Halliday JA, Beeney LJ, Speight J. Diabetes and emotional health: a practical guide for healthcare professionals supporting adults with Type 1 and Type 2 diabetes. London: Diabetes UK; 2019. 2nd ed.
31. Hayes SC, Strosahl KD, Wilson KG. *Acceptance and Commitment Therapy: The Process and Practice of Mindful Change.* 2nd ed. New York: Guilford Press; 2012.
32. Fabian-Therond C, Ahuja S, Papachristou Nadal I, Holt RIG, Watson S, Hussain S, et al. Optimising the prevention, detection and management of diabetes distress in adults with type 1 diabetes: feasibility study protocol (D-stress feasibility study). Submitted to BMJ Open. 2026. doi:10.64898/2026.08.17.26360546