GACD
GLOBAL ALLIANCE FOR CHRONIC DISEASES
AN ALLIANCE OF HEALTH RESEARCH FUNDERS

From implementation research to impact

The GACD Diabetes Research Programme Report

Contents

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Abbreviations

BMI Body mass index

CVD Cardiovascular disease

DIP Diabetes in pregnancy

DIP can be an interchangeable term with GDM, but sometimes can include both GDM and pre-existing diabetic status before pregnancy (as exhibited by the DM01 project).

GACD Global Alliance for Chronic Diseases

GDM Gestational diabetes

HbA1c Haemoglobin A1c

A blood test that measures the average blood sugar level over the past 90 days.

HDL High density lipoprotein

HIC High-income country

LDL Low density lipoprotein

LMIC Low- or middle-income country

NCD Non-communicable disease

OGTT Oral glucose tolerance test

RCT Randomised control trial

T2D Type 2 diabetes

TMFs Theories, models, and frameworks

WHO World Health Organization

Project codes

This report serves as a summary of the work undertaken by 14 implementation science projects funded under the GACD Diabetes Research Programme. Throughout, we refer to the 14 projects by their GACD codes – DM01, DM02, etc to DM17 – to help the reader move easily through the text. While reading, you may wish to refer to **page 15** for the list of full project titles and **Table 2** for a summary of project characteristics.

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Executive summary

The global burden of diabetes is increasing every year, with levels projected to more than double from 2021 to 2050.[1] The Global Alliance for Chronic Diseases (GACD) launched a funding call for type 2 diabetes (T2D) and gestational diabetes (GDM) implementation research projects in 2013 and those funded became the GACD Diabetes Research Programme. The 14 projects, spanning 19 countries, studied implementation of evidence-based interventions addressing risk factors, lifestyle changes, and complications of T2D. All 14 projects tackled prevention and/or management of T2D or GDM in resource constrained settings in low- and middle-income countries (LMICs) or underserved populations, including Indigenous populations and other groups, experiencing health disparities in high-income countries. A key intention of GACD in its support for implementation science is to generate relevant research findings that give healthcare providers and decision-makers evidence on how to implement programmes and policies effectively.

This report serves as a summary of the work undertaken by the GACD Diabetes Research Programme projects and, where possible, seeks to provide an initial description and synthesis of the methods, strategies, results, and impact of the projects. The report provides a springboard for researchers to further consider the potential for future meta-syntheses of implementation science projects and invites readers to build on the interpretations presented.

In preparing this report it was recognised that the field of implementation science has evolved rapidly, and terminology has varied over the 10 years since the projects commenced. This presents a challenge for analysis and meta-synthesis. However, the authors of this report have attempted to standardise language using contemporary terms in the field, to ease understanding, interpreting, and conveying the findings.

Furthermore, the COVID-19 pandemic disrupted many of the projects, leading to unforeseen delays and challenges. Consequently, this report compiles available findings from each project, acknowledging that research progress varied due to these unprecedented circumstances. The information presented should be read in conjunction with the publications and other outputs from each project. To date, there are 181 peer reviewed publications spanning eighty journals, all collated on the GACD publications portal.

The Diabetes Research Programme highlights the central importance of engaging stakeholders to increase the likelihood of delivering relevant and sustainable outcomes and impacts. More than 20 stakeholder groups were engaged across the programme using a variety of mechanisms. Service users and healthcare professionals were engaged in every project. Local policymakers were the next most frequently engaged group; they, along with national policymakers, were found to be of great benefit, due to access to and influence on national health systems and guidance. Indeed, a thorough formative research phase that meaningfully engaged key stakeholders was often indicative of overall success.

Across the programme, project teams adopted a multifaceted research strategy, incorporating a variety of methodologies and research tools. Six study designs were utilised across projects to investigate the complex interplay of factors influencing implementation. To provide a robust theoretical foundation, 17 implementation science theories, models, and frameworks were systematically integrated into the studies.

Understanding context and equity is critical. Thorough and thoughtful assessment reveals specific factors and patterns that may be barriers or enablers to implementation. Across projects, the need to tailor all aspects of the implementation plan to contextual factors is emphasised. The challenge of knowing to what extent context can, and should, be taken into account in studies is also acknowledged. The prevailing social determinants of health and related equity challenges cannot be ignored, calling attention to a consideration of more upstream contextual factors when implementing T2D and GDM interventions. The collated contextual data and recurring trends observed in multiple settings can be used to inform the development and refinement of future implementation strategies and research.

Analysis identified nine themes to describe the range of implementation strategies designed and employed across projects. These themes provide a base for further analyses, highlighting trends in both the use of particular implementation strategies in specific settings, and repeated combinations of themes. Knowledge building for service users was one of the most common implementation strategy themes and its importance to improving overall T2D outcomes is emphasised in all target populations. On the other hand, despite m-Health being another common theme, the need to carefully assess the application of such strategies in any study is acknowledged, due to the varied project outcomes that have emerged.

Results and outcomes are examined in relation to these overarching implementation strategy themes. Additionally, the report provides a broader perspective on how the projects have collectively advanced implementation science and contributed to wider healthcare goals. Key lessons learned from these efforts are also highlighted.

Whilst health and socioeconomic impact can take time, the outcomes from GACD implementation research have informed and influenced change in healthcare policy and practice for T2D and GDM. To date, twelve out of the fourteen projects have reported impact. Most frequently this is associated with

strengthened national health systems, influence on health programmes, strategies, or guidelines, and programmes taken to scale. Beyond this report, detailed narrative case studies of project impact are provided on the GACD website.

Collective impact was nurtured further through participation of project teams in the GACD Research Network. Within this, members work collaboratively both within their disease area and more broadly on topics of cross-cutting interest. The Research Network also acts as a hub for capacity and capability strengthening. Researchers within the diabetes projects led, contributed to, and learned from training events aimed to broaden and deepen expertise in implementation science for non-communicable diseases, particularly in LMICs. The shared resources and collaborative publications are available on the GACD website. It is hoped that through networking and knowledge sharing, project teams and the programme overall progressed with the best likelihood of collective impact.

It is noteworthy that in 2020, several years after the GACD Diabetes Research Programme was initiated, the Lancet Commission on Diabetes[2] offered four major recommendations to overcome the diabetes burden, through closing the gap in (i) diabetes prevention, (ii) professional knowledge in diabetes, (iii) diabetes care, and (iv) the data gap in diabetes. As the Diabetes Research Programme progresses, its outcomes and impact are becoming increasingly evident. The programme demonstrates a strong capacity to address these previously identified implementation gaps in the field.

1 Introduction

Global burden of diabetes

Diabetes is a serious, chronic, non-communicable disease (NCD) and is one of the leading causes of death and disability worldwide.[3–5] Broadly speaking, diabetes is the body's inability to produce or utilise the hormone insulin, which maintains blood glucose homeostasis.[6] The long-term consequences of diabetes are severe, and it is a major cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputation.[6] In 2021, it was estimated 529 million people were living with diabetes worldwide and prevalence is growing. Latest estimates predict that by 2050, more than 1.31 billion people will have diabetes. Moreover, in every country, those who are discriminated against and marginalised experience the greatest diabetes morbidity and mortality burden.[2]

Diabetes is an umbrella term that encompasses multiple different conditions.[7,8] This can include (not exclusively):

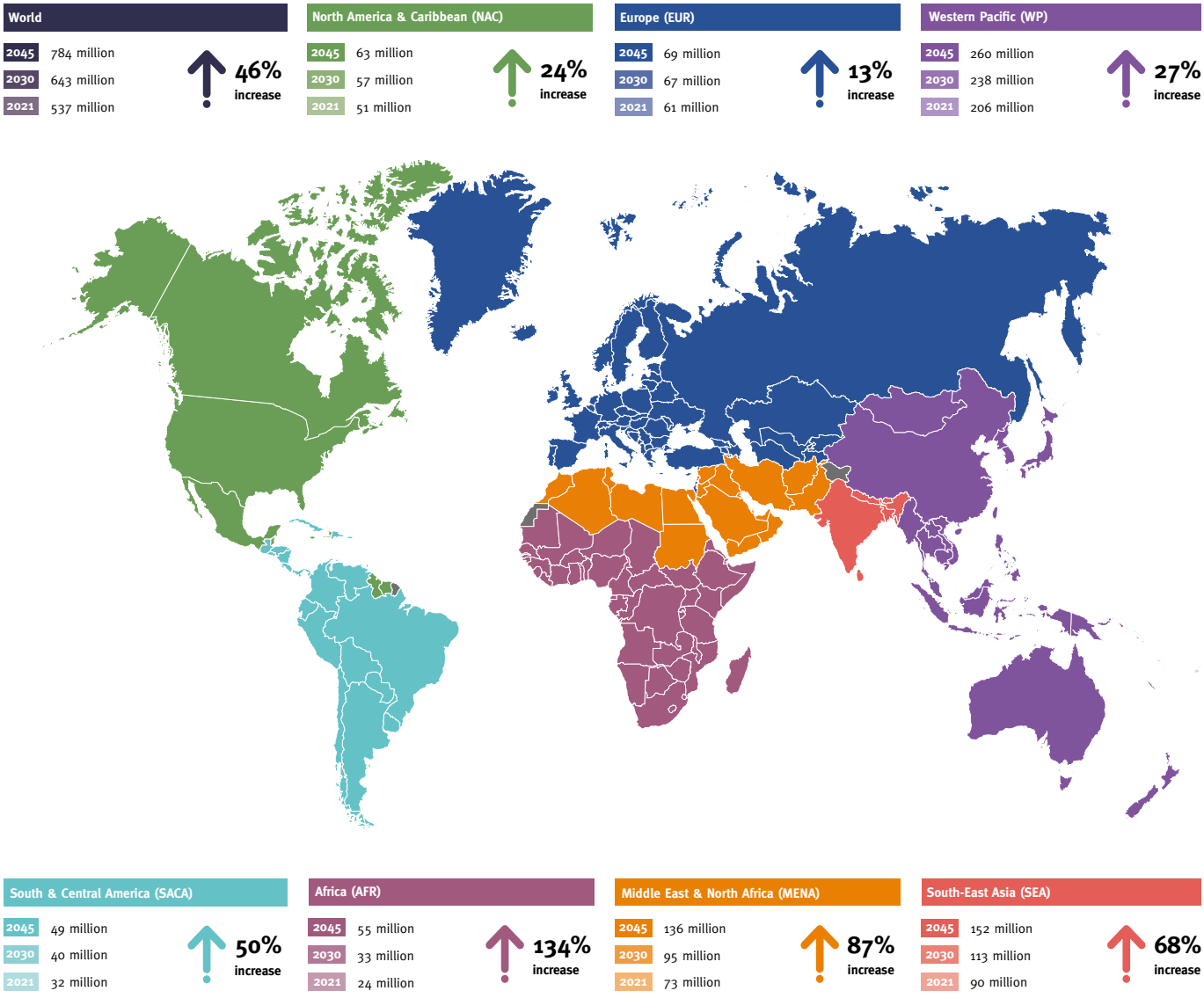
- **Type 1 diabetes** is characterised by the body's inability to produce sufficient insulin and is most often a consequence of genetics.
- **Type 2 diabetes (T2D)** is a condition reflecting the body's inability to utilise the insulin it produces effectively.[6,9] In 2019, approximately 6% of the world's population were diagnosed with diabetes, with 80% of these cases occurring amongst people in low- and middle-income countries (LMICs).[2,10] In high income countries with a history of colonisation, First Nations peoples experience a disproportionate burden of diabetes, with prevalence as high as 40% in Aboriginal people in remote Central Australia.[11]

  It is estimated that of this global burden of diabetes, up to 95% can be attributed to T2D.[12] **Figure 1** displays the worldwide diabetes prevalence, with projected increases until 2045.[13] Key risk factors are associated with the development of T2D, although disease development is often preventable with healthy diet, sufficient physical activity, and maintaining a healthy weight.
- **Gestational diabetes mellitus (GDM)** has been defined for many years as 'glucose intolerance that begins or is first recognised during pregnancy'.[7] However, its classification has been questioned and subsequently adapted, to account for limitations in recognising overt diabetes in women prior to pregnancy.[7,8] GDM is itself also a risk factor for T2D, with about 60% of women with GDM going on to develop T2D later in life.[14,15] The prevalence of GDM varies globally, ranging from 1 to 28%, dependent on specific population characteristics such as age and ethnicity. Across Africa, where there is a general 5% prevalence of diabetes, there is a 12% prevalence of hyperglycaemia in pregnancy.[16]

Diabetes not only has direct impact on an individual's own health and quality of life, but there are also wider consequences at individual, family, and societal levels. Living with T2D increases the risk of developing many other co-morbidities, ranging from chronic kidney disease to neurological conditions such as depression.[17] From a biological perspective, diabetes in pregnancy (DIP), encompassing GDM and pre-existing diabetes, can influence future generations. It is a contributing factor to the global burden of T2D, increasing the risk for both mothers and their children.[18,19]

Economically, the direct costs of healthcare for diabetes are high, but the added loss of income and earnings through ill health can exacerbate poverty with further impacts at individual, family, and societal levels. With prevalence increasing, it has been estimated that the global economic burden of diabetes will have doubled to $2.5 trillion (USD) between 2015 and 2030.[20]

Figure 1 Worldwide diabetes prevalence per International Diabetes Federation region of people aged 20–79 years. 2021–2045 projected increases in prevalence shown.



Reproduced with permission. Source: International Diabetes Federation. IDF Diabetes Atlas, 10th edn. Brussels, Belgium: International Diabetes Federation, 2021. http://www.diabetesatlas.org

Implementation science and its role in NCD control

For many chronic diseases including T2D, there are strong evidence-based interventions that can reduce the risk of developing diabetes and/or the risk of developing diabetic complications. Indeed, the World Health Organization (WHO) Global NCD Action Plan Appendix 3 identifies cost-effective 'best buy' interventions targeting risk factors or diabetes management that governments worldwide might adopt.[21] However, often the evidence of effectiveness has only been determined in specific (frequently high income) settings. Strategies for implementing such interventions successfully in very different contexts and cultures are often lacking. This is where implementation science plays a significant role.

Implementation science was defined early in its conception as "the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practice into routine practice and, hence, to improve the quality and effectiveness of health services".[22] Through implementation science, investigators apply rigorous research methods drawing from diverse disciplines to study strategies that facilitate the uptake of evidence-based health interventions into regular use in ways that remain effective but are accessible and equitable.[23] A key feature of implementation science is its transdisciplinary nature and active engagement with multiple stakeholders – including academics, healthcare workers, service users, and policymakers – in the research endeavour itself.

The GACD Diabetes Research Programme

In 2013, the Global Alliance for Chronic Diseases (GACD) launched a joint call for implementation research proposals focused on prevention and management of T2D. Ten international funding agencies participated in the call (**Table 1**). The overarching aim was to tackle the growing global burden of T2D in LMICs and Indigenous Populations in Canada and Australia (populations in high-income countries (HICs) experiencing health inequities) by developing implementation science-based evidence intended to inform policy and practice.

About the Global Alliance for Chronic Diseases (GACD)

The GACD is an international alliance of major public research funding agencies dedicated specifically to combating NCDs in underserved populations across the world. As an alliance of funders, GACD leverages substantial resources to support critical implementation research initiatives in tackling the growing burden of NCDs.

Through its funding calls and capacity development activities, GACD fosters international collaboration between researchers, policymakers, and stakeholders from diverse backgrounds. This collaborative approach promotes the exchange of best practices, accelerates learning, and amplifies the impact of NCD implementation research globally.

For more information, please see the GACD website: www.gacd.org

At the outset, 17 proposals were awarded funding and became projects under the GACD Diabetes Research Programme (DM01 to DM17). However, two proposals were not funded in the end (DM05, DM09). One project (DM06), although funded, has not participated in this reporting. This report focuses on the remaining 14 projects of the Diabetes Research Programme.

The total funding for projects within the programme exceeded $21 million (USD).* The research within the programme explored implementation of evidence-based interventions addressing risk factors (including GDM), lifestyle, and behaviour changes, and reducing the complications of T2D in 19 countries around the world.

The funded projects aimed to equip healthcare providers and decision-makers with solid evidence for implementing effective diabetes prevention and control programmes that would:

- Reduce health inequalities and inequities in the prevention and management of T2D in both a local and global context.
- Provide evidence on the effective scaling up of interventions at the local, national and regional level.

GACD prioritises knowledge sharing across all projects within a Research Programme. This is achieved by integrating project teams from all its Research Programmes into the GACD Research Network. This community fosters collaboration through thematic working groups that span projects and programmes. Project teams are also expected (and funded) to attend regular networking events, including workshops and the GACD Annual Scientific Meeting. These events aim to create synergies and leverage accumulated knowledge, ultimately maximising the impact of all projects.

Table 1 GACD Associate Members (funding agencies) who participated in the diabetes funding call.

Due to co-funding arrangements, some projects are listed under more than one agency, resulting in a total exceeding 17 projects.

GACD Associate Member (funding agency)	Country or region	No. of diabetes projects funded
National Health and Medical Research Council	Australia	3
Canadian Institutes of Health Research with International Development Research Canada	Canada	4
South African Medical Research Council	South Africa	2
European Commission	Europe	2
Consejo Nacional de Humanidades, Ciencias y Tecnologías (CONACyT) [National Council of Humanities, Sciences and Technologies]	Mexico	2
UK Medical Research Council	UK	2
US National Institutes of Health	US	3
Indian Council of Medical Research	India	1
Chinese Academy of Medical Sciences	China	2

* This figure is approximate, as it takes into account currency exchange rates at the time the funding was awarded.

End-of-Programme report

Aims

This report serves as a summary of the work undertaken by 14 projects funded under the GACD Diabetes Research Programme and, where possible, seeks to provide an initial description and synthesis of the methods, strategies, results, and impact of the projects. The report provides a springboard for researchers to further consider the potential for future meta-syntheses of implementation science projects and invites readers to build on the interpretations presented. The report is accompanied by complementary outputs to aid endeavours to further explore these specific data and/or develop the broader field of implementation science, including:

- A commentary article written by GACD researchers reflecting on this report is in development.
- An online, interrogatable database containing information submitted by diabetes project teams (currently only available to GACD project teams on request).
- Visual one-page summaries of key messages in the report publicly available on the GACD website, tailored to specific audiences.
- A ready-made slide set summarising report content.
- A set of impact case studies on the GACD website.
- Visuals and text for social media posts related to report dissemination.

Implementation science terminology in this report

The funding call that initiated the GACD Diabetes Research Programme was the second joint call launched by GACD. At the time the field of implementation science was in its infancy, with agreement on terminology and conceptual frameworks still emerging. Since then, the field has undergone rapid advancement with a proliferation of awarded grants, publications, established methodologies and more widely accepted terminology.

In part related to its transdisciplinary nature, implementation science has grappled with homonymy (multiple meanings for the same term) and synonymy (different terms with the same, or overlapping, meanings). To achieve internal consistency in use of terminology, this report refers to the contemporary PEDALS framework suggested by Xu and colleagues in 2024 to align with sections of this report.[24]

References to themes or categories under these terms refers to common trends and groupings found through analysis of all project data. Terms such as 'research methods' and 'study designs' refer to the existing scientific classification of studies, such as randomised trials or observational studies. Whereas 'activities used' refers to the specific processes used to carry out the evidence-based intervention, for example focus groups, counselling, or training.

P	**Problem**	The health-related issue at hand. In this report, we describe the 'implementation gap'.
E	**Evidence-based intervention**	The innovation or change in practice with demonstrable clinical effectiveness, sometimes categorised as the "7 Ps":[25] programmes, practices, principles, procedures, products, pills, and policies.
D	**Determinants**	The barriers, enablers and broader contextual factors influencing the implementation strategy used.
A	**Action**	The implementation strategies used to address the determinants. This report uses the terms 'implementation strategy' and 'strategies to address the implementation gap'. The term implementation strategy became increasingly frequent in the extant literature during the early- to mid-2010s, peaking in 2023 (so far) as a term used in over 1,000 PubMed indexed publications.† When the GACD diabetes project teams were developing their research plans and undertaking their studies, it was unlikely the term implementation strategy was being used in this capacity, if at all. More commonly, researchers in this emerging field were using the historically biomedical and epidemiological term 'intervention' to describe their activities. Therefore, due to the vague differentiation between 'intervention' and 'implementation strategy', it has been challenging at times to categorise and separate them in this report. Although efforts have been made to refer to one or the other as explicitly as possible, significant overlap was inevitable given the nature of the field. In this report, when neither 'E' nor 'A' and related terms are mentioned, or if phrases from both are used in conjunction, it can be assumed that the terms were used interchangeably in those instances.
L	**Long-term**	The sustainability and efficacy of the implementation strategies. For this report, we asked project teams to report their outcomes according to the framework proposed by Proctor et al.[26,27]
S	**Scale**	Refers to the robust evaluation of scale through the study design and research methods used. A scientifically rigorous 'S' helps to generate generalisable knowledge. Details on study design and research methods are addressed in Section 5. Wherever possible in this report, the 'S' when used in the context of the PEDALS framework will focus on generalisable knowledge derived from the projects.

† PubMed search (March 2024) for titles and abstracts containing "implementation science" and/or "implementation research"; for illustrative purposes.

With regards to equity challenges faced by projects, we report the strategies used to overcome issues as 'amelioration tactics', rather than implementation strategies, to avoid confusion between these and determinants.

Disclaimer

The aim of this report is to synthesise, summarise, and appraise the findings and impacts of the projects across the Diabetes Research Programme. The authors have made an attempt to standardise the reporting in line with contemporary implementation science categorisation. However, this was done purely for ease of understanding, interpreting, and conveying the findings, not to impose defined guidelines on standardised terminology.

Preparation of this report

A narrative synthesis approach was used to compile information across the Diabetes Research Programme, informed by the guidance of Popay and colleagues.[28] A 27-question pro forma covering all aspects of the project process – from research methods to key findings – was developed in collaboration between GACD staff and primary reviewers. Each project team was invited to complete the pro forma and the contents of each completed pro forma extracted into a database. The data were iteratively categorised by at least two GACD staff. Categorised data were then grouped by project characteristics, such as country of implementation or target population to ascertain trends. Groupings were tabulated into a range of formats and interpreted. The interpretation was reviewed by those noted in Report contributors.

For this report, the GACD diabetes project teams were asked to report their interventions by retrofitting them into contemporaneously and more recently published reporting guidelines,[27] outcome frameworks,[26] and strategy categories.[23,29,30] The retrofitting process highlighted the inherent variability of research projects, across the research process, but most strikingly in the design and application of implementation strategies. Identifying a common rubric among implementation research projects is a challenge and hinders meta-synthesis. Our contributors have, however, made a bold attempt.

2 Overview of the GACD Diabetes Research Programme

Introduction

This report collates the activities of 14 projects spanning more than 25 institutions in 19 countries funded under the GACD Diabetes Research Programme. Full project descriptions can be found on the GACD website.

Whilst all are focused on aspects of T2D prevention or management, there is a breadth of different contexts, settings, populations, and approaches embedded within the studies. Table 2 provides summary characteristics of each project, including primary aim, countries of implementation, duration etc. Table 3 summarises each project using the *PEDALS* framework[24] format, as described on page 12, capturing the problem, determinants and strategies used.

Project spotlights

A selection of projects from the programme are examined in further detail throughout this report as **Project spotlights**. These projects were selected to display the breadth and variety across the programme, encompassing four WHO regions, Indigenous, rural, and underserved communities, people living with T2D, those at risk of developing T2D, and women with GDM and/or DIP, which encompasses both GDM and pre-existing T2D. They also highlight the standout features and findings of each project, such as stakeholder engagement strategies, programme scale ups, and implementation strategies.

Impact case studies

In addition, case studies that highlight specific stories of impact from selected projects are available on the GACD impact webpage.

The 14 projects

DM01	Improving the management of diabetes in pregnancy in remote Australia.
DM02	**SMART Diabetes: S**ystematic **M**edical **A**ssessment, **R**eferral and Treatment for **Diabetes** care in China using Lay Family Health Promoters.
DM03	**IINDIAGO (I**ntegrated **IN**tervention for **DIA**betes r**I**sk after **G**estati**O**nal diabetes): An integrated health system intervention aimed at reducing type 2 diabetes risk in disadvantaged women after gestational diabetes in South Africa.
DM04	**CHAPP: C**ommunity **H**ealth **A**ssessment **P**rogram in the **P**hilippines.
DM07	**SMART2D:** A people-centred approach through **S**elf-**MA**nagement and **R**eciprocal learning for the prevention and management of **T**ype **2 D**iabetes.
DM08	**Feel4Diabetes (F**amilies across **E**urope following a h**E**althy **L**ifestyle **4 Diabetes** prevention): Developing and implementing a community-based intervention to create a more supportive social and physical environment for lifestyle changes to prevent diabetes vulnerable families across Europe.
DM10	Desarrollo de una red social interactiva para el control metabolico de los pacientes con diabetes. [Development of an interactive social network for metabolic control of patients with diabetes]
DM11	Desarrollo y validación de un software ligado a un portal de internet que facilite el tratamiento médico y el empoderamiento del paciente con diabetes tipo 2, la interacción con el personal médico y la generación de un registro en tiempo real. [Development and validation of software to provide medical treatment and patient empowerment to type 2 diabetics, through interaction with medical staff and real-time recording]
DM12	Mobile phone text-messaging to support treatment for people with type 2 diabetes in sub-Saharan Africa: a pragmatic individually randomised trial
DM13	**The Bangladesh D-Magic Trial: D**iabetes **M**ellitus **A**ction through **G**roups or **I**nformation for better **C**ontrol.
DM14	Implementation of foot thermometry and SMS to prevent diabetic foot ulcer
DM15	**BIGPIC: B**ridging **I**ncome **G**eneration with Grou**P** **I**ntegrated **C**are.
DM16	A lifestyle intervention program for the prevention of type 2 diabetes mellitus among South Asian women with gestational diabetes mellitus.
DM17	Tools and practices to reduce CVD and complications in diabetics in Mexico.

Table 2 Summary characteristics of the 14 diabetes projects.

Project ID	Duration										Country(ies) of implementation	WHO region					Country level income				Target group		
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023		AFRO	EURO	PAHO	SEARO	WPRO	Low	Lower Middle	Upper Middle	High	GDM and/or DIP	At risk of T2D	Living with T2D
DM01		→	→	→	→	→	→				Australia					✓				✓	✓‡		
DM02		→	→	→	→	→					China					✓			✓				✓
DM03		→	→	→	→	→	→	→	→	→	South Africa	✓							✓		✓		
DM04		→	→	→	→	→	→				Philippines					✓		✓				✓	✓
DM07		→	→	→	→	→	→				South Africa	✓							✓				
		→	→	→	→	→	→				Uganda	✓					✓					✓	✓
		→	→	→	→	→	→				Sweden		✓							✓			
DM08	→	→	→	→	→	→					Belgium		✓							✓			
	→	→	→	→	→	→					Bulgaria		✓						✓				
	→	→	→	→	→	→					Finland		✓							✓			
	→	→	→	→	→	→					Greece		✓							✓		✓	
	→	→	→	→	→	→					Hungary		✓							✓			
	→	→	→	→	→	→					Spain		✓							✓			
DM10		→	→	→							Mexico			✓					✓				✓
DM11		→	→	→	→						Mexico			✓					✓				✓
DM12		→	→	→	→	→					Malawi	✓					✓						✓
		→	→	→	→	→					South Africa	✓											
DM13		→	→	→	→						Bangladesh				✓			✓					✓
DM14		→	→	→							Peru			✓					✓				✓
DM15		→	→	→	→	→	→	→			Kenya	✓						✓					✓
DM16		→	→	→	→	→	→	→			Bangladesh				✓			✓					
		→	→	→	→	→	→	→			India				✓			✓			✓		
		→	→	→	→	→	→	→			Sri Lanka				✓			✓					
DM17		→	→	→	→	→	→	→			Mexico			✓					✓				✓

Strategy icon key

Community health programme · Community mobilisation · Electronic data management · Facilitator-led group sessions · Microfinance · Mobile application and/or software · Telephone calls · Text messages · Voice messages

Primary aim(s)	Study design summary	Strategies to address the implementation gap *Ordered alphabetically*
To improve systems of care and services for women with diabetes in pregnancy in remote Australia.	Pre/post analysis, with interim process evaluation.	
To develop the SMART Diabetes system and determine its clinical impact for people with T2D.	Cluster randomised control trial, with mixed methods process and economic evaluations.	
To evaluate a novel health system intervention to reduce the risk of developing T2D among women with recent GDM.	Pre/post cross-sectional analysis.	
To adapt the elements of the expanded Cardiovascular Health Awareness Program (CHAP) intervention model to LMICs and evaluate its effectiveness in preventing T2D.	Parallel community cluster randomised controlled trial.	
To enhance T2D care capacity through task-sharing with non-physician providers, empowering community health workers, and building peer support networks.	Hybrid type 2 effectiveness-implementation trial using cluster randomised design.	
To develop, implement, and evaluate a school and community-based intervention to prevent T2D in underserved families experiencing health disparities across Europe.	Cluster randomised control trial.	
To develop a smartphone app and an interactive social network to minimise risk-related attitudes and change behaviours of people with T2D in Mexico.	*Information not available.*	
To develop and validate a tech tool for patient empowerment, quality care delivery, and real-time intervention effectiveness assessment in diabetes management.	Prospective, observational study.	
To assess if SMS text messages can improve health and medication adherence for T2D patients, using a low-cost mobile health system in real-world healthcare settings.	Randomised control trial.	
To prevent intermediate hyperglycaemia and T2D and improve control of T2D in Bangladesh.	Cluster randomised controlled trial with process and economic evaluations.	
To compare the incidence of diabetic foot ulcer between the arm that receives thermometry alone and the arm that receives thermometry and messages (SMS and voice message).	Randomised trial, with process evaluation.	
To explore social and cultural influences, along with potential benefits and challenges, of combining group medical visits with microfinance programmes to reduce cardiovascular disease risk in rural communities.	Four-arm cluster-randomised control trial.	
To test a culturally sensitive, low-cost programme in South Asia to see if it helps women with GDM avoid worsening blood sugar levels after childbirth.	Open-label parallel-group individual randomised trial.	
To evaluate the effectiveness of Meta Salud Diabetes, a group-based behaviour-change intervention to reduce cardiovascular risk among people with T2D.	Two-arm cluster randomised control trial, with process evaluation.	

Health promotion materials Knowledge building and training for healthcare professionals Knowledge building for service users

‡ *Indigenous population. Abbreviations:* ***GDM****, gestational diabetes;* ***DIP****, diabetes in pregnancy;* ***LMIC****, low- and middle-income country;* ***T2D****, type 2 diabetes mellitus.*

Table 3 Summary characteristics of the 14 diabetes projects, as per the PEDALS framework.[24]

Project ID	Problem (implementation gap) (P)									Determinants (barriers and/or enablers) (D)														
	Management of GDM, DIP and/or postpartum care	Inform policy for more effective healthcare strategies	Improved health promotion	Cost-effective health screening, prevention and/or control	Improved treatment adherence	Improved reporting and care for diabetic foot ulcers	Senior-friendly applications	Improved quality of care and/or access	Improved relationship between services users and healthcare facilities	Community behaviours	Knowledge and education	Access to healthcare facilities or medication	Data collection, recording and referrals	Practitioner trust, confidence and/or expertise	Political climate	Natural disasters and emergencies	Gender inequality	Pervasive poverty and inequality	Economic status	Health systems and structure	Human resources	Stakeholder Involvement	Inclusivity
DM01	✓	✓						✓		✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓
DM02		✓	✓		✓			✓	✓	✓	✓	✓		✓					✓	✓	✓	✓	
DM03	✓		✓					✓			✓			✓	✓	✓	✓	✓		✓		✓	
DM04			✓	✓						✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
DM07			✓	✓						✓	✓	✓	✓	✓	✓	✓				✓	✓		
DM08		✓	✓	✓						✓	✓								✓			✓	
DM10		✓					✓			✓													
DM11					✓			✓	✓				✓										
DM12				✓						✓		✓	✓	✓		✓				✓		✓	
DM13			✓							✓	✓	✓		✓			✓		✓				
DM14						✓				✓	✓							✓		✓			
DM15				✓				✓	✓			✓	✓								✓		
DM16	✓									✓	✓			✓		✓							
DM17			✓								✓											✓	

Strategy icon key

Community health programme · Community mobilisation · Electronic data management · Facilitator-led group sessions · Microfinance · Mobile application and/or software · Telephone calls · Text messages · Voice messages

Strategies to address the implementation gap (E & A) *Ordered alphabetically*	Outcome measures (using the Proctor et al. 2011 framework) (L)												Scale (generalisability of research) (S)									
													Strengthened national health system to respond to the burden of diabetes						Influenced national health programmes, strategies, or guidelines			Programme scale ups
	Acceptability	Adoption	Appropriateness	Accessibility	Feasibility	Fidelity	Penetration	Cost	Effectiveness	Satisfaction	Function	Patient-centredness	Improved confidence and skills via training	Improved adherence to clinical guidelines	Support for intervention delivery	Adapted national health programmes	Improved referrals and communication	Increased resources	Working with policymakers and other important stakeholders	Better community engagement	Integration and inclusion of minority groups	Scale ups (S), expansion (E) or further research (R)
		✓							✓				✓	✓			✓	✓	✓		✓	E
					✓	✓		✓	✓					✓	✓				✓			
	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓		✓		✓		S
									✓													S, R
	✓	✓		✓				✓	✓											✓	✓	S, R
															✓			✓				
	✓	✓			✓				✓	✓	✓	✓	✓					✓				
	✓				✓			✓	✓													
	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓					✓	✓	✓	✓	S
				✓					✓						✓			✓	✓			R
									✓									✓				S
	✓	✓	✓		✓	✓			✓	✓											✓	
	✓	✓			✓	✓			✓	✓		✓	✓	✓	✓	✓						S, E

Health promotion materials Knowledge building and training for healthcare professionals Knowledge building for service users

Project characteristics

Target populations

The remit of GACD is to tackle health disparities and improve health equity whether in resource constrained settings as in LMICs or amongst underserved populations in HICs, including Indigenous and First Nations people. The focus of the projects varied between T2D and GDM, and between prevention and management. Although approximately half of the projects focused on T2D prevention, and the other half focused on T2D management, some projects focused on both, such as DM02 and DM13. DM14 was unique in focusing on preventing diabetic foot ulcers (DFU) as a complication of T2D.

Geographic range

GACD projects by nature are collaborative. More than half (9/14) of the projects within the programme explored implementation in more than one country. Some countries were the location for multiple projects. These included Mexico and South Africa, both hosting three different projects and Bangladesh hosting two different projects.

Twelve projects were implemented in LMICs (China, Philippines, India, Bangladesh, Sri Lanka, Kenya, Malawi, Uganda, South Africa, Mexico, and Peru). Four projects were implemented amongst underserved populations experiencing health disparities in HICs (Australia, Sweden, Finland, Hungary, Bulgaria, Spain, Greece, and Belgium).

Figure 2 displays the geographical spread of the 14 diabetes projects.

Implementation gap

Each project aimed to fill an identified implementation gap ('P' in *PEDALS*[24]). Despite the overarching theme amongst all projects being related to T2D and/or GDM, there were a number of different focus areas. These included: management of GDM, DIP and/or postpartum care; informing policy for more effective healthcare strategies; improved health promotion; cost-effective health screening; prevention and/or control programmes; improving treatment adherence; improved reporting and care for diabetic foot ulcers; creating senior-friendly mobile applications; improving quality of care and/or access; and improving relationships between services users and healthcare facilities. **Figure 3** outlines the number of projects addressing each implementation gap. **Table 3** summarises the implementation gaps that each project focused on as part of the PEDALS framework.[24]

Evidence-based interventions

As mentioned on **page 12** evidence-based interventions ('E' in *PEDALS*[24]), are the innovations or changes in practice with prior demonstrable clinical effectiveness. Interventions often demonstrate varying effectiveness when applied to different settings. Implementation research addresses this challenge by systematically evaluating both the clinical impact and the successful adoption of these interventions in new contexts.

Terminology in the field at the time funding was announced was relatively undeveloped and the terms 'evidence-based intervention' or 'intervention' were typically used synonymously with the term 'implementation strategy'. With this in mind, we use the project teams' reported descriptions of activities to define the evidence-based interventions.

Figure 2 Geographical spread of the 14 diabetes projects.

Within the programme different projects focused on different populations:

7%
focused solely on those at risk of developing T2D

21%
on women living with GDM and/or DIP (at risk of T2D, or with pre-existing T2D)

29%
focused on both those at risk of developing T2D and people living with T2D

43%
focused solely on people living with T2D

Implementation strategies

A variety of implementation strategies ('A' in *PEDALS*[24]) were used to implement the evidence-based interventions explored in the projects. To differentiate from evidence-based interventions, we created themed categories to describe implementation strategies. **Knowledge building for service users** and **m-Health** were the most common strategy themes. **Figure 4** summarises the range of strategies used by projects, indicating number and percentage of projects that utilised each strategy. Further details and discussion can be found in Section 7.

Risk factors addressed

Many of the projects in the programme tackled known risk factors associated with T2D. These included hyperglycaemia or impaired glucose tolerance, physical inactivity or sedentary lifestyle, diet and nutrition, overweight and obesity, GDM, and hypertension and cardiovascular disease (CVD). Other recognised risk factors including tobacco smoking, alcohol intake, stress and/or poor mental health, dyslipidaemia, and lack of social support were also addressed but to a lesser extent.

Figure 5 shows risk factors addressed across all projects.

Figure 3 Implementation gaps addressed by the 14 diabetes projects.

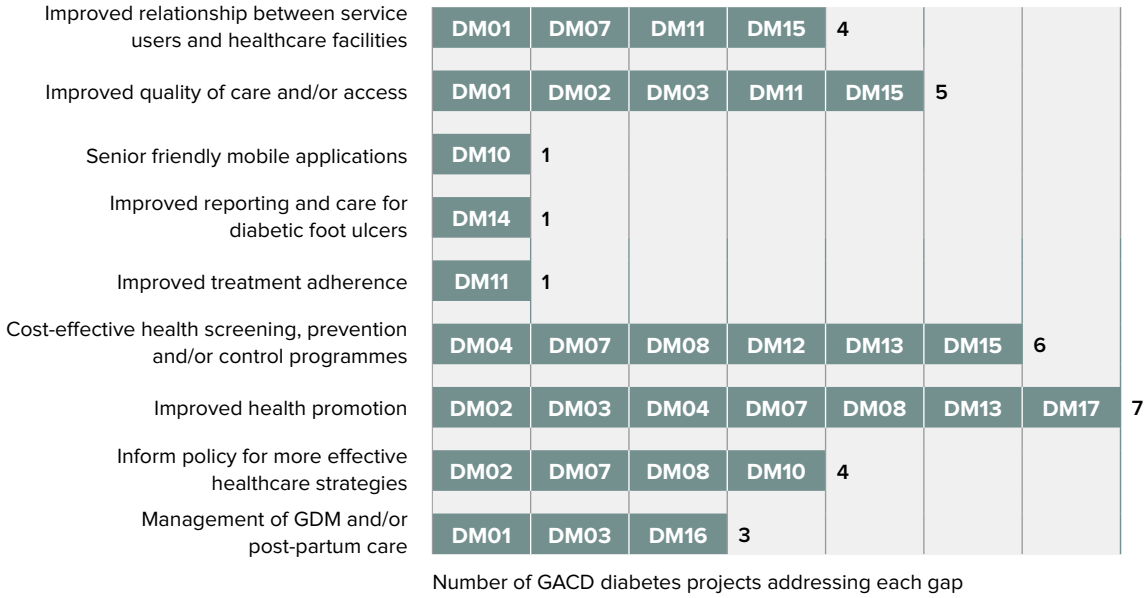


Figure 4 Summary of implementation strategies used across the 14 diabetes projects.

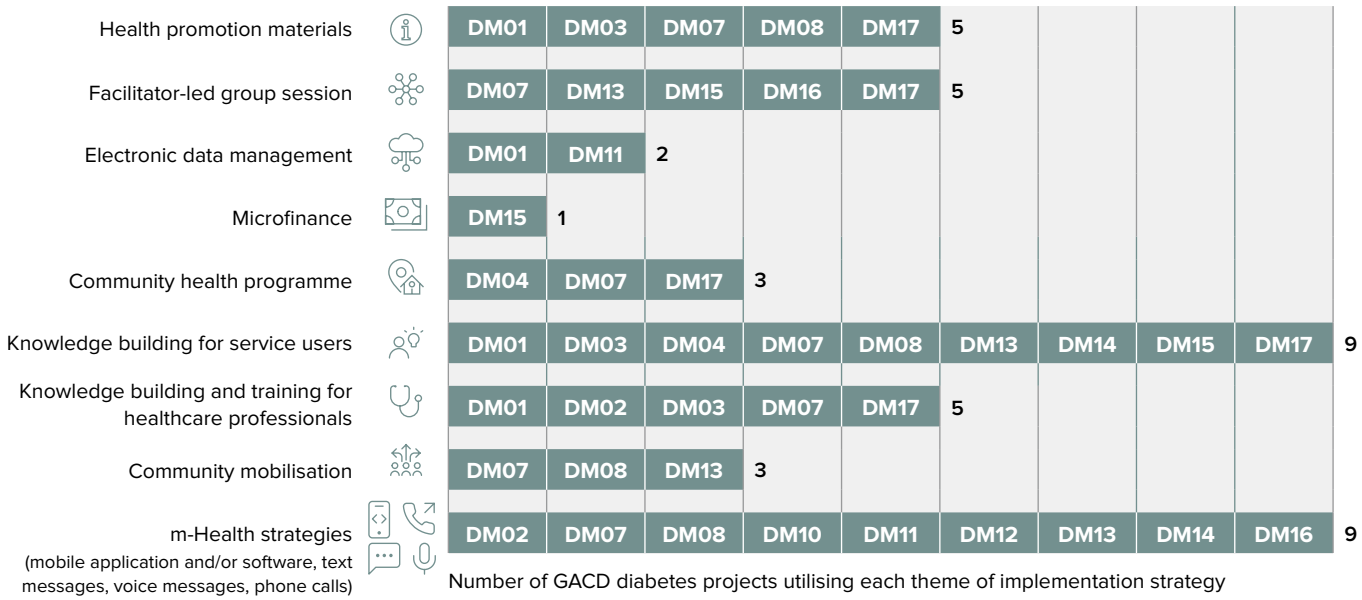
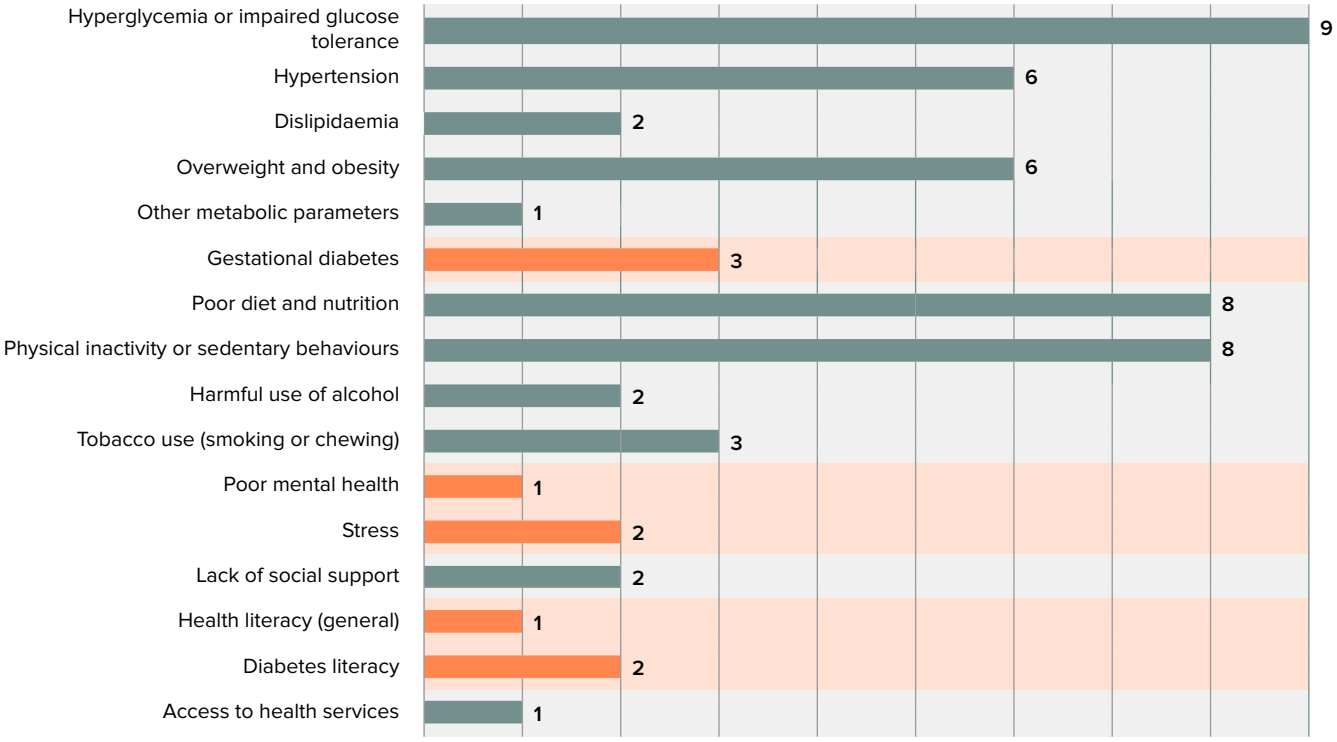


Figure 5 **Risk factors addressed across the 14 diabetes projects, grouped by risk factor category.**



Top group, components of metabolic syndrome; Second group, GDM; Third group, lifestyle factors; Fourth group, mental health and wellbeing; Fifth group, social factors; Sixth group, health literacy; Last group, systemic factors.

Section 2 summary

- Fourteen projects across 19 countries, all based in LMICs and/or working with underserved populations, including Indigenous populations.
- Target populations included those at risk of developing T2D, those living with T2D, GDM and/or DIP, or a combination.
- Implementation gaps varied with most projects focusing on improving quality of care and health promotion, and providing cost-effective health screening, prevention and/or control programmes.
- Risk factors included lifestyle factors, components of metabolic syndrome, mental health and wellbeing, social factors, health literacy and systemic factors.
- Implementation strategies varied, with knowledge building and the use of m-Health activities being the most popular.

3 Theories of change to understand how programme components interact

Theories of Change (TOCs) and logic models are both valuable for planning, designing interventions, and evaluating implementation outcomes. While TOCs typically delve into the why of change, outlining anticipated and known causal links between activities and outcomes,[31] logic models present the what – a linear roadmap of inputs, activities, outputs, and impacts.[32] TOCs acknowledge external influences, while logic models more often focus on internal programme functions.

Understanding these distinctions allows researchers to choose the right tool: TOCs for mapping out complex systems, logic models for clear programme visualisation and outcome tracking. A logic model is a graphical representation of the theoretical interrelationships between inputs, activities, outputs, outcomes and impacts, typically depicted as a sequence of boxes connected with arrows.

Eleven projects reported developing theories of change or logic models: DM01, DM02, DM03, DM04, DM07, DM11, DM12, DM13, DM15, DM16, DM17. These were varied in format, reflecting the diversity of the project needs and the expertise within the teams.

As an example, in DM17, a multilayered context framework[33] (**Figure 6**) was used to identify potential layers of influence within the system as well as elements within each level that could potentially be barriers and facilitators to the implementation of the Meta Salud Diabetes programme. The framework is based on prior frameworks that use the social-ecological model[34] and the COACH tool.[35] These layers of influence then informed the development of their logic model, depicting the anticipated process from inputs, to activities, to outcomes (short-, medium-, and long-term); see **Table 4**.

As a reminder, we refer to the 14 projects by their GACD codes – DM01, DM02, DM03, etc – to help the reader move easily through the text. While reading, you may wish to refer to **page 15** for the list of full project titles and **Table 2** for a summary of project characteristics.

Figure 6 DM17's multi-layered framework for measuring context in clinical settings.

Reproduced from Ingram M et al. (2019) Front Public Health. 7:347.[33] under the Creative Commons Attribution License (CC BY).

Table 4 DM17's project logic model.

Inputs	Activities	Short-term outcomes
People with diabetes who participate in chronic disease self-help groups (GAM) within state-run health centres. Government guidelines for GAM and diabetes and cardiovascular disease prevention. Previous evidence-based interventions.	13 weekly education sessions: • Information on diabetes management and cardiovascular risk reduction. • Small-group discussion and reflection. • Participatory education techniques aimed at awareness-raising. • Goal-setting and weekly monitoring of glucose, blood pressure, eating and physical activity habits. • Physical activity routine.	Acquire information and skills to make healthy changes to nutrition and physical activity habits for diabetes self-management. Improve biomedical indicators: • BMI • HbA1c • LDL and HDL cholesterol • Triglycerides • Blood pressure
Health centre staff who facilitate existing chronic disease self-help groups (GAM): nurses, health promoters, physicians, among others.	Train GAM facilitators to implement MSD. Provide materials (including MSD Facilitator Handbook and Participant Workbook). Provide instructions that encourage self-evaluation.	Learn participatory methodology for health promotion and diabetes secondary prevention education. Improve skills for facilitating GAM and other chronic disease prevention interventions.

***GAM**, chronic disease self-help groups; **MSD**, Meta Salud Diabetes programme.*

This table was prepared by the DM17 research team, with special thanks to Catalina Denman, Maia Ingram, Jill de Zapien, and Elsa Cornejo.

Medium-term outcomes	Long-term outcomes	Goal
Learn how to make and maintain healthy eating and nutrition behaviour change. Promote family and community involvement in diabetes secondary prevention. Reduce stress related to living with diabetes.	Maintain individual behavior change goals for longer than three months. Foster empowerment; personal and collective agency. Improve emotional well-being. Promote self-help group cohesion.	Improve the physical and emotional well-being of participants with diabetes.
Promote an emphasis on salutogenesis rather than pathogenesis. Promote facilitator self-evaluation and continuous improvement of GAM implementation.	Broaden the focus of diabetes prevention and care activities within health centres from the individual patient level to other socioecological levels. Extend the focus of diabetes care beyond a biomedical approach.	Reinforce a health promotion perspective within the health sector.

Section 3 summary

- TOCs and logic models are important at multiple stages throughout a project, providing the why and what, respectively.
- Eleven projects from the GACD Diabetes Research Programme used a TOC or logic model.
- DM17 provides an example of a multi-layered context framework, building from the socio-ecological model and the COACH tool.

Further reading

To explore the theories of change and logic models created across the Diabetes Research Programme, please access the publications below.

DM01	MacKay D et al. (2020) BMC Health Serv Res. 20(1):814.
DM02	Zhang P et al. (2024) Lancet Reg Health West Pac. 49:101130.
DM03	Murphy K et al. (2023) BMC Public Health. 23(1):894.
DM04	Agarwal G et al. (2019) BMC Public Health. 19(1):682.
DM07	De Man J et al. (2019) PLoS One. 14(3): e0213530.
DM12	Leon N et al. (2021) BMC Public Health. 21(1):147.
DM13	Morrison J et al. (2019) BMC Endocr Disord. 19(1):118. Jennings HM et al. (2019) Glob Health Action. 12(1):1550736. Morrison J et al. (2022) Glob Public Health. 17(7):1299-1313.
DM15	Pastakia SD et al. (2017) J Gen Intern Med. 32(5):540-548.
DM16	Shanthosh J et al. (2020) BMJ Open. 10(12):e037774.
DM17	Ingram M et al. (2019) Front Public Health. 7:347.

4 Stakeholder engagement

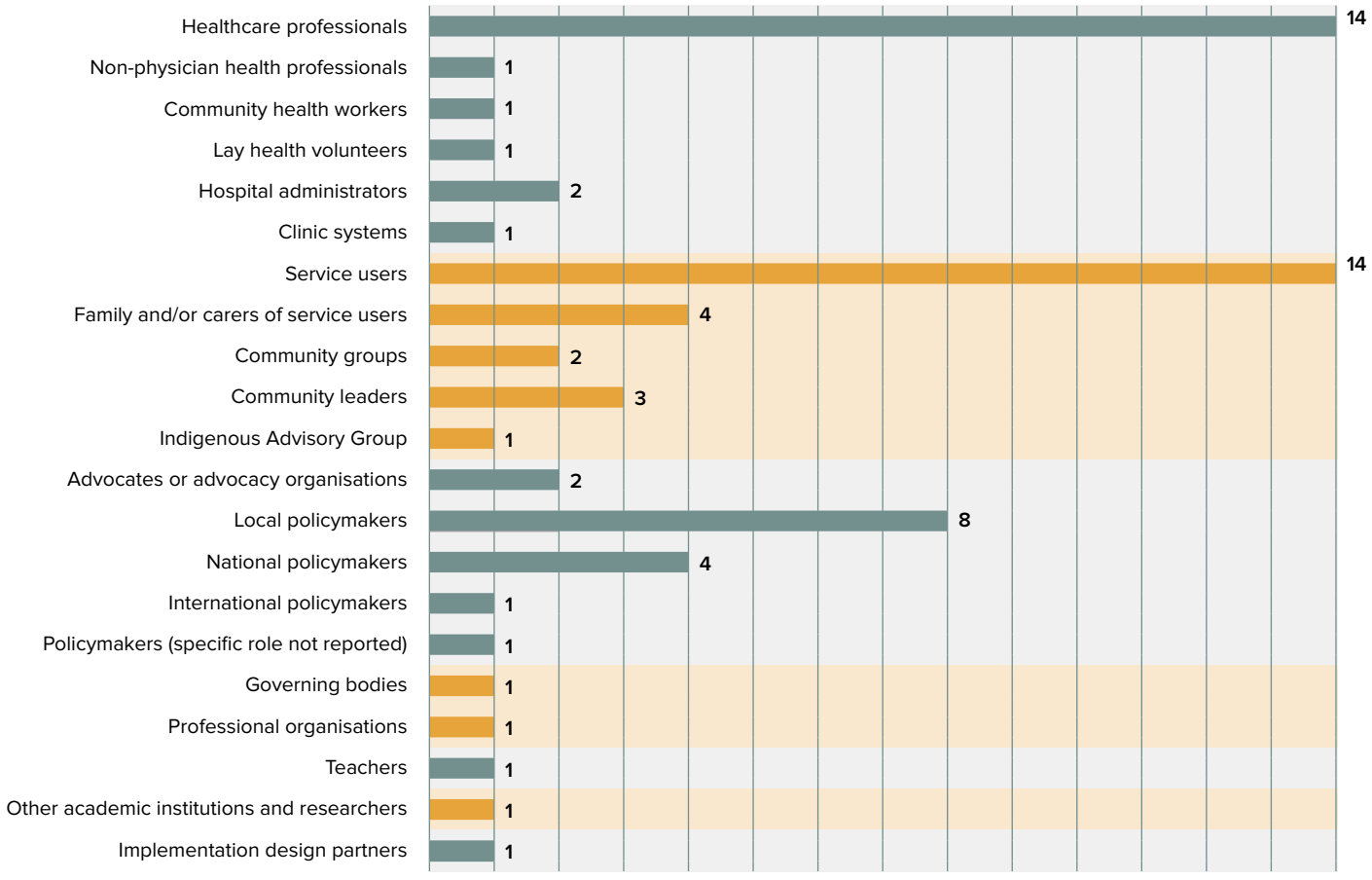
Implementation research is most effective when conducted in collaboration with relevant stakeholders. Identifying and engaging with these individuals is crucial and, ideally, should be done before, during, and after the study. Key stakeholders often include the people who will ultimately benefit from the research, as well as their families and communities. By involving diverse stakeholders in a collaborative approach, implementation research can more effectively address the challenges of diabetes prevention and management.

In the GACD Diabetes Research Programme, 21 stakeholder groups were engaged across the 14 projects. Service users and healthcare professionals were the most commonly engaged parties, involved in 100% of projects. Local policymakers were the second most common stakeholder group, engaged by eight projects (57%). Other common stakeholder groups included family and/or carers of service users, lay healthcare workers and/or volunteers, community leaders, and national policymakers (**Figure 7**).

Family members of service users

Four projects engaged with families and/or carers of services users (DM02, DM11, DM13, DM14), and one included family as target populations (DM08). DM08 was a particularly interesting example of family involvement across six European countries, as they measured the interaction between multiple psychosocial factors and relationship dynamics, and their overall effects on T2D risk.

Figure 7 Stakeholder groups and frequency of engagement across the 14 diabetes projects.



DM02 interviewed family members of service users in China to help with development and design of their mobile application by understanding the service user needs and preferences. They also included family and/or carers in the evaluation stages of the project.

In the case of DM11 (Mexico) and DM14 (Peru), family members and/or carers of service users were included in data collection, to ensure that service users were providing correct information, or if the service users were unable to provide information on their own. DM11 also went on to include family and/or carers in their trial. DM13 had a focus on community mobilisation in Bangladesh, and so regularly engaged with family and/or carers throughout the project, specifically during formative research, community intervention activities, and as participants of qualitative and quantitative evaluation.

Community leaders and groups

Community leaders and community groups were also engaged by DM13. The former was included in the same capacity as family and/or carers, with the addition of engagement at the community orientation meeting at the start of the project, where they sought community consent for the project, involvement in the randomisation process for the trial, and inclusion in the community advisory committees in each sub-district, who informed and influenced project activities throughout. The latter was also included in the same capacity as family and/or carers, with the addition of engagement using Visual Participatory Analysis to contribute to interpretation of study findings, and inclusion in the community advisory committees.

DM15 also engaged both community groups and specific leaders in Kenya, and DM04 engaged community leaders only. In DM15, both stakeholder groups were engaged using focus group discussions to improve the interpretation of study findings during the study. DM04 specifically engaged with community leaders in the Philippines through qualitative interviews regarding their perceptions about how to adapt the CHAP-P programme to the local setting and integrate it with the existing health system.

Healthcare workers

Healthcare workers constituted a variety of expertise including, facility-based health workers, community health workers, lay health volunteers, non-physician health professionals such as auxiliary nurses, dieticians, midwives and counsellors, and hospital administrators. Four projects engaged with lay health workers and/or volunteers (DM04, DM07, DM10, DM16). DM04 engaged with lay health volunteers in the same capacity as community leaders, as well as during evaluation of the CHAP-P programme, which led to improved programme design and implementation. Hospital administrators were engaged by DM10 and DM16, as part of project development and throughout the implementation.

Similarly, DM16 also included non-physician health professionals as part of their implementation strategy. Community and facility-based health workers were an integral part of DM07, since they were utilised as part of the implementation strategy. This involved training and information sessions at multiple stages, to improve T2D outcomes for service users. There was an emphasis on how use of community health workers was accessible, low-cost and low-intensity, and so ideal for resource limited settings.

Engaging with policymakers

Five projects proactively engaged national or international policymakers, although, it has been reflected that maintaining their engagement throughout projects proved challenging. Opportunities to engage with national or international policymakers can be more limited than engaging with local policymakers, but it is widely recognised it is still important to engage with them where possible as this can lead to greater impact. Research team members found it easier to build relationships with local policymakers than at the national or international level and a significant challenge at the time hindering interaction was the national and international response to the COVID-19 pandemic, both constraining travel and interaction as well as diverting political attention.

In Northern Australia, one of the projects, DM01, seeking to improve DIP outcomes engaged with a vast array of stakeholders and have reflected on their engagement in detail. Further details can be seen in **Project spotlight 1**.

Engagement strategies and timing

To cultivate stakeholder involvement a range of engagement strategies were employed, including qualitative interviews, focus group discussions, surveys, and meetings. It is noteworthy that the majority of stakeholders were engaged before as well as during the implementation of the evidence-based intervention. Frequently stakeholders were engaged at more than one point in the projects, with ten projects engaging policymakers at least at two points. Local policymakers were engaged equally before, during and after implementation. Importantly, local policymakers have emerged as particularly impactful contributors, fostering strong connections between research, policy, and practice.

As a reminder, we refer to the 14 projects by their GACD codes – DM01, DM02, DM03, etc – to help the reader move easily through the text. While reading, you may wish to refer to **page 13** for the list of full project titles and **Table 2** for a summary of project characteristics.

Section 4 summary

- Twenty-one different stakeholder groups were engaged across all projects.
- Healthcare professionals and service users were most commonly engaged, and local policymakers were second most engaged.
- Service users and healthcare professionals were engaged in all projects.
- Family and/or carers of service users, community groups and/or leaders, and lay healthcare workers and volunteers were the next most common stakeholder groups to be engaged. They provided contextual data and allowed for subsequent adaptations in each project setting.
- Engagement strategies varied in style and timing, with the majority being engaged during development or implementation stages, using interviews, meetings, focus group discussions or surveys.

Further reading

To explore stakeholder engagement across the Diabetes Research Programme, please access the publications below.

DM01	Maple-Brown LJ et al. (2020) The Lancet Diabetes & Endocrinology 8(7), 559-560.
DM07	Al-Murani F et al. (2019) Global Health Action 12:1609313.
DM13	Pires M et al. (2022). J Epidem and Comm-Health 76:586-594. Mannell J et al. (2020) Journal of Mixed Methods. Research 15(1), 18-36.
DM15	Dong R et al. (2021) PLoS One 16(6): e0248496. Leung CL et al. (2020) BMC Health Services. Research 20: 415.
DM17	Aceves B et al. (2021) BMC Health Services Research 21(177). Velázquez-González OM et al. (2020) Horizonte Sanitario 19(3):441-52.

Project spotlight 1

DM01 Improving the management of diabetes in pregnancy in remote Australia

Aims

1 To improve systems of care and services for women with diabetes in pregnancy (DIP) in remote Australia.

2 To expand the Northern Territory DIP Clinical Register across all regions of the Northern Territory, thereby scaling-up and extending coverage of an innovative clinical system.

3 To establish a DIP Clinical Register in Far North Queensland.

Location

Australia – Northern Territory and Far North Queensland.

Implementation strategies

The intervention aimed to strengthen systems of care for diabetes in pregnancy through addressing five key components:

- Increasing workforce capacity, skills and knowledge and improving the health literacy of health professionals and women.
- Improving access to healthcare through culturally and clinically appropriate pathways.
- Improving information management and communication.
- Enhancing policies and guidelines and promoting through clinical champions.
- Embedding the Northern Territory and Far North Queensland Diabetes in Pregnancy Clinical Register within the models of care as a continuous quality improvement tool.

This study was conducted by the Diabetes Across the Lifecourse: Northern Australia Partnership ("the Partnership"), which has a vision of working in partnership with Aboriginal and Torres Strait Islander people, primary health care and community-controlled organisations to break the cycle of type 2 diabetes and related conditions.

Stakeholder engagement

Aboriginal and Torres Strait Islander Advisory Group

The Aboriginal and Torres Strait Islander Advisory Group was formed during this study, and informed study implementation activities, evaluation and interpretation of evaluation findings.

The Advisory Group were essential in ensuring a strong Aboriginal and Torres Strait Islander voice relating to all aspects of the study. During and after this study, the Advisory Group has resulted in two-way capacity-building across the Partnership, and has determined the priorities for the Partnership's current and future research.

See next page for *Stakeholder engagement* table.

Suggestions for future research

Process evaluation findings from this could be applicable to other settings, including:

- Importance of strong relationships between implementation team and external stakeholders.
- Having champions in roles which are well-placed to influence clinical practice.
- Ensuring implementation activities are well aligned with health service priorities.
- Where possible, integrating implementation activities with existing health service systems.
- Ensuring study involves leadership from people in key target population (First Nations women in this case).

Stakeholder engagement

Stakeholder	Engagement strategy			Reflections
	Before study	**During study**	**After study**	
Service users (Women with GDM)	Not directly engaged as study participants; the study's Aboriginal and Torres Strait Islander Advisory Group (see below) includes representation of women with lived experiences of diabetes in pregnancy.			
Healthcare professionals	Consulted with during formative work – interviews, focus groups, surveys. Some clinicians included as investigators and members of the study's Clinical Reference Group, with regular investigator meetings and annual Clinical Reference Group meetings. Investigators were invited to regular investigator meetings.	Regular educational presentations in a variety of formats across multiple health professional groups. Distribution of Partnership newsletters, policy and practice updates, and key findings reports from the Diabetes in Pregnancy Clinical Registers. Distribution of postpartum follow-up lists to clinics. Ongoing consultation, including annual Clinical Reference Group, quarterly Advisory Group meeting and active seeking of feedback such as after educational presentations. Investigators were invited to regular investigator meetings.	Presentations and written updates distributed to healthcare professionals regarding study findings. Ongoing consultation through the Clinical Reference Group and Advisory Group on issues such as the sustainability of the Diabetes in Pregnancy Clinical Registers and other ongoing efforts to improve systems of care for diabetes in pregnancy; increased frequency of Clinical Reference Group meetings to quarterly. Investigators continue to be invited to regular investigator meetings, with several informing the direction of subsequent projects through the Partnership's Steering Committee.	Study activities relating to engaging healthcare professionals were highly valued and contributed to development of a network where clinicians could access support in providing care for women with diabetes in pregnancy. However, maintaining engagement was found to be resource-intensive and had challenges, including high clinician turnover, limited clinician capacity and a variable degree of clinician interest.
Local policymakers	Consulted through meetings and formal qualitative interviews; invited to be study investigators. Included as investigators.	In collaboration with local policymakers, local guidelines were reviewed, updated and promoted as part of the study. Inclusion in Clinical Reference Group. Investigators were invited to regular investigator meetings.	Advised of study findings. Ongoing consultation through the Clinical Reference Group and other forums, such as the Diabetes Network, regarding sustainability of the Diabetes in Pregnancy Clinical Registers. Investigator meetings and Partnership Steering Committee meetings.	Facilitated by strong pre-existing relationships between the Partnership and local policy makers.
National policymakers	Study principal investigator Prof Maple-Brown sat on Councils of the Australian Diabetes Society and the Australasian Diabetes in Pregnancy Society and National Diabetes Strategy Expert Reference Group, and therefore had a direct influence on guidelines at a national level and was able to promote the importance of the issue of diabetes in pregnancy among First Nations populations at this national level, as did other Investigators Profs Shaw, McIntyre, Oats and Adj Prof Connors.		Study findings informed the Partnership's submission to a federal government parliamentary inquiry regarding diabetes.	
Advocates or advocacy organisations	Representatives of the Aboriginal Medical Services Alliance Northern Territory are included on the Partnership's Steering Committee, with a representative of Diabetes Australia also having been invited.			

5 Research methods, study designs, and theoretical foundations

Implementation science is a field that has emerged from a highly multidisciplinary background and in tackling an implementation research question project teams have a wide array of theories, models and frameworks to draw on. These are used to develop and inform the implementation strategy to be used.

Within the GACD Diabetes Research Programme a range of research methods and study designs were used; see **Table 5** for summary descriptions. These included a feasibility study, a prospective observational study, pre/post analyses, a hybrid type 2 effectiveness-implementation study, and individual randomised trials, and cluster randomised trials. The most common study design was the cluster randomised trial, used by seven projects. Four projects integrated process evaluations into their design and two projects integrated an economic evaluation.

Researcher reflections on methods and designs

On reflection, most project teams were satisfied with the selected methods and design, considering them appropriate for their project's aims and context. Combining qualitative and quantitative data collection and analysis through mixed methods approaches allowed for a comprehensive understanding of the projects' impact, including implementation barriers and enablers, and effectiveness outcomes. Further strengths were recognised in formative research undertaken *with* stakeholders, as this helped ensure relevance and acceptability of the approach to implementation. Additionally, project teams noted the benefits of a strong theoretical foundation, grounded in established theories, models, and frameworks.

In hindsight, many lessons were learned, and project teams would make several improvements if they were to undertake the project again. These included taking a different perspective to designing the research (e.g., taking a health systems approach to explicitly work with the multiplicity of elements interacting to impact an outcome), team building aspects (stimulating cohesion), and data processing aspects (e.g., user-friendly platform designs). Furthermore, project teams noted the importance of accurate power calculations that account for inconsistent follow-up durations (although this cannot always be reliably predicted) and the value of the formative or pilot research phase. Lastly, the impact of the COVID-19 pandemic cannot be understated. Contingency planning for future research projects that includes remote intervention delivery is now a more common component of a 'Plan B'.

Theories, models, and frameworks (TMFs)

TMFs are used in implementation research for three main purposes:

1 To help guide the process of translating research into practice (constituting process models).

2 To understand influencing factors on the implementation outcomes (constituting implementation theories, classic theories and determinant frameworks).

3 To evaluate implementation strategies.

See **Figure 8** for Nilsen's (2015) schema sorting implementation science theories, models, and frameworks.[36]

Despite this typology, there is considerable diversity in the application of these, depending on factors such as context, populations, the intervention type and level(s), and the stage of evidence development.[37]

Across the 14 projects, teams reported using 17 TMFs across a range of purposes, including formative work, intervention implementation, strategy refinement, and evaluation. **Table 6** indicates which TMFs were used and how they were applied during the research process.

The most commonly used TMFs were COM-B (capability, opportunity, motivation and behaviour), an established behaviour change model, used by five projects, followed by RE-AIM (reach, effectiveness, adoption, implementation, maintenance), the MRC Framework for Process Evaluation of Complex Interventions, and the Normalisation Process Theory, each used by three projects.

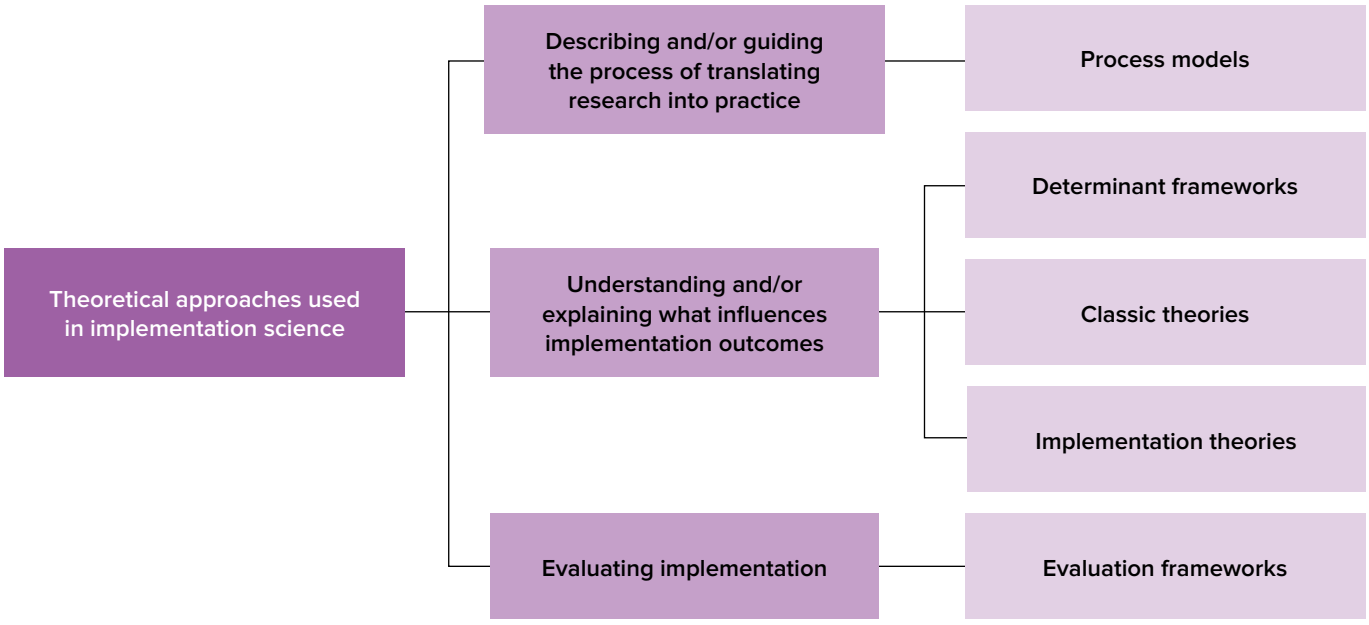
Eight projects used one or more TMFs to inform their formative work; five projects used one or more TMFs to inform intervention implementation; four projects used one or more TMFs to help design and refine their implementation strategies; and 12 projects used one or more TMFs to evaluate implementation.

Eleven of the reported TMFs were used for more than one purpose. For example, the Theoretical Framework of Acceptability was used by DM11 to inform formative work and intervention implementation, and by DM07 to inform evaluation.

Using Nilsen's (2015)[36] categorisation of TMFs, the implementation theories category and the evaluation frameworks category were the most frequently employed by project teams, with eight projects utilising each type.

DM07 provides an example of researchers creating a tailormade framework for their project (**Figure 9**). The team incorporated elements of behaviour change theories, chronic care models and health systems theories alongside contextual data. Their framework was produced over multiple stages, beginning with a thorough literature review of studies with contemporary and conceptual frameworks using factors identified as important for self-management of T2D at four different levels: system, actor, environment and individual. Contextual factors such as the physical environment or socio-cultural elements, were then considered, culminating in an integrated and contemporary framework displaying important interactions between factors and communities. The framework shows a close-up look on the individual level, revealing mediating factors (shown by five white circles), self-management skills (shown by the pentagon), and self-management tasks (shown centrally within the pentagon).[39]

Figure 8 Nilsen's (2015) schema categorising TMFs in implementation research.



Reproduced from Nilsen P. (2015) Implementation Sci. 10, 53.[36] under the Creative Commons Attribution License (CC BY).

Figure 9 DM07's tailored framework (from De Man et al., 2019[39]).

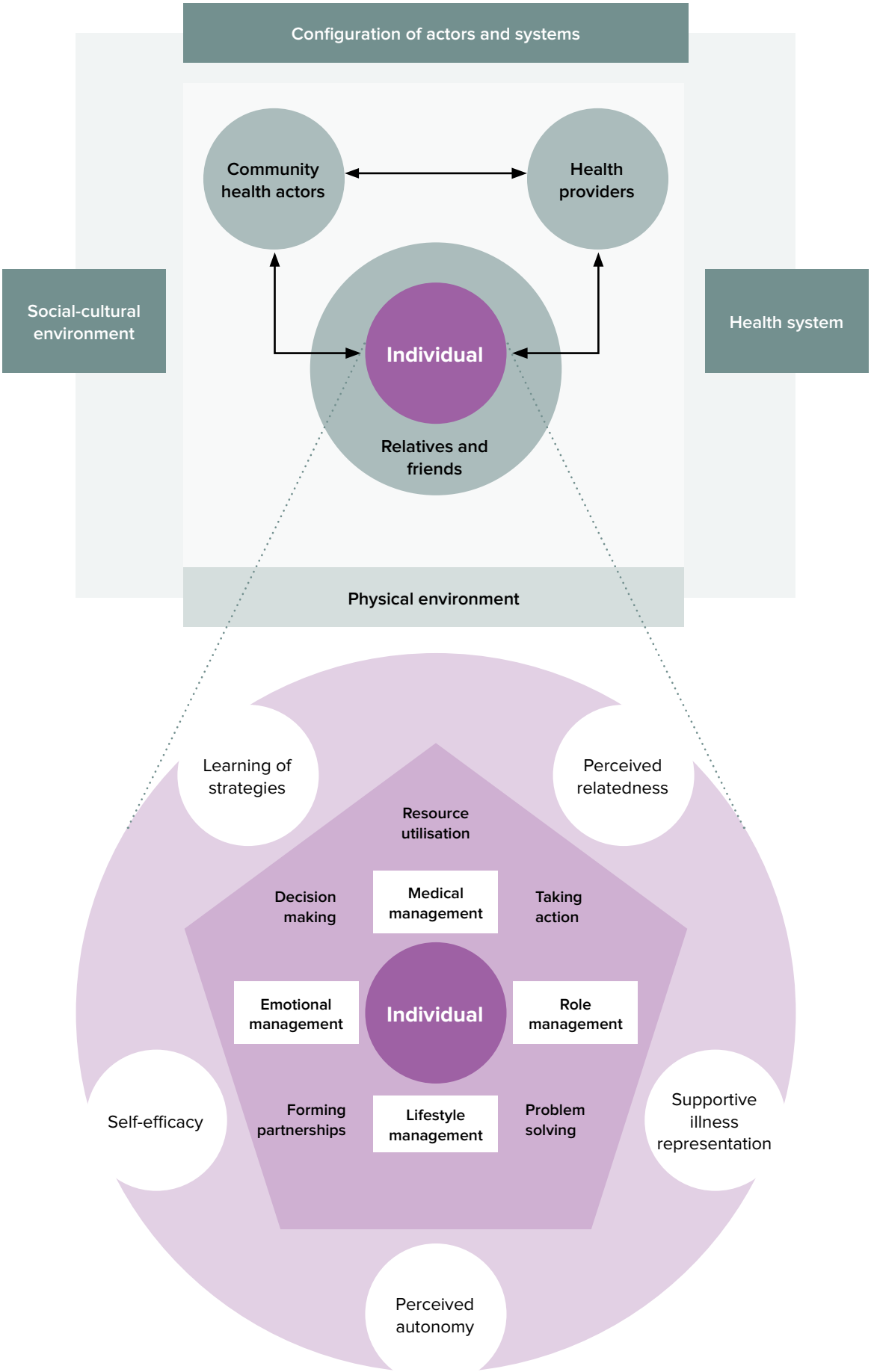


Table 5 Study design summary of the 14 diabetes projects.

Project ID	Summary description of study design	Feasibility study	Prospective cohort	Pre/post analysis	Randomised trial		
					Individual	Cluster	No. of arms
DM01	Pre/post analysis, with interim process evaluation			✓			
DM02	Cluster randomised control trial, with mixed methods process and economic evaluations					✓	Two
DM03	Pre/post cross-sectional analysis			✓			
DM04	Cluster randomised controlled trial					✓	Two
DM07	Hybrid type 2 effectiveness-implementation cluster randomised trial, with integrated feasibility study	✓				✓	Two
DM08	Cluster randomised control trial					✓	Two
DM11	Prospective, observational study		✓				
DM12	Randomised controlled trial				✓		Two
DM13	Cluster randomised controlled trial, with concurrent process and economic evaluations					✓	Three
DM14	Randomised trial, with process evaluation				✓		Two
DM15	Cluster randomised control trial					✓	Four
DM16	Open-label parallel-group individual randomised trial				✓		Two
DM17	Cluster randomised controlled trial					✓	Two

Information unavailable for DM10.

Process evaluation	Economic evaluation	Reflections on methods used, as reported by project teams (edited for brevity)
✓		Methods and design were considered appropriate, enabling analysis of clinical outcomes, as well as implementation enablers and barriers. Mixed methods allowed data collection relating to perspectives across a breadth of clinicians, as well as in-depth exploration of perspectives through qualitative interviews.
✓	✓	The mixed-methods approach was considered optimal. The MRC Guidance on Evaluation of Complex Interventions published after this project completed) would have been useful to include were the project team to start again.
✓		Methods and design were considered appropriate, though evolved into an exploratory trial due to the contextual adaptations needed. In retrospect the project team would have strengthened the formal health systems research component; however, this was challenging in an international collaboration during the COVID-19 pandemic. Using student-led research to conduct formative research, analyse lessons learned (or not), and contribute to the process evaluation was valuable: strengthening research capacities and providing complementary perspectives for triangulation. However, this fragmented the overall approach.
		The original method was a stepped wedge cluster randomised trial. However, during discussions between the researchers, local leaders, and healthcare workers, the project team reviewed their approach and opted for a parallel cluster randomised controlled trial was more feasible to implement.
✓		A strength of the research methods was designing the study from a strong evidence base based on a Theory of Change that incorporated Self-Determination Theory – and contextualised strategies based upon formative research and collaboration with local and sub-national stakeholders, to ensure relevance, acceptability and feasibility for scale up.
✓	✓	On reflection, the selected research methods and study design were the most appropriate choice for the project.
		To further strengthen the research methods, the research team would improve the platform for patients including a friendlier appearance and user experience, expanding with an app for mobile phones, including alarms or reminders for future blood tests or taking medications. For healthcare professionals, they would modify or exclude variables shown to be inconsequential and include additional variables adapted to the intervention strategies.
✓		The project team determined that the use of mixed methods and clinical outcomes was a direct response to the needs of key stakeholders. They intend to replicate this approach in future projects to ensure that their research results remain relevant.
✓	✓	The project team were satisfied with their selected research methods and study design.
✓		The approach taken was considered the best option for this project. In the future, the project may benefit from a formative study and an expanded process evaluation component.
		On reflection, the project team deemed their approach as the best design choice for their study. However, the project team noted it is crucial to understand the limitations of whatever programme you are trying to implement and assess potential (in)equity issues in your plan before you begin the processes.
✓		The study team found their methods effective and may be suitable for similar kinds of enquiry. A chi-square test for the power calculation was planned but recruitment delays led them to use a survival analysis due to varying follow-up times. Despite a strong initial phase promoting engagement, the anticipated behaviour change was not achieved. Learning from the COVID-19 pandemic's impact, they would include a remote delivery plan for future studies.
		The quantitative and qualitative methods were consistent with the research objectives and a good choice for the project as they permitted depth and breadth, but if the project team were to repeat the study, they would have initiated with a longer pilot period to better understand the administrative changes which modified some health centre's context prior to the RCT.

Table 6 Application of theories, models, and frameworks in the research process.

Nilsen (2015) category	Theory, model, or framework*	No. of projects	Application in projects			
			Formative work	Intervention implementation	Strategy refinement	Analysis and/or evaluation
Process models	Knowledge to Action Framework	1			DM04	
	Human Centred Design	1	DM15		DM15	
Determinant frameworks	Theoretical Domains Framework	1	DM13			
	Socio-Ecological Model	1	DM13	DM13		DM13
	Systems Assessment Tool	2	DM01, DM11	DM11	DM11	
	Determinant Frameworks**	1			DM11	DM11
Classic theories	Diffusion of Innovation	1			DM04	DM04
	Biopsychosocial Conceptual Model	1	DM12	DM12	DM12	DM12
	Health Action Process Approach	2	DM08	DM08, DM11		
Implementation theories	COM-B	5	DM02, DM03, DM12, DM13			DM02, DM16
	Normalisation Process Theory	3				DM07, DM16, DM17
	Theoretical Framework of Acceptability	2	DM11	DM11		DM07
Evaluation frameworks	RE-AIM Framework	3				DM01, DM02, DM16
	MRC Framework for Process Evaluation of Complex Interventions	3				DM03, DM13, DM14
	PRECEDE–PROCEED	1	DM08	DM08		DM08
	Saunders Process Evaluation Framework	1	DM15	DM15	DM15	
Strategy frameworks	Behaviour Change Wheel	1	DM03			

* *Categorised as per Wang et al. 2023[38] wherever possible.*

** *Specific frameworks not reported.*

Section 5 summary

- Six different study designs were used across all projects: feasibility study, a prospective observational study, pre/post analyses, a hybrid type 2 effectiveness-implementation study, an individual randomised trial, and cluster randomised trials (most common).
- Mixed methods approaches were reflected on with the most positivity.
- A thorough pilot or development stage, which incorporated stakeholder engagement proved most beneficial in a successful study design and implementation strategy.
- Seventeen TMFs were used across projects to inform and evaluate the research.
- Improvements were suggested in team building, research and data processing aspects.
- DM07 provides an example of a tailormade framework using contemporary TMFs.

Further reading

To explore research methods and study designs used across the Diabetes Research Programme, please access the publications below.

DM01	MacKay D et al. (2020) BMC Health Services Research. 20(1):814.
DM02	Peiris D (2016) Implementation Science 11(1), 1-9.
DM03	Norris SA et al. (2024). BMJ open 14(1), e073316.
DM04	Agarwal G et al. (2019) BMC Public Health 19, 682.
DM07	Guwatudde D et al. (2018) BMJ Open 8(3):e019981.
DM12	Farmer A et al. (2019) JMIR Res Protoc 8(6):e12377.
DM13	Fottrell E et al. (2018) BMJ Glob Health, 3 (6), e000787.
DM14	Lazo-Porras M et al. (2016) Trials 17(1), 1-10.
DM15	Vedanthan R et al. (2017) American Heart Journal 188: 175-185.
DM16	Gupta Y et al. (2018) Diabetic Medicine 36(2): 243-251.
DM17	Sabo S et al. (2018) BMJ Open 8:e020762.


BADAS
CHRI

6 Context

Contextual factors have a substantial impact on the successful implementation of an evidence-based intervention. Taking context into account can help bridge the 'know-do' gap and improve the field of implementation science.[40] Contextual factors can vary from local influences, such as the location of healthcare facilities, to nationwide influences such as political climate. Similarly, context can also be time-specific, for example previous conflict zones, expected seasons of natural disasters like drought or monsoons, and emergency situations like the COVID-19 pandemic. Furthermore, issues of equity add to the contextual climate of any given setting, such as gender inequalities, discrimination, and structural racism.[41] Although it is difficult to standardise what context encompasses, it highlights the importance of understanding the settings in which interventions are being implemented. For further exploration, watch the GACD workshop on working with context to implement NCD programmes.

Often, contextual factors bring to light barriers and/or enablers that are crucial to take onboard for successful implementation research, alongside identifying and overcoming equity challenges where possible. Assessing and understanding context will allow needs of target populations to be identified, and therefore enable more collaborative implementation strategies, helping to close the gap in diabetes prevention and management. The identified context-specific enablers or barriers ('D' in *PEDALS*[24]), as well as equity challenges and amelioration tactics add valuable insight not only for future T2D and GDM research, but also target areas for advancing the field of implementation science.

Understanding context

A systems approach to context

As part of the cross thematic activities of the GACD Research Network a Concepts and Context working group was established, which explored how context is characterised and assessed during the implementation of NCD programmes at different levels. The working group used context-specific data from 20 GACD projects, targeting hypertension, diabetes, and lung diseases.[42] This revealed that project teams used diverse methods (formal/informal assessments, stakeholder engagement, local resources) to assess context across five levels (individual, community, healthcare setting, local/district, state/national). It was common (85% of projects) to assess three or more levels of contexts within the same project, as well as to investigate inter-linkages between different contextual layers. Contextual insights informed intervention adaptation, participation, and communication. Furthermore, the working group identified themes related to incorporating contextual lessons into implementation, including service/information provision, stakeholder engagement, and feedback mechanisms.

For more on GACD working groups involving diabetes projects, see Section 9.

Context-specific barriers and enablers

Within the GACD Diabetes Research Programme 87 contextual factors were identified and reported across projects, which might impact the implementation strategies being explored. The majority of factors identified were barriers (57 factors making up 65%). A further 18 factors were listed as enablers (21%), and the remaining 12 factors fell in both categories depending on the particular context of individual projects (14%). Multiple projects reported the same factors, and so the frequency total (153) surpasses the overall total of 87 individual contextual factors. The frequency of contextual factors reported was 93/153 for barriers, 26/153 for enablers, and 34/153 for both.

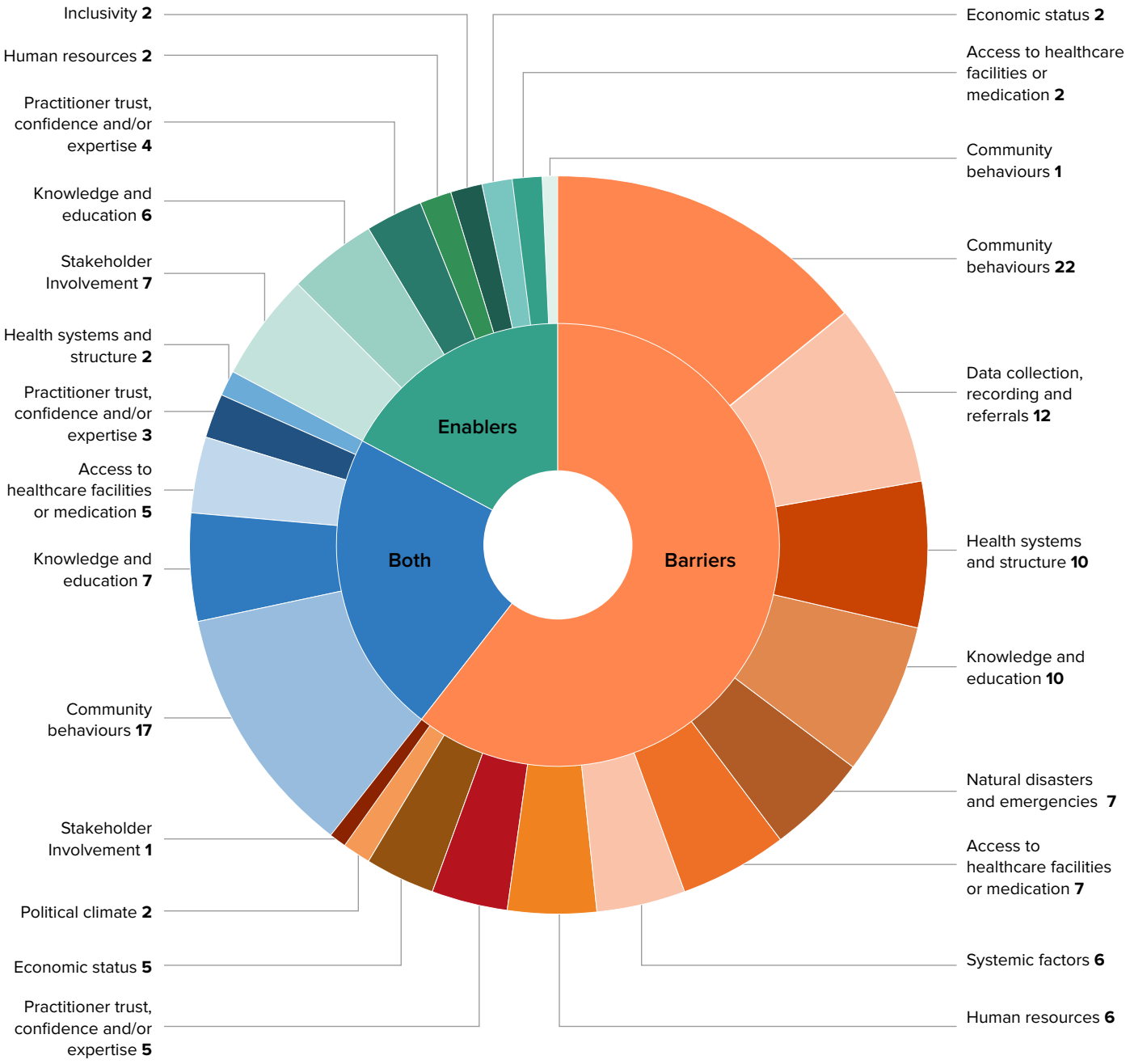
In this report these factors are further grouped by common themes into the following categories: community behaviours, knowledge and education, access to healthcare facilities and/or medication, data collection, recording and referrals, human resources, practitioner trust, confidence and/or expertise, health systems and structure, stakeholder involvement, political climate, economic status, inclusivity, and natural disasters and emergencies. **Annex 1** gives a detailed overview of barriers and enablers encountered by each project. The colours correspond with those of **Figure 10**, which summarise the themes in a sunburst diagram. The frequency shown beside each theme is a tally to how many projects reported a factor under that theme.

Barriers

All projects experienced barriers in some shape or form, whether anticipated or unexpected. Four projects faced barriers that directly impacted their implementation gap, and 10 projects identified barriers that were unexpected or indirectly affected the implementation strategies.

Most barriers fell under the category of *community behaviours* (22/93). *Data collection, recording and referrals* (12/93), *health systems and structure* (10/93), and *knowledge and education* (10/93) were three most common barrier themes following community behaviours. Individual factors

Figure 10 Sunburst diagram of context-specific barriers and enablers faced by the 14 diabetes projects.



Slices of the inner sunburst ring show barriers in orange, enablers in green, and both in blue. Different shades of each colour in the outer sunburst ring correlate with the core colour of the inner sunburst ring. Details of each barrier and enabler can be seen in the Annex, where the colours correspond to this figure. The frequency shown beside each theme is a tally to how many projects reported a factor under that theme.

within these categories included factors such as poor communication between primary and secondary healthcare facilities, fragmented or duplicative health systems, and low patient education levels. Other categories included *natural disasters and emergencies* (7/93) such as changes in weather, *political climate* (2/93), *systemic factors* (6/93) such as gender inequality, *economic status* (5/93), *practitioner trust, confidence and/or expertise* (5/93), *access to healthcare facilities or medication* (7/93), *human resources* (6/93), and *stakeholder involvement* (1/93).

Four projects also faced barriers that directly impacted their strategies for implementation. This included gender inequality, ageing populations' reluctance to engage with mobile software, incompatibility of electronic record systems with existing methods, poverty, and lack of service user engagement. These findings provided useful examples of where challenges faced by strategies can be valuable in adapting future research. Further details on lessons learnt can be found in Section 10.

COVID-19

The COVID-19 pandemic was an unanticipated barrier that significantly affected the progression and completion of projects, in particular all projects focused on GDM or DIP (DM01, DM03, DM12, DM16). Two further projects (DM04 and DM13) faced delays in their related scale up projects due to COVID-19 but with less significant impacts on their overall progression and completion.

Severe restrictions on social distancing and travel affected face-to-face engagement aspects including service user interactions and data collection. Being pregnant put individuals at a higher risk of serious illness from infection,[43] which may explain the larger setbacks experienced by GDM projects.

For example, in Northern Australia DM01 working on DIP, the project team clinicians had to prioritise COVID-19 related pandemic work over research commitments, in addition face-to-face activities were severely restricted hampering data collection. However, despite these issues the project still reached completion, albeit with delays.

Similarly, in Cape Town, South Africa, the IINDIAGO study DM03 working with women with GDM, the pandemic followed a severe period of drought, both unprecedented events for which advanced preparation was not possible. Again, the restrictions on face-to-face interaction and travel affected data collection resulting in a reduced study sample size. Due to these setbacks and delays, the data from this project are still being analysed.

In South Asia, the *Living* study DM16 working with women with GDM, had issues recruiting women and delivering some parts of their intervention, with a need to switch to remote interviews rather than in-person.

Project teams reflected that in the future, having remote contingency plans during formative work would avoid setbacks.

Enablers

The majority of enablers can be grouped under the two thematic categories *stakeholder involvement* (7/26) and *knowledge and education* (6/26). Individual factors within these themes included factors such as existing educational or community health programmes to link the study to, introduction of health-related activities for the general population, stakeholder support, and local government or council involvement and initiatives. Other themes included *practitioner trust, confidence and/or expertise* (4/26), *human resources* (2/26), *inclusivity* (2/26), *economic status* (2/26), *access to healthcare facilities or medication* (2/26), and *community behaviours* (1/26).

Both barriers and enablers

A notable finding from analysis of the research projects was the variation in whether a factor was reported as a barrier or an enabler which was entirely linked to the particular context, setting and culture in which the implementation study was taking place. **Figure 10** and **Annex 1** capture the 14% of factors (in blue) which exhibited this phenomenon. Interestingly, most factors in this category could be grouped under the theme of *community behaviours* (17/34) and include a range of individual factors. For example, community behaviours such as fear could be an enabler where fear of getting sick made service users more likely to adhere to a healthy lifestyle, or as a barrier where fear of healthcare professionals or medication leads to lack of health seeking or adherence to medication. Other themes included *knowledge and education* (7/34), *access to healthcare facilities or medication* (5/34), *practitioner trust, confidence and/or expertise* (3/34), and *health systems and structure* (2/34).

Addressing equity

Achieving health equity is essential to reducing the global burden of disease, including T2D. Inequity only widens the gap in care within populations, with this being an established concept even in HICs.[44] The landmark 'Marmot Review' in the UK identified the 'health gap' phenomenon, highlighting the inversely proportional relationship between socioeconomic status of individuals and their health outcomes, such that poverty is correlated with worse health outcomes.[44] Related contextual factors that interplay with poverty, such as education levels or living conditions, encompass the umbrella term *social determinants of health*. Such equity concerns can also be applied to and adapted for other underserved population settings or LMICs. In the context of T2D, there is a known disproportionate burden worldwide, which can be attributed to social determinants of health, including socioeconomic status (income, education levels, and occupation), physical environment (infrastructure and housing), food environment (security, availability and/or access, and affordability), health care facilities (access, quality, and affordability), and social factors (cohesion, support, and capital).[41,45] Common equity issues that arise in LMICs and/or underserved populations can include discrimination associated with gender, race, disability and age. These are often linked to wider community beliefs and behaviours. These all feed into the issues faced in implementation research, where inequitable healthcare and provisions lead to skewed health outcomes across different contexts.[46] Social determinants of health, alongside general contextual factors underscore the key adaptations required to implement effective strategies for T2D prevention.

Within the Diabetes Research Programme, similar equity challenges arose due to contextual differences. Ten projects reported having assessed equity challenges. These challenges included gender inequality, especially the autonomy and expectations of women in patriarchal settings, access to or reach of healthcare facilities, access to or knowledge about mobile phones, age, disability

Table 7 Arising equity challenges across the 14 projects and strategies to ameliorate them.

Equity challenges			Amelioration tactics	
Challenge category	**Challenge details**	**Project ID**	**Tactic details**	**Tactic categories**
Systemic factors	Health systems often not culturally appropriate for Aboriginal and Torres Strait Islander people	DM01	Embedding of Aboriginal and Torres Strait Islander leadership in the study through inclusion of Aboriginal and Torres Strait Islander investigators and establishment of the Aboriginal and Torres Strait Islander Advisory Group and creation of culturally appropriate educational resources.	Adapt to cultural norms Education and/or training Inclusivity
	Global North and South balance	DM03	Rich collaboration with Global North partner, with no imbalance in partnership, Master's students from Canada visited the sites to conduct process evaluations.	Relationship building
	Inequity in resources in academic institutions	DM17	Openly discussed and looked for ways to increase economic resources to the Mexican institution.	Capacity building
	Inequities in resources within ministry of health	DM17	Provided continued capacity building and partnering with ministry of health beyond the original plans of project.	Capacity building
Environmental factors	Limited access to health services in remote areas	DM01	Embedding of Aboriginal and Torres Strait Islander leadership in the study through inclusion of Aboriginal and Torres Strait Islander investigators and establishment of the Aboriginal and Torres Strait Islander Advisory Group and creation of culturally appropriate educational resources.	Adapt to cultural norms Education and/or training Inclusivity
	More difficulty using digital health technologies in rural areas than urban	DM02	Family members engaged to help with application usage.	Family and/or community
	Variable access to high quality services in rural areas than urban	DM02	Worked with local centres for disease control to implement a quality improvement strategy with care providers in both rural and urban areas.	Quality control
	Low participation rate in urban areas	DM04	Location of CHAP-P implementation moved around to different locations in the community, which slightly improved the participation rate but did not affect it significantly.	Adapt to improve reach
	Difficulty in sustaining peer-based intervention due to contextual factors	DM07	Improved feasibility of the intervention for a disadvantaged population in Sweden by change of delivery strategy from peer group to telephone coaching.	Adapt to improve reach
	Distance needed to travel to reach group sessions	DM13	Arranged venue and time in coordination with communities.	Adapt to improve reach Adapt to cultural norms
Age, sex, and constitutional factors	Gender inequality	DM03	Female scientists involved, project focus on women specifically.	Inclusivity
	Racial or ethnic bias	DM03	MPH student – All PhD students from South Africa.	Inclusivity
	Age and disability status of group members	DM13	Arranged venue and time in coordination with communities.	Adapt to improve reach Adapt to cultural norms
	Gendered barriers to participation	DM13	Made separate groups for men and women to attend and gave them opportunities to work together.	Adapt to cultural norms
	May not be fully representative of general population	DM15	Acknowledged though that the economic challenges experienced by the study participants are not dissimilar from a large proportion of the global population.	Generalisability
Living and working conditions*	Conflicting working hours of groups members	DM13	Arranged venue and time in coordination with communities.	Adapt to improve reach Adapt to cultural norms
	Low tech literacy	DM14	Trained the participant to use the cell phone or include the carer so him/her can receive the messages.	Education and/or training
Social and community networks	No access to cell (mobile) phones	DM14	Included the participants if the carer has an operative cell phone.	Family and/or community
	Hierarchical arrangements in health care settings and broader society adversely impacting participants' ease of expressing experiences and asking questions	DM16	Frequent communications within and across teams; rapport-building between the research team and site staff; meetings in different groupings and individually, e.g., all personnel at a site, personnel at a particular designation from various sites, one-to-one phone calls, etc. to encourage articulation of challenges and experiences.	Capacity building Relationship building

** Including educational levels.*

status, race/ethnicity, resource availability, and relationships between service users and healthcare professionals. Ameliorations were administered in most projects to overcome the equity challenges. Tactics included respecting local gender norms, accommodating spaces within easy reach of service users, and increased access to resources required in the intervention settings. DM15 in particular focused on addressing social determinants of health into its clinical care delivery. The project team recognised it as an important implementation strategy for NCD management, in particular for individuals confronting socio economic and insurance coverage challenges. They concluded that given the impoverishing effects of out-of-pocket expenditures for substantial direct (user fees, medications) and indirect (transportation) costs borne by patients with hypertension and diabetes, it is critical to adopt both clinical and socio-economic approaches to NCD management in low-resource settings worldwide. A more detailed overview of DM15 can be found in the **Project spotlight 2**. The details of the challenges and their amelioration strategies can be seen in **Table 7**.

Using contextual factors to inform implementation strategies

As noted at the start of this section, context encompasses a broad range of interacting factors that may change over time – from local physical attributes such as resources at a healthcare facility, to the prevailing political milieu, to the interrelationships between key actors. Once a research team has assessed and better understood the context of their implementation project, this information can be used to inform the development of effective, tailored implementation strategies (the actions taken to implement the new programme, practice, or policy) targeted at the relevant level (individual, family, community, organisation, society).

There is no set process or agreed methodology for designing implementation strategies that address barriers and/or build on enablers in a given context. Indeed, a 2019 study[47] aimed to identify which ERIC implementation strategies[30] would best address specific CFIR[48]-based contextual barriers but found few consistent relationships between them. Such work in practice is guided by the experience and expertise of a well-placed research team.

For example, the DM02 project team in China assessed readiness for implementation and identified barriers and enablers via a mixed methods approach, including 42 stakeholder interviews (18 patients with T2D, 13 family members, seven primary care providers, and four local health administrators). The barriers and enablers were mapped onto the COM-B model to clearly delineate between the capacity, opportunity, and motivation of primary care providers and of service users.

Based on this information, the research team were able to develop a tailored, interactive mobile health management system. The implementation of this new system was integrated with assistive implementation strategies, including audits and feedback provision, on-demand technical assistance, altering incentive schemes, and quality monitoring. **Figure 11** summarises DM02's barriers and enablers, interactive mobile health management system, and assistive implementation strategies; please refer to Peiris et al.[49] for further information.

Section 7 provides more detail on the implementation strategies developed and executed across all projects.

Section 6 summary

- Understanding context and equity is key in implementing effective strategies.
- Context specific barriers and enablers across projects were found to fall under broad categories of community behaviours, knowledge and education, access to healthcare facilities and/or medication, data collection, recording and referrals, human resources, practitioner trust, confidence and/or expertise, health systems and structure, stakeholder involvement, political climate, economic status, inclusivity, and natural disasters and emergencies.
- Certain factors were consistently either barriers or enablers across all projects which faced them, whereas other factors differed depending on the setting.
- Equity challenges and amelioration tactics bought to light the importance of social determinants of health and their effects on overall context.
- Using such contextual information should inform the creation of appropriate implementation strategies in the future.

Figure 11 DM02's journey from context assessment to implementation strategies.

This figure illustrates how the DM07 team (i) assessed the context of their project, identifying barriers and enablers; (ii) developed their core implementation strategy theme; and (iii) designed their specific implementation strategies. It should be noted that although the barriers and enablers are separated into delineated categories as per the COM-B model, these factors are actually in flux, with varying degrees of intensity over time and location; this is represented by the interweaving arrows.

Barriers and enablers identified via quantitative and qualitative methods, categorised by COM-B component

	COM-B: Capacity		COM-B: Opportunity		COM-B: Motivation	
	Primary care providers	Service users	Primary care providers	Service users	Primary care providers	Service
Barriers	Education gap. Licensure gap. Aging doctors in rural clinics. Overburdened staff. Clinical inertia.	Low education level and ageing population. Insufficient health literacy and misinformation.	Lack of patient tracking system for disease management. Lack of performance evaluation and awards based on disease control targets.	Lack of self-monitoring.	Lower pay for doctors in rural clinics. Heavy workload. Unclear career development path.	Low motivation for health-seeking behaviour. Patient inertia.
Enablers	Workshops on NCD prevention and contro. On-site technical guidance. Visits from experts.	Health education and physical examination activities organised by primary care providers.	High availability of essential medical equipment. Access to essential medicine. Health information systems.	The National Basic Public Health Service Program and health insurance. Support from family members. Support from m-Health technology.	Recognition in society and job fulfilment. Basic salary for providing public health service.	High motivation for small gifts.

Patients and family health promoters

- Registration and settings.
- CVD risk assessment.
- Healthy status summary.
- Personalised decision support.
- Fasting blood glucose, blood pressures, LDL cholesterol monitoring and feedback.
- Alerts for delayed risk factor monitoring or extreme levels.
- Communication support.
- Healthy lifestyle promotion.
- Health education.
- Performance incentive.

Governors

- Performance ranking among jurisdictional communities.
- Statistics and report on key variables among different subpopulations.

Core implementation strategy theme: Interactive mobile health management system

Primary care providers

- Registration and settings.
- Patient tracking for diabetes management.
- Health status summary.
- Personalised decision support.
- Alerts for delayed risk factor monitoring or extreme levels.
- Communication support.
- Health education.
- Statistics and tracking.
- Performance incentive.

Implementation strategies to complement the interactive mobile health management system

- **Audit and provide feedback:** provide timely clinical feedback, helping the local health administrators to monitor diabetes management status.
- **Tailor strategies and use data experts:** actively collect data (monthly active users, % of patients who submit their blood pressure and blood glucose on time) from the m-Health system and check the level of fidelity of the project implementation.
- **Obtain and use patient and family feedback:** annual field trips.
- **Technical assistance:** actively collected users feedback on the m-Health management system and provide timely solutions.
- **Build stakeholder knowledge:** Conduct ongoing training, develop educational materials, distribute educational materials, conduct educational meetings, and make training dynamic.
- **Intervene with patients** to enhance uptake and adherence, involve patients and family members, and alter incentive or allowance structures.
- **Develop and implement tools for quality monitoring.**

Project spotlight 2

DM15 BIGPIC: Bridging Income Generation with Group Integrated Care

Aims

1 a. Identify contextual factors, facilitators and barriers that may impact integration of group medical visits and microfinance for cardiovascular disease (CVD) risk reduction, using combination of qualitative research methods including:

   i. Baraza (Kenyan traditional community gatherings).

   ii. Focus group discussions among individuals with or at risk of T2D, microfinance group members, and rural health workers.

   b. Use the above findings to develop a contextually and culturally appropriate integrated group medical visit-microfinance model to reduce CVD risk among individuals with T2D or at increased risk of T2D.

2 a. Evaluate effectiveness of above via a four-arm cluster randomised control trial.

   b. Mediation analysis to evaluate influence of changes in social network characteristics on intermediate factors and intervention outcomes.

   c. Moderation analysis to evaluate the influence of baseline social network characteristics on effectiveness of interventions.

3 Evaluate cost-effectiveness of each arm via decreased systolic blood pressure (SBP), percentage change in QRISK score, and DALYs saved

Location

Western Kenya.

Implementation strategies

Group medical visits integrated into microfinance groups aimed at reducing CVD risk among individuals with T2D and at increased risk for T2D in Western Kenya, and that the key modifiable CVD risk factor to be addressed is BP.

Research methods

- BIGPIC builds on AMPATH's existing infrastructure and experience in managing NCDs and HIV/AIDS in Western Kenya.
- Two outcomes were measured: one-year change in SBP, and QRISK CVD score.

Study design

Four-arm cluster randomised controlled trial comparing:

1 Usual clinical care (UC).

2 Usual clinical care + microfinance groups (MF).

3 Group medical visits only with no microfinance (GMV).

4 Group medical visits integrated into microfinance groups (GMV-MF).

Key findings

- A strategy combining group medical visits and microfinance for individuals with diabetes or hypertension in Kenya led to clinically meaningful systolic blood pressure reductions associated with cardiovascular benefit
- One-year change in SBP showed decline in all arms, with GMV-MF being highest (11.4 mmHg UC, 14.8 mmHg MF, 14.7 mmHg GMV, 16.4 mmHg GMV-MF).
- Although the significance threshold was not met in hypothesis testing, confidence intervals for GMV-MF were consistent with impact ranging from substantive benefit to neutral effect.
- GMV and GMV-MF were found to benefit women more than men.
- MF and GMV-MF were found to benefit poorer individuals the most.
- One-year change in overall CVD risk was greatest in GMV-MF compared to UC.

Suggestions for future research

- The results support the approach of incorporating social determinants of health into clinical care delivery, in particular, individuals without health insurance and with lower baseline earning/wealth.
- Given the impoverishing effects of out-of-pocket expenditures for substantial direct (user fees, medications) and indirect (transportation) costs borne by patients with hypertension and diabetes, it is critical to adopt both clinical and socio-economic approaches.
- BIGPIC will add to strategies for effective reduction in CVD and T2D risk worldwide in low resource or vulnerable settings.

7 Implementation strategies

Implementation strategies are the specific, deliberate actions taken to integrate evidence-based interventions into real-world settings to improve health outcomes. These strategies aim to address barriers, leverage facilitators, and bridge the gap between what we know works and how it is applied in practice. Implementation strategies employed can be discrete (a single approach or technique) or multifaceted (combining two or more strategies) and can target determinants at multiple levels (individual, family, healthcare facility, environment, etc).

Given the diversity of target populations, stakeholders, countries, and health systems tackled within the Diabetes Research Programme, the 'how' employed by project teams to implement the evidence-based interventions is similarly diverse. Using a narrative approach to synthesis[28] offers an avenue for understanding collective findings. In the Diabetes Research Programme strategies used to address the implementation gap across projects can be grouped under the following nine themes: knowledge building and training for clinicians and healthcare professionals; knowledge building for service users; m-Health strategies including text messages, voice messages, phone calls and mobile applications and/or software; community mobilisation; community health programmes; health promotion materials; facilitator-led group sessions; electronic data collection and sharing; and microfinance. The process and justification for this categorisation are discussed in later in this section. Filling the knowledge, care and data gaps in diabetes is emphasised by the Lancet Commission[10] to reduce the T2D burden. Implementation strategies used across the projects and their related findings support this statement.

The key findings of each project are discussed in more detail in Section 8. A summary of each project's implementation strategies in conjunction with evidence-based interventions is shown in **Table 8**.

Standardisation of implementation strategy categories

Several efforts to standardise the lexicon for different implementation strategies have been made, notably Leeman et al.'s five classes of implementation strategies[50] and the Expert Recommendations for Implementing Change (ERIC) project.[23,29,30] To further aid transparency and comparability, Proctor and colleagues proposed standardised reporting of implementation strategies and related outcomes.[26,27]

For this report, the GACD diabetes project teams were asked to report their implementation strategies by retrofitting them into contemporary ERIC project categories and Proctor et al.'s reporting framework. However, as noted earlier, when the project teams were developing their research plans and undertaking their studies, it was unlikely the term implementation strategy was being used in its contemporary capacity, if at all. At the time, implementation research as a field was more typically using 'intervention' to describe its activities – which complicates retrospective reporting and synthesis. The ensuing conflation between 'evidence-based intervention' and 'implementation strategies' is further exacerbated by the complex nature of implementation, where, as Pfadenhauer and colleagues[51] put it "the boundaries between what constitutes the intervention, its implementation and context are often blurred". Consequently, it becomes challenging – practically and philosophically – for those reporting and those interpreting, to tease apart the evidence-based intervention, the context, and the implementation strategies and fit them neatly into present day categories and reporting frameworks.

Despite these challenges, some trends are discernible. Eleven projects reported 24 implementation strategies according to Proctor et al.'s framework and the ERIC categories (DM02, DM03, DM04, DM08, DM10, DM11, DM12, DM13, DM14, DM16, and DM17). Projects reported between one and eight implementation strategies with varying levels of detail. Some projects reported each strategy individually, while others opted to report multifaceted strategy 'bundles' together.

The most commonly reported 'actors' – stakeholders who deliver the implementation strategy – were researchers, who were cited in 11 strategies across three projects. However, the actors reported by the most projects were patients and healthcare workers, each reported by six projects. Interestingly, of the 24 action targets reported, patients and healthcare workers were once again the most commonly reported.

Of the nine ERIC categories, the categories most commonly reported among projects were 'Adapt and tailor to context' and 'Train and educate stakeholders' (eight projects each), followed by 'Evaluative and iterative strategies' and 'Engage consumers' (seven projects each). The least reported ERIC categories were 'Support clinicians', 'Utilise financial strategies', and 'Change infrastructure', each reported by two projects.

The DM02 project team provided a valuable example of reporting implementation strategies according to the ERIC categories; more details are shown in **Table 9**.

Table 8 Comparing strategies to implement evidence-based diabetes interventions.

Project ID	Description of activities to implement evidence-based diabetes interventions	Summary of strategies to address implementation gap *(ordered alphabetically)*
DM01	Increase workforce capacity, skills, health literacy and knowledge of health professionals; improve health literacy of women. Improve access to healthcare through culturally and clinically appropriate pathways. Enhance policies and guidelines, promoting through clinical champions. Improve information management and communication. Embed a Diabetes in Pregnancy Clinical Register within the models of care.	
DM02	Interactive mobile health management system. Engagement of family health promoters.	
DM03	Enhance ante-natal education and support for women with GDM. Simplify post-partum follow-up by integrating six-week post-partum OGTT into well-baby clinic visit. Train and support health workers (lay counsellors) to offer client-centred brief motivational counselling. Offer brief motivational counselling and supportive materials during pregnancy and in first year post-partum to support sustained behaviour change and enable women to address their health priorities.	
DM04	Community-based, primary care-centred, volunteer-led, free, cardiovascular risk-assessment and blood pressure monitoring programme combined with health education sessions for community dwelling older adults. Formal partnership between universities in the Philippines and Canada and local communities.	
DM07	Increase service user knowledge and skills to initiate and sustain lifestyle changes. Strengthen support from the environment through peer-led sessions (Uganda), facilitator-led sessions (South Africa), telephone support (Sweden), and care companions.	
DM08	'All families' component delivered at schools, home and the local municipalities: Schools promoted healthy behaviours through teachers and newsletters for parents; Local resources for physical activity were identified and promoted. 'High-risk families' component delivered out of the school setting, in families found to be at increased risk for T2D: Individualised assessments at a community centre; Seven lifestyle counselling sessions (year 1); Motivational SMS support (year 2).	
DM10	Developed an app for the follow of T2D patients.	
DM11	The use of an electronic registry for input of the main clinical indicators for a quality-of-care intervention.	
DM12	Ecological momentary intervention designed to support adherence to chronic medication and attendance at routine health care visits.	
DM13	Community mobilisation through a structured programme facilitator-led monthly group meetings applying a Participatory Learning and Action (PLA) cycle focused on diabetes prevention and control. Twice weekly m-Health voice messages promoting awareness and behaviour change to reduce T2D risk.	
DM14	SMS interventions to improve adherence to self-assessment (via thermometry) to detect diabetic foot ulcers.	
DM15	Group medical visits integrated into microfinance groups aimed at reducing CVD risk among individuals with diabetes and at increased risk for diabetes.	
DM16	12-month planned programme of four 90-minute, face-to-face, facilitator-led group sessions over six months, followed by two face-to-face individual sessions for those who were persistently overweight or had gained >2% body weight. Intervention group participants also received detailed written information and 84 pre-recorded voice or text messages over 42 weeks, with monthly follow-up calls after completion of the group sessions.	
DM17	Meta Salud Diabetes: 13-week intervention to reducing behavioural and clinical risk for CVD in adults with T2D; plus, systematic engagement of local, state, and national decision makers essential to scale up and sustain the intervention into the standard package of services offered by government-run health centres.	

Strategy icon key

ERIC category, as reported by project teams								
Evaluative and iterative strategies	Interactive assistance	Adapt and tailor to context	Develop stakeholder interrelationships	Train and educate stakeholders	Support clinicians	Engage consumers	Financial strategies	Change infrastructure
✓			✓	✓	✓			✓
✓	✓	✓	✓	✓		✓	✓	
✓	✓	✓	✓	✓	✓	✓		✓
✓		✓						
		✓	✓		✓	✓		
✓			✓	✓				
	✓							
✓	✓	✓	✓		✓	✓		✓
		✓				✓		
✓	✓	✓	✓	✓		✓	✓	
✓		✓	✓	✓		✓		
		✓			✓		✓	
				✓		✓		
		✓		✓				

Health promotion materials Knowledge building and training for healthcare professionals Knowledge building for service users

***CVD**, cardiovascular disease; **GDM**, gestational diabetes mellitus; **OGTT**, oral glucose tolerance test; **T2D**, type 2 diabetes mellitus.*

Table 9 DM02's implementation strategies, grouped by ERIC category.

ERIC category[30]	Actor(s)	Action	Action target	Timing	Outcomes[26]
Evaluative and iterative strategies	The research team	**Assess for readiness and identify barriers and facilitators** The research team interviewed patients with T2D, family members, primary care providers, and local health administrators to learn about the barriers and facilitators of diabetes management in primary healthcare setting.	Patients, family members, primary care providers, local health administrators.	Phase 1 of the trial.	Acceptability, Adoption, Appropriateness, Feasibility, Fidelity
	Patients, primary care providers	**Audit and provide feedback** The m-Health management system collected and recorded patients' self-recorded and primary care provider-recorded blood pressure and blood glucose. This action provides timely clinical feedback, helping the local health administrators to monitor diabetes management status.	Patients (and family), healthcare professionals, local health administrators.	Phase 2 of the trial.	
	The research team	**Obtain and use patient and family feedback** The research team conducted field investigations with patients to identify implementation obstacles and collect suggestions.	Patients, family members, primary care providers, local health administrators.	Annual field investigations during phase 2 of the trial.	Fidelity, Penetration, Sustainability
Interactive assistance	The research team	**Technical assistance** The research team actively collected users feedback on the m-Health management system and provided timely solutions. T2D management statistics were summarised on a website to which local health administrators had access.	Service users, local health administrators.	Daily during phase 2 of the trial.	Fidelity
Adapt and tailor to context	The research team, m-Health management system	**Tailor strategies and use data experts** The research team actively collect data (monthly active users, % of patients who submit their blood pressure and blood glucose on time) from the m-Health system and check the level of fidelity of the project implementation.	Service users	Daily during phase 2 of the trial.	Adoption, Fidelity, Penetration, Sustainability
Develop stakeholder interrelationships	The research team	**Develop and sustain stakeholder engagement** Build a coalition, conduct local consensus discussions, develop academic partnerships, identify and prepare champions, identify early adopters, inform local opinion leaders, organise clinician implementation team meetings, and promote network weaving.	Stakeholders	Quarterly meetings for primary care providers, facilitated by the research team during phase 2 of the trial.	Fidelity
Train and educate stakeholders	The research team	**Build stakeholder knowledge** Conduct ongoing training, develop educational materials, distribute educational materials, conduct educational meetings, and make training dynamic.	Primary care providers	Quarterly training for primary care providers, facilitated by the research team during phase 2 of the trial.	Adoption, Fidelity, Penetration, Sustainability

ERIC category[30]	Actor(s)	Action	Action target	Timing	Outcomes[26]
Engage consumers, Financial strategies	The research team	**Intervene with patients to enhance uptake and adherence, involve patients and family members, and alter incentive or allowance structures** The research team developed an incentive scheme to encourage patients to use the app more often and created performance-based payment to encourage primary care providers to abide to the implementation protocol.	Service users	Phase 2 of the trial.	Fidelity
Evaluative and iterative strategies	The research team	**Develop and implement tools for quality monitoring** The research team developed and organised quality monitoring systems.	–	At the beginning of the study.	Fidelity

Implementation strategy themes for this report

To more clearly identify trends, the implementation strategies reported by each project were allocated into nine broad thematic areas, with the m-Health theme containing four further subthemes. Each theme is represented by the following icons and, for this report, characterised by the broad description given below, with justifications and details about overlap following. *The themes are listed alphabetically.*

Community health programme

Taking an existing or explicitly created health programme and applying it to a novel setting.

Community mobilisation

Ensuring community engagement and resultant behaviour change.

Electronic data management

The use of data registers or similar systems, and/or focus on referrals.

Facilitator-led group sessions

The use of structured sessions with a leading member or members, as being central to project outcomes.

Health promotion materials

The use of resources, such as leaflets, containing information on health as a central activity.

Knowledge building and training for healthcare professionals

Activities that engaged building the skillset of healthcare professionals.

Knowledge building for service users

Engaging participants to gain new information or adapt their existing knowledge of healthcare, in any capacity.

Microfinance

A financial-based assistance service, designed to reach people who are excluded from or lack access to tradition banking.

m-Health

Mobile application and/or software

The creation and use of a computer software and/or mobile application, to collect and analyse health data.

Telephone calls

The use of phone calls, to collect and analyse relevant data.

Text messages

The use of text messages, to send health-related reminders and/or promotional matierals, and to collect and analyse relevant data.

Voice messages

The use of voice messages, to send health-related reminders and/or promotional matierals, and to collect and analyse relevant data.

The nature of implementation research demands engaging with complexity. The evidence-based interventions are often complex, combining best practice, patient preference, and clinical judgement. In addition, researchers seek to implement them into larger, adaptive systems. Such systems can, and often do, involve dynamic emergence of processes and factors, actors mediating their behaviours through internal and perhaps unpredictable heuristics, nested hierarchical systems that co-evolve, and non-linearity of processes.

Furthermore, the implementation strategies to address the implementation gap within the complex system are themselves beset with further complexity, where numerous 'single' strategies are combined into multifaceted strategy 'bundles'. Typically, such bundles target different levels of the system, such as individual, community, organisation, and society. It is a challenge to unpick the relative impact of each individual strategy but doing so may not be warranted as the 'bundle' interacts as a whole with and within the adaptive system.

Additionally, the intervention and implementation strategies combined exhibit further complex interactions with other factors such as multidimensional contexts, feedback loops along anticipated pathways, and diverse characteristics among smaller and smaller subpopulations. Given this complexity, a certain level of overlap between the nine themes was inevitable. When mentioning the use of multiple themes in any given project, it refers to either the use of combined strategies or separate arms of each study design. Details of study designs can be found in **Section 5**, summarised in **Table 5**.

Having begun exploration of the complexities of context in **Section 6**, this section tackles the multi-component aspect of implementation strategies.

As a reminder, we refer to the 14 projects by their GACD codes – DM01, DM02, DM03, etc – to help the reader move easily through the text. While reading, you may wish to refer to **page 13** for the list of full project titles and **Table 2** for a summary of project characteristics.

Knowledge building for service users

This was the broadest and one of the most common themes, constituting nine projects (DM01, DM03, DM04, DM07, DM08, DM13, DM14, DM15, DM17). Projects were classed under this theme if their implementation strategy involved engaging participants to gain new information or adapt their existing knowledge of healthcare, in any capacity. This theme was always implemented alongside at least one other, if not more.

m-Health strategies

Mobile application and/or software, telephone calls, text messages and voice messages

m-Health strategies were the one of most common themes, implemented by nine projects (DM02, DM07, DM08, DM10, DM11, DM12, DM13, DM14, DM16). Projects were classed under this theme if their implementation strategy explicitly involved one of the four activities grouped under m-Health. Of these projects, two solely utilised m-Health strategies (DM10 developed a mobile application and/or software whilst DM12 utilised text messaging), whilst all others used other themes either in conjunction or in separate arms of their trial. Four projects also implemented knowledge building for service users (DM07, DM08, DM13, DM14); three implemented facilitator-led group sessions (DM07, DM13, DM16); three used community mobilisation (DM07, DM08, DM13); two used knowledge building and training for healthcare professionals (DM02, DM07); two used health promotion materials (DM07, DM08); one used community health programmes (DM07); and one used electronic data management (DM11). DM11 was unique in creating software to empower service users and improve treatment, alongside collecting data electronically.

Facilitator-led group sessions

This was the third most common theme, implemented by five projects (DM07, DM13, DM15, DM16, DM17). Projects were classed under this theme if their implementation strategy explicitly mentioned the use of structured sessions with a leading member or members, as being central to project outcomes. DM07 and DM13 noted that their facilitator-led group sessions used members of the target population as facilitators, which could be considered as peer-led. DM03 was unique in mentioning the use of peer support, but otherwise not specifying the use of facilitator-led group sessions. This theme was always used in unison with at least two others. These included knowledge building for service users (DM07, DM13, DM15, DM17), m-Health strategies (DM16 using telephone calls, text and voice messages, DM07 using telephone calls only and DM13 using voice messages only), community mobilisation (DM07), and microfinance (DM15). DM07 and DM17 also implemented knowledge building and training for healthcare professionals, health promotion materials, and community health programmes.

Knowledge building and training for healthcare professionals

Five projects were classed under knowledge building and training for healthcare professionals (DM01, DM02, DM03, DM07, DM17). Projects were classes under this theme if their implementation strategy explicitly involved activities that engaged building the skillset of healthcare professionals. This theme was used in conjunction with knowledge building for service users in four out of the five projects, which sheds light on the impact one may have on the other. Moreover, health promotion materials were implemented concurrently in four projects (DM01, DM03, DM07, DM17). Facilitator-led group sessions were implemented by two projects (DM07, DM17), as were m-Health strategies (DM02 created a mobile application, DM07 used telephone calls), and community health programmes (DM07, DM17). DM01 also implemented electronic data management.

Health promotion materials

Five projects were classed under health promotion materials (DM01, DM03, DM07, DM08, DM17). Projects were classed under this theme if their implementation strategy explicitly mentioned the use of such materials as a central implementation strategy. This theme was always used alongside knowledge building for service users, as health promotion aims to increase knowledge, and at least two other themes. Four out of the five projects also used knowledge building and training for healthcare professionals (DM01, DM03, DM07, DM17). DM01 also utilised electronic data management. Two projects utilised community mobilisation and m-Health strategies (DM07 using telephone calls and

DM08 using text messaging). Two projects utilised community health programmes and facilitator-led sessions (DM07, DM17).

Community health programmes

Three projects were classed under community health programmes (DM04, DM07, DM17). Projects were classed under this theme if their implementation strategy emphasised taking an existing or explicitly created health programme and applying it to a novel setting. As such programmes often include community engagement through education, it is understandable that all three projects also implemented knowledge building for service users. Health promotion materials and facilitator-led group sessions were also implemented by DM07 and DM17. DM07 additionally utilised community mobilisation. This raises the question as to whether health promotion materials, facilitator-led sessions and community mobilisation also go hand-in-hand with community health programmes. Ultimately, these categories were kept separate, rather than grouped, to attempt to display the depth and breadth of strategies, as reported by individual project teams.

Community mobilisation

Three projects were classed under community mobilisation (DM07, DM08, DM13). Projects were classed under this theme if their implementation strategy explicitly emphasised ensuring community engagement and resultant behaviour change. As mentioned previously, education is an instrumental part of this strategy, and so all three projects also implemented knowledge building for service users. Likewise, all three projects used an element of m-Health. DM07 and DM08 also utilised health promotion materials. DM07 and DM13 also utilised facilitator-led group sessions. DM07 further implemented community health programmes.

Electronic data management

Two projects were classed under electronic data management (DM01, DM11). Projects were classed under this theme if their implementation strategy explicitly mentioned the use of data registers or similar systems, and/or focus on referrals. DM11 used this alongside software development, whereas DM01 also used this as a tool for knowledge building and training for healthcare professionals. The project team also emphasised improving women's perceptions and behaviours around T2D and GDM. Therefore, DM01 was also categorised under knowledge building for service users. DM01 also produced health promotion materials.

Microfinance

DM15 was the only project to implement microfinance. It was used alongside facilitator-led group sessions and knowledge building for service users.

Trends in multi-component implementation strategies

All themes apart from two components of m-Health (mobile applications and/or software and text messages), were always employed in conjunction with at least one other strategy type.

Telephone calls and voice messages were always accompanied by facilitator-led group sessions, but not vice versa. Health promotion materials was always accompanied by knowledge building for service users, as was community health programmes and community mobilisation, whether or not used in combination with each other. This was not the case in the reverse situation, i.e. not all projects that implemented knowledge building for service users also implemented health promotion materials, community health programmes and community mobilisation. Nevertheless, within the six projects that implemented these three themes, there was significant interplay and overlap between the activities used. Furthermore, from these six projects, all of them had a certain degree of positive and indicative findings (apart from DM03, which is yet to analyse its data). This brings to light the advantages of the relationship between these three themes and its impact on education, which could provide a potential focus area for future research.

Interestingly, all projects carried out in the SEARO WHO region utilised an aspect of m-Health and facilitator-led group sessions. Both projects based in the EURO WHO region utilised an aspect of m-Health, health promotion materials, knowledge building for service user and community mobilisation. The majority of these projects had positive findings, suggesting the benefits in implementing such strategies in these given settings, or refining them further to tailor to the contextual factors.

Table 10 displays which implementation strategies were used in combination, and by which projects, in a matrix format. Table should be read left to right. Pink boxes indicate that when the strategy theme in the left-hand column was used in a project, it was always paired with the strategy theme noted in the top row, but not necessarily vice versa. For example, when the strategy theme of community health programmes was employed, this was always paired with knowledge building for service users; however, the strategy theme of knowledge building for service users was not always paired with community health programmes. Orange indicates that the strategy was used alone in the noted project.

Table 10 Matrix showing which implementation strategy themes were used in combination, and by which projects.

Table should be read left to right. Pink boxes indicate that when the strategy theme in the left-hand column was used in a project, it was always paired with the strategy theme noted in the top row, but not necessarily vice versa. For example, when the strategy theme of community health programmes was employed, this was always paired with knowledge building for service users; however, the strategy theme of knowledge building for service users was not always paired with community health programmes.

**HCPs, healthcare professionals.*

					
 **Community health programme**		DM07		DM07, DM17	DM07, DM17
 **Community mobilisation**	DM07			DM07, DM13	DM07, DM08
 **Electronic data management**					DM01
 **Facilitator-led group sessions**	DM07, DM17	DM07, DM13			DM07
 **Health promotion materials**	DM07, DM17	DM07, DM08	DM01	DM07	
 **Knowledge building and training for HCPs***	DM07, DM17	DM07	DM01	DM07, DM17	DM01, DM03, DM07, DM17
 **Knowledge building for service users**	DM04, DM07, DM17	DM07, DM08, DM13	DM01	DM07, DM13, DM15, DM17	DM01, DM03, DM07, DM08, DM17
 **Microfinance**				DM15	
 **Mobile application and/or software**			DM11		
 **Telephone calls**	DM07	DM07		DM07, DM16	DM07
 **Text messages**		DM08		DM16	DM08
 **Voice messages**		DM13		DM13, DM16	

Colour key

- Two strategies used in combination by the noted projects
- Strategies not used in combination in the projects
- Strategy in left-hand column always used in combination with strategy in the top row
- Strategy used alone by the noted project

DM07, DM17	DM04, DM07, DM17			DM07		
	DM07, DM08, DM13			DM07	DM08	DM13
DM01	DM01		DM11			
DM07, DM17	DM07, DM13, DM15, DM17	DM15		DM07, DM16	DM16	DM13, DM16
DM01, DM03, DM07, DM17	DM01, DM03, DM07, DM08, DM17			DM07	DM08	
	DM01, DM03, DM07, DM17		DM02	DM07		
DM01, DM03, DM07, DM17		DM15		DM07	DM08, DM14	DM13
	DM15					
DM02			DM10			
DM07	DM07				DM16	DM16
	DM08, DM14			DM16	DM12	DM16
	DM13			DM16	DM16	

Section 7 summary

- Implementation science remains an emerging field, so consistency in terminology and classification is difficult.
- In this report, nine themes were created to encompass all the strategies implemented by the projects: community health programmes, community mobilisation, electronic data management, facilitator-led sessions, health promotion materials, knowledge building and training for healthcare professionals, knowledge building for service users, microfinance, and m-Health (including telephone calls, text messages, voice messages and mobile applications and/or software).
- Knowledge building for service users was the most commonly implemented theme, followed by m-Health strategies.
- Some themes were always used in conjunction with another theme, either in combination or in separate arms of studies, whilst others were used alone.
- Although knowledge building was found to bring about positive impacts in target populations, the impacts of m-Health varied, with successes often being related to a different theme within the same project.
- The trends seen between commonly grouped themes create scope for future tailored research in these areas.

8 Key findings

Summary of measures

Almost all projects in the Diabetes Research Programme measured clinical factors like HbA1c (hyperglycaemia or glucose control) and serum cholesterol levels, T2D incidence, blood pressure, body weight reduction, and waist circumference reduction to quantify changes in diabetic status and/or risk of participants. DM14 focused solely on clinical factors related to diabetic foot ulcers (DFU). Other factors measured included perceptions of diabetes and behaviours such as health related risk-taking (i.e., dietary habits or tobacco usage, knowledge, and awareness).

Two projects measured systems level factors such as retention in care, diabetes management outcomes, and equitable access to healthcare for vulnerable populations (DM07 and DM08). Two projects focused on data recording and collection and found the importance of this in improving health systems and quality of care (DM01, DM11). In the cases of DM01 and DM07, these were measured alongside clinical factors.

The social determinants of health were considered by most projects (see Section 6), however three projects explicitly sought to measure the impact of their implementation activities on such determinants (DM08, DM15, DM16). All three projects focused their studies on individuals with low socioeconomic status, with DM16 specifically highlighting the cultural norms for women in their given context as important determining factors too. See **Project spotlights 2** and **3** for more details on DM15 and DM08.

Main results and trends

Table 11 summarises the results from each project, indicating whether the measured clinical, behavioural and system-level factors improved (✓), evidence of change was not statistically significant (O), or were adversely affected (**X**) following implementation of the project. It also provides implementation outcomes, patient-centredness, and client outcomes, reported by projects using the Proctor et al. (2011) framework.[26] These outcomes are displayed as positively received (✓), or negatively received (**X**), utilising relevant corresponding terminology for each outcome.

One project emphasised from its findings that education and training programmes for health professionals were important to improve health outcomes (DM17). DM03 noted how considering context in general is important in achieving impactful results. Two projects found that rural areas had higher levels of participation and better outcomes compared to urban areas (DM02 and DM04).

Ten projects found at least some significant differences in results from their evidence-based interventions investigated. Out of the remaining four projects, two are yet to analyse their results, and one found other incidental correlations.

Amongst projects that utilised m-Health implementation strategies, 57% found their implementation strategies to be effective. Within these, half attributed their effectiveness to combining m-Health with another implementation strategy, often knowledge building for service users and/or community mobilisation. Knowledge building was a key implementation strategy. Amongst projects that used this strategy, 89% found some or substantial effectiveness. Of the other implementation strategies employed (community mobilisation, electronic data collection, community health programmes, microfinance, health promotion materials, peer-led group sessions, and facilitator-led group sessions), all strategies had successful outcomes, except for when used in conjunction with m-Health strategies.

Table 11 Key outcomes measured and results summary across the14 diabetes projects, categorised by Proctor et al.'s (2011) outcome framework.

Project ID	Implementation outcomes							Clinical outcomes						
	Acceptability	Appropriateness	Feasibility	Adoption	Fidelity	Penetration	Cost	HbA1c	Serum cholesterol	Fasting and 2-hour blood glucose	Blood pressure	DFU	T2D incidence	T2D outcomes
	Measured (**M**); accepted/ appropriate/ feasible/ adopted (✓); unaccepted/ inappropriate/ unfeasible/ unadopted (**X**)				Fidelity maintained (✓); Not maintained (**X**)	Integrated into service setting (✓); not integrated (**X**)	Cost effective (✓); neutral (**O**); not cost effective (**X**)	Improved (✓); no significant change (**O**); adversely affected (**X**)						
DM01	✓			✓		✓								
DM02					✓			✓	✓	✓	✓			
DM03	*Data yet to be analysed*													
DM04			✓		✓	✓	O	✓						
DM07	M	M	M	M	M			O ✓*					O *	
DM08	✓		✓	✓			✓ (Greece and Spain)	✓*		✓*				
DM10	*Information unavailable*													
DM11	✓		✓	✓ X*										
DM12	✓		X				✓	✓			✓			
DM13	✓	✓	✓		✓		✓			✓ PLA O m-Health				✓ PLA O m-Health
DM14	✓ X*			✓	✓ X*			O				✓*		
DM15	M		M	M			M				✓			
DM16	✓	✓	✓	✓	✓*			O						
DM17	✓		✓ X*	✓ X*	✓			✓						

* *See **Table 12** for details.*

		Service outcomes			Behavioural outcomes				Client outcomes		System-level factors			
Body weight reduction	Waist circumference reduction	Patient centredness	Efficiency	Effectiveness	Perceptions of diabetes	Health related risk-taking e.g. diet or tobacco use	Knowledge	Awareness	Function	Satisfaction	Retention in care	Diabetes management outcomes	Education and/or training programmes for healthcare professionals	Data collection and recording
		Achieved (✓); not achieved (X)			Improved (✓); no significant change (O); adversely affected (X)				Achieved (✓); not considered (O); not achieved (X)		Improved (✓); no significant change (O); adversely affected (X)			
													✓	✓
												✓		✓
					✓	✓				✓				
											✓	✓		
✓*	✓*					✓*								
		✓							✓	✓				✓
O	O						✓ PLA ✓ O m-Health	✓ PLA ✓ O m-Health						
										✓				
		M	M	M						M				
				X*						✓				
		✓		✓						✓			✓	

Findings by implementation strategies

Key findings are displayed below by implementation strategies, only mentioning projects under themes where trends were noted.

Knowledge building for service users

Knowledge building for service users was one of the two most common implementation strategies, used by nine projects. As this strategy was always implemented alongside at least one other, it represents the importance of knowledge building for service users as a key element in successful implementation research for NCDs, alongside other clinical, behavioural and system-level outcomes. Often, projects indicated significant differences and/or promising results if positive changes were found in this area, even if it was not part of the primary aims. DM08 demonstrates how it incorporated knowledge building for service users as part of its community health programme implementation strategy in detail, which can be found in **Project spotlight 3**.

m-Health strategies

Mobile application and/or software, telephone calls, text messages and voice messages

m-Health were the other most common implementation strategies used across the projects, implemented by nine projects. DM02 found decreases in HbA1c, blood pressure and cholesterol levels amongst the intervention group, through the use of an innovative health management app. Similarly, DM12 also utilised m-Health strategies, but found that SMS text messages did not lead to improved glycaemia, however, they did find an impact on blood pressure and achievement of treatment goals. The mechanisms for this are unclear. They suggested that text messages alone may be unsuccessful unless accompanied by health system strengthening and other forms of self-management support for T2D. Likewise, DM16 also found that their intervention did not prevent deterioration in glycaemic status amongst women with GDM. DM13 utilised m-Health in one arm of their study and participatory learning action (PLA) for community mobilisation in another. m-Health voice messaging increased knowledge and awareness of T2D but had no detectable effect on the population prevalence of T2D and intermediate hyperglycaemia. DM10 and DM11 both created mobile applications and software to engage service users in an enjoyable and easy manner, providing both health-related information and self-monitoring systems. In the case of DM11, this was combined with compiling a more informative electronic data registry of health information.

For DM07, DM08 and DM14, m-Health strategies were not used as part of the primary aims of their studies, but as supplementary activities. DM07 used telephone calls to evaluate training amongst healthcare professionals involved in the study. DM14 used messaging to remind participants to use their foot thermometer devices and record readings, as well as to promote healthy footcare practices. Similarly, DM08 used text messaging as motivational support for service users in the second year of their implementation strategy.

The findings raise critical questions about the efficacy of standalone m-Health strategies. Indeed, project reflections from three project teams (DM12, DM13, DM16) noted this. It may be that m-Health strategies should always be combined with additional strategies in order to achieve successful outcomes, rather than be standalone. It was also noted that adaptations to the type of m-Health strategies used could improve future outcomes. For example, DM13 suggested optimising engagement with voice messages by (i) sending identifiable messages from a trusted source; (ii) increasing population participation in the design of m-Health interventions to inform modelling and increase relevance to T2DM and non-diabetics; and (ii) participant interaction with an m-Health message to enable choice according to preferences. Suggestions from DM14 similarly included considering participants' messaging preferences, as well as staying up to date with most accessible and commonly used communication methods in the target population, e.g. WhatsApp rather than SMS. DM16 noted that alternative implementation strategies would be more effective than m-Health, if not in combination.

Facilitator-led group sessions

This was the third most common theme, implemented by five projects (DM07, DM13, DM15, DM16, DM17). Projects found facilitator-led group sessions to be a useful activity, both in the context of knowledge building for professionals and/or service users, and for community mobilisation and engagement. It is worth noting that facilitator-led group sessions varied in design and content between each project. For example, some sessions were led by health professionals, whilst others use non-healthcare professionals or lay healthcare workers. DM03 was unique in using peer support groups.

Knowledge building and training for healthcare professionals

DM01, DM02, DM03, DM07 and DM17 used knowledge building and training for healthcare professionals. DM07 was able to demonstrate that when minimum level quality care is lacking, even minimal improvements in the facility care, such as training nurses to follow-up patients and encourage participants to keep appointments, can provide significant improvements in retention in care and diabetes management outcomes. Despite this, clinical outcomes varied. Similarly, DM17 recognised the need for training of health personnel. However, limitations in maintaining implementation arose from institutional factors. These related to the demanding workload of the health centre staff, the lack of recognition of the work carried out in the 'Grupos de Apoyo Mutuo' (GAM) and the set requirements for GAM. Patient outcomes from DM17 showed significant changes. The mixed results across projects that used this implementation strategy indicate the need for further implementation research in this area, with emphasis on overcoming barriers faced by these projects. DM02 mentioned that healthcare professionals also engaged with their SMARTDiabetes platform. Similarly, DM01 intended to improve the knowledge and skillset of healthcare professionals through creation of a comprehensive electronic data registry and improved care guidelines. Health promotion materials were also produced to support clinicians in counselling women.

Health promotion materials

DM01, DM03, DM07, DM08 and DM17 used health promotion materials. DM01 produced health promotion materials, which were designed to support clinicians in counselling women. DM08 reported that successful outcomes

from use of health promotion materials as part of their community mobilisation strategy. This was used alongside text messaging. Since this theme was always used in conjunction with another type, it highlights its effectiveness as a component of a multifaceted set of strategies, rather than stand-alone. Projects reported the overall aim of increasing community awareness and instigating behaviour change, in which the use of health promotion materials appeared to be a useful activity.

Community health programmes

Three projects implemented this strategy. DM04 found that a community health programme adapted from use in Canada to the Philippines led to significant reduction in HbA1c levels amongst rural populations, where participation was also higher compared to urban populations. However, no significant differences were observed amongst urban populations, alongside a much lower participation rate. Secondary outcomes including perceptions and risk behaviours regarding cardiometabolic diseases also followed the same trend. Overall, it was found to be an effective intervention that showed promising results for expansion of such programmes in other LMICs, however the outcomes were very much population dependent. Similarly, DM17's community health programmes also found promising evidence to support the use of educational programmes in populations with T2D, the development and improvement of policy, the need to train health personnel, and support of NCD control with a *salutogenic* (health promoting) and participatory approach.

The importance of adapting to context was highlighted amongst these projects, bringing into light valuable questions about levels of efficacy in different settings. This not only applies across different countries but within them too, as stated by DM04, with the stark difference in outcomes and participation between rural and urban settings within the Philippines. However, it may be difficult to correlate the significance of the outcomes to either setting if the differences in participation rate may have led to sampling bias. This provides scope for considerations for future research in these settings. Likewise, DM17 is in the process of expanding their programmes to underserved populationa in the USA, where similar contextual considerations are needed. The importance of contextual factors is discussed in more detail in Section 6.

Community mobilisation

DM13 compared m-Health for health promotion in one arm of their study with Participatory Learning and Action (PLA) for community mobilisation in another. PLA increased the health literacy of individuals and communities, developing their knowledge, capacity and self-confidence to enact healthy behaviours. Community, household and individual capacity increased through social support and social networks, which then created an enabling community context, further strengthening agency and enabling community action. This increased opportunities for healthy behaviour. Community actions addressed lack of awareness about diabetes, gendered barriers to physical activity, and lack of access to blood glucose testing. There was reduction in the prevalence of diabetes and intermediate hyperglycaemia in the general population, and in the two-year incidence of diabetes among individuals with intermediate hyperglycaemia. The DM08 project team also used community mobilisation, implementing a screening programme in schools, to reach families within the community, in combination with a lifestyle change intervention. The strategy identified parents and families at high risk for T2D and led to improvements in lifestyle behaviours and clinical indices. DM08 showed that their community mobilisation strategy was easy-to-apply, relatively low-cost, and could be scalable in a sustainable way.

The overall positivity seen from these projects provides a good foundation for future implementation research. Similar to projects that utilised community health programmes, there was emphasis on contextual factors. For example, DM08 acknowledged that adaptations are needed for existing variations among European countries with regards to socio-cultural values, environmental structures and lifestyle patterns.

Electronic data management

Both DM01 and DM11 highlighted the importance of having transparency in data sharing between healthcare facilities to improve quality of care. DM11's analysis contributed to a 'quality cycle' by identifying areas where T2D care can be improved and highlighting gaps in medical attention. The created registry allowed importance stakeholders such as Ministries of Health and policymakers to access accurate and up-to-date data easily. Not only does this show the possible applications of electronic data management, but also provides ways to improve logistics, patient outcomes, and potential accessibility to treatments.

Microfinance

DM15 was the only project to focus on microfinance. Using the rationale that diabetes threatens to create a large healthcare and financial burden on LMICs, the project team implemented a strategy combining group medical visits and microfinance for individuals with diabetes or hypertension in Kenya. It led to clinically meaningful systolic blood pressure reductions associated with cardiovascular benefit. The results supported the approach of incorporating social determinants of health into clinical care, in particular for individuals without health insurance and with lower baseline earnings/wealth. Given the impoverishing effects of out-of-pocket expenditures for substantial direct (user fees, medications) and indirect (transportation) costs borne by patients with hypertension and diabetes, it was noted how critical it is to adopt both clinical and socio-economic approaches.

As a reminder, we refer to the 14 projects by their GACD codes – DM01, DM02, DM03, etc – to help the reader move easily through the text. While reading, you may wish to refer to **page 13** for the list of full project titles and **Table 2** for a summary of project characteristics.

Big picture messages

In addition to reporting key findings, project teams were asked to provide 'big picture' messages. These were short summaries that presented the ways in which each project's work contributed to the implementation science and wider healthcare targets at a macro-level. Overarching messages included the importance of low-cost and accessible initiatives such as screening services, training for health professionals, education and health promotion for service users and integrating group medical visits with microfinance incentive. The vital nature of assessing contextual factors in depth, not just across countries, but in different settings within countries was also a key finding. This highlights a consideration of underpinning social determinants of health when assessing context and hence developing the most suitable implementation strategies for any given target population. It was also noted that using existing research in not only similar settings but similar fields such as infectious disease protocols, can also be useful in development of appropriate interventions.

Accessibility was investigated in a number of ways throughout the projects, such as screening for high-risk families or comparing differences in engagement in rural compared to urban settings. Overall, taking the intervention into the communities and integrating with them, rather than expecting the individuals to come to the intervention, was crucial. This type of community mobilisation has been shown to lead to significantly positive results across projects. The successes seen even on smaller scales throughout the projects shine light on the potential that exists in implementing activities such as low-intensity training for healthcare professionals. Although cost-efficiency and intensity-levels would need to be measured more accurately and on a wider scale to comment on with certainty, the possibility that these types of interventions open for future expansion and refinement of research in this field is still promising at this stage.

Less common themes that emerged included improving quality of care by ensuring data transparency through electronic collection and sharing, and how m-Health techniques, although of mixed success when used alone, can be useful supplementary tools for broader implementation strategies.

Table 12 details the main findings of all projects alongside 'big picture' messages as reported by project teams.

Table 12 Findings and big picture messages across the 14 diabetes projects, grouped by target population.

Project ID	Details of findings	Big picture message, as reported by project teams (edited for brevity)
Projects targeting GDM and/or DIP		
DM01	*Analysis to be published.*	**Early message from published interim evaluation:** The early phase of the study had a positive perceived impact on systems of care for women with hyperglycaemia in pregnancy, including increased clinician awareness of hyperglycaemia in pregnancy, earlier referral for specialist care and a focus on improving communication with women.
DM03	*Trial and final process evaluation data to be analysed.*	*Trial and final process evaluation data to be analysed.* **Interim 'big picture' message:** This project demonstrated the importance of tailoring and adapting to context, even within a country and province. Implementation was well received by all stakeholders. While few lessons from HIV integration have been transferred to GDM and T2D, this experience demonstrates that integration is possible.
DM16	**Pre-randomisation, pregnant women presenting for OGTT:** 9% had T2D; 34% had pre-diabetes at a median of 6.9 months post-partum. **Post-implementation:** Of those with pre-diabetes at baseline, 20% developed T2D during follow-up, compared with 3% among those with baseline normoglycemia, identifying a particularly high-risk group. **HbA1c:** A light-intensity informational intervention designed for relevance to local context, preferences and resources, delivered by minimally trained health care personnel in hospital settings did not prevent deterioration in glycaemic status among women with recent GDM from urban centres in South Asia.	Identifying alternative approaches to T2D prevention for women with gestational diabetes in urban areas of South Asia is required. This population represents a high-risk group for the development of T2D. This study identified several socioeconomic challenges to behaviour change in women with recent GDM, and pointed to potential solutions in policy, health care practice, and addressing sociocultural norms for improved community health. These challenges and ways to address them are learnings that can be applied to other settings, especially in disease prevention and health promotion for persons with limited autonomy, in South Asia and other regions with similar socio-political contexts.

Project ID	Details of findings	Big picture message, as reported by project teams (edited for brevity)
DM16 cont.	**Adoption:** Teams could adopt it with additional resources. Patients' knowledge increased, but behavioural changes were limited by family dynamics and economic constraints. **Appropriateness and Feasibility:** The intervention was well-designed and feasible. **Fidelity:** The intervention was conducted as planned until COVID-19 necessitated remote delivery. **Effectiveness:** The intervention was ineffective compared to usual care. Higher intensity or additional components may be needed. **Satisfaction:** Participants appreciated increased awareness and healthcare team involvement. Implementation teams valued skill development and health promotion.	
Projects targeting people at risk of T2D and people living with T2D		
DM04	**HbA1c:** Significantly reduced community level HbA1c in rural communities where the participation rate was high (27.7%), but not in urban communities where participation rate was low (7.3%). **Perceptions of diabetes and health related risk-taking:** There was improvement in secondary outcomes (perceptions and risk behaviours regarding cardiometabolic diseases) among residents from rural communities compared to urban communities.	CHAP-P was an acceptable and feasible community-based primary care programme to decrease cardiovascular and T2D risk in the communities in the Philippines. Effectiveness varied depending on the type of community.
DM07	**Retention in care:** In Uganda compared to the usual care arm, rates of retention in care were significantly higher in the facility care arm. In South Africa, incident rates of retention in care were significantly higher compared to those in the facility care arm. **Glycaemic control:** Adjusted analysis revealed no significant differences in rates, in Uganda, or in South Africa. **Conversion to normal glucose amongst participants at high risk of diabetes:** In Uganda, compared to the usual care arm, there was a significantly higher rate of conversion in the facility only arm and in the integrated care arm, whereas in South Africa compared to the facility care arm, reduction was significantly lower in the integrated care arm. **Incidence of diabetes amongst participants at high risk of diabetes:** No significant differences observed between study arms, in Uganda, or in South Africa.	The study was able to demonstrate that when minimum level quality care is lacking, even minimal improvements in the facility care like training nurses to follow-up patients and encourage participants to keep appointments; can provide significant improvements in retention into care and in diabetes management outcomes.
DM13	**Participatory Learning and Action (PLA):** Implementation was associated with reduced T2D prevalence – 21% absolute reduction in T2D prevalence and intermediate hyperglycaemia in the general population; 9% absolute reduction in the two-year incidence of T2D among people with intermediate hyperglycaemia. **m-Health:** Messaging increased knowledge and awareness of T2D but had no detectable effect on the population prevalence of T2D and intermediate hyperglycaemia.	PLA boosted health knowledge and confidence, empowering individuals and communities to adopt healthy habits. Social support networks grew, fostering an enabling environment for community action. They tackled issues like T2D awareness, activity barriers, and testing access. This resulted in large, significant reductions in diabetes burden. The project team suggests m-Health be part of a broader strategy to empower communities and create a supportive environment for lasting change.

Project ID	Details of findings	Big picture message, as reported by project teams (edited for brevity)
DM15	**Blood pressure:** One-year change in systolic blood pressure showed decline in all arms, with GMV-MF being highest (11.4 mmHg UC, 14.8 mmHg MF, 14.7 mmHg GMV, 16.4 mmHg GMV-MF). Although the significance threshold was not met in hypothesis testing, confidence intervals for GMV-MF were consistent with impact ranging from substantive benefit to neutral effect. GMV and GMV-MF were found to benefit women more than men. MF and GMV-MF were found to benefit poorer individuals the most. One-year change in overall CVD risk was greatest in GMV-MF compared to UC. **Change in social networks and cost-effectiveness:** Analyses have been completed and manuscripts are under development.	A strategy combining group medical visits and microfinance for individuals with diabetes or hypertension in Kenya led to clinically meaningful systolic blood pressure reductions associated with cardiovascular benefit. Results of this project add to the body of knowledge on innovative, scalable, and sustainable strategies for effectively reducing CVD risk in diabetes among populations in low-resource settings worldwide. ***UC,*** *usual care.* ***MF,*** *usual care and microfinance groups only.* ***GMV,*** *group medical visits only.* ***GMV-MF,*** *group medical visits and microfinance groups.*
Projects targeting people living with T2D		
DM02	**Primary outcomes (HbA1c, blood pressure, serum cholesterol):** Difference in proportion of patients achieving at least two "ABC" goals (any two of the following, HbA1c <7.0%, both systolic/diastolic blood pressure (SBP/DBP) <140/80 mmHg and LDL-c <100mg/dl or 2.6mmol/L) 30 at 24 months). The intervention was associated with improved "ABC" rates: 339 [35.9%] intervention vs 276 [29.9%] usual care; RR 1.20 (1.02 to 1.40, p=0.025). There was significant heterogeneity by geography: Rural 220 [42.6%] vs 158 [31.0%]; urban 119 [27.9%] vs 118 [28.6%]; p=0.022 for interaction.	A multi-faceted digital diabetes management platform was effective in improving diabetes risk factor control rates, particularly in rural areas where there are more intimate links between patients and their doctors and support from family members may be stronger. The findings support replication, spread and scale-up of such intervention strategies, however tailoring to local contextual requirements is needed.
DM10	*Information not available.*	Improving health care delivery systems and the delivery of effective interventions.
DM11	**Accessibility:** Easily accessible by healthcare professionals with minimal training. **Adoption:** Widely adopted by healthcare professionals, but patient adoption requires computer access and an app for data upload. User-friendly, but may need customization for different clinics. **Feasibility:** Proven feasible in many clinics of the National Institute of Medical Sciences and Nutrition. Global authorization may be needed for wider implementation. **Effectiveness:** Effective for diabetes care with potential for adaptation to other chronic diseases. **Patient-centredness:** All included variables align with quality care standards. **Satisfaction:** Well-received by healthcare professionals, with minor adjustments based on feedback. **Function:** System operates smoothly with reliable internet access.	This analysis contributes to a 'quality cycle' by identifying areas where T2D care can be improved and highlighting gaps in medical attention. The registry provides real-time statistics and is continuously updated, allowing for easy download and offering valuable data for Ministries of Health and policymakers. These data can be used to improve logistics, patient outcomes, and accessibility to treatments.
DM12	**m-Health:** SMS was unsuccessful in lowering glycaemic level but did lower blood pressure and support treatment goal achievement. **Acceptability:** SMS found as acceptable amongst users SMS found as acceptable amongst users. **Costs:** Costs per patient SMS was most significant expenditure, with set-up costs becoming minimal when scaled.	Whilst SMS text messages do not lead to improved glycaemia in these low-resource settings there appeared to be an impact on blood pressure and achievement of treatment goals but the mechanisms for this are unclear. Text messages alone, may be unsuccessful unless accompanied by health system strengthening and other forms of self-management support for T2D. Opportunities to influence change have been severely limited during and after COVID-19.

Project ID	Details of findings	Big picture message, as reported by project teams (edited for brevity)
DM12 cont.	**Feasibility:** Day-to-day interactions between clinicians and patients not feasible, which in hindsight may have affected results in local context.	
DM14	**Diabetic Foot Ulcer (DFU) incidence:** Foot ulcer incidence was 11.4% in the control arm and 24.1% in the intervention arm. Compared to the thermometry-only control arm, the adjusted hazard ratio of DFU in the thermometry + m-Health intervention arm adjusted by site was 2.12. A history of previous foot ulcers was reported with more frequency in the intervention arm; 65.9% vs. 48.2% in the control arm. **Adherence frequency:** The frequency of ≥80% of adherence to daily temperature measurement was 87.2% (103/118) among the study participants that returned the logbook. There was no evidence of a difference between study arms in the secondary outcomes of adherence to daily temperature measurements or reduction of HbA1c.	The delivery of interventions to prevent diabetic foot ulcers in people at high risk of ulcerations was improved through effective implementation. Screening of neuropathy in people with T2D in health services should be routinely promoted.
DM17	The intervention was successfully delivered by health staff in charge of the mutual support groups (Grupos de Ayuda Mutua: GAM) of the health centres. **HbA1c:** The intervention resulted in important changes in HbA1c as well as other health markers. The control group also saw modest changes. **Acceptability:** The intervention model was well-received as a patient education and empowerment framework. It provided a new approach for delivering actionable information and behavior modifications. **Adoption:** Adoption was high during research but declined afterward due to resource limitations. **Feasibility:** Feasibility depended on local leadership, space, and personnel. **Fidelity:** Fidelity was achieved, including a crucial booster session. **Satisfaction:** Patient satisfaction was extremely high, driven by the patient-centred, empowering approach.	Experiences from this project demonstrate the importance of generating evidence to support educational programs in populations with T2D, developing and improving respective policies, recognising the need for training health personnel, and supporting NCD control with a salutogenic (health promoting) and participatory approach. This project provided the opportunity for a true partnership between the academic institutions and the ministry of health in the state of Sonora. It provided the opportunity for real world testing of an evidence-based strategy in a resource limited clinical environment.
Projects targeting people at risk of T2D		
DM08	**Favourable lifestyle changes (health related risk-taking):** Lifestyle changes were achieved over the intervention period, such as a decrease in the consumption of sugary drinks and sweets (all countries), a decrease in screen time (all countries), an increase in breakfast and fruit consumption (Greece and Spain) and an increase in water intake (Belgium and Finland). **The participants who benefitted most by achieving at least a 5% reduction in body weight, waist circumference and glycaemic indices:** Those living in Southern and Eastern Europe, who received more intensive intervention, younger (<40 years old) adults, those who had >12 years of education, those who were unemployed and perceived their body weight to be higher than normal benefitted most.	This school-based systematic screening program, combined with lifestyle interventions, effectively identified parents and families at high risk for T2D. It led to improvements in their lifestyle behaviours and health markers. This approach was easy to implement, relatively inexpensive, and has the potential to be expanded and maintained over time.

Section 8 summary

- Clinical effectiveness outcomes were the most common measures across all projects, followed by system level outcomes.
- Social determinants of health were measured by three projects.
- Implementation outcomes reported using the Proctor et al. 2011 framework varied across projects.
- Knowledge building for service users was one of the most common implementation strategies used by projects, always paired with at least one other theme. This emphasised the importance of knowledge building for service users in improved T2D outcomes.
- m-Health strategies were also commonly used, however the impact and effect from these varied, raising questions on their blanket effectiveness across all contexts.
- Community health programmes, community mobilisation and health promotion strategies were always used together, along with knowledge building for service users, shedding light on the potential benefits of implementation strategies under these themes.
- Overarching 'big picture' messages from projects centred around creating low-cost and accessible schemes, adapted to local contexts.

Further reading

To explore results and key findings across the Diabetes Research Programme, please access the publications below.

DM01	Kirkham R et al. (2017) PLoS One 12(8): e0179487. MacKay D et al. (2021) Int J Gyn and Obs 155(2):179-194.
DM02	Zhang P et al. (2024) Lancet Reg Health West Pac. 49:101130.
DM07	Absetz P et al. (2020) Translational Behavioral Medicine 10(1):25-34.
DM08	Willems R et al (2021) Prev Med 153:106722.
DM12	Leon N et al. (2021) BMC Public Health 21, 1576.
DM13	Morrison J et al. (2019) BMC Endocrine Disorders, 19 (1), 118.
DM14	Lazo-Porras M et al. (2020) Wellcome Open Res 5:23.
DM15	Leung CL et al. (2020) BMC Health Services Research 20: 415
DM16	Gupta Y et al. (2023) Diabetes Res Clin Pract 204:110893.
DM17	Aceves B et al. (2021) Front Public Health. 9:617468.

Project spotlight 3

DM08 Feel4Diabetes (Families across Europe following a hEalthy Lifestyle 4 Diabetes prevention)

Developing and implementing a community-based intervention to create a more supportive social and physical environment for lifestyle changes to prevent diabetes in vulnerable families across Europe

Aims

- The EU-funded Feel4Diabetes-study focused on the development, implementation and evaluation of a school and community-based intervention to prevent type 2 diabetes in vulnerable families across Europe.
- The Feel4Diabetes intervention promoted healthy eating and active lifestyle through the provision of a more supportive social and physical environment at home, school and municipality level, as well as lifestyle counselling to the parents with increased type 2 diabetes risk.

Location

Belgium, Bulgaria, Finland, Greece, Hungary, Spain.

Implementation strategies

The Feel4Diabetes-intervention consisted of two components:

- The 'all families' component, which was delivered at schools, home and the local municipalities:
  - Delivered by school teachers.
  - Focused on changes in school, home and local municipality social and physical environment to assist families to reach lifestyle recommendations.
  - At school level: trained teachers aimed to create a more supportive social and physical environment promoting a healthy and active lifestyle for the children during school hours, such as providing opportunities and acting as role models for healthy behaviours – complemented with simple and easy-to-read newsletters, aiming to inform and actively engage the families.
  - At local municipality level: available infrastructure and human resources to support the lifestyle and behavioural changes of the families were identified and promoted e.g. access to sports halls and parks or school-setting playgrounds after school hours or active commuting, etc. – opportunities were identified by the local research groups in collaboration with the local municipality authorities and then communicated to the parents via newsletters.
- The 'high-risk families' component, which was delivered out of the school setting, in families found to be at increased risk for type 2 diabetes:
  - Delivered by trained health professionals.
  - Implemented in addition to 'all families' to support and encourage high-risk families to achieve lifestyle recommendations.
  - The adult members of the 'high-risk families' were invited to the local community centre (e.g. university, health promotion centre or any other available community centre) within the municipality to undergo a more detailed assessment.
  - Intervention spread over two years: Year 1) seven lifestyle counselling sessions spread over the year, Year 2) participants received motivational guidance via SMS sent to their mobile phones.

Research methods

Evaluation of outcomes and impact of the Feel4Diabetes-intervention through:

- Children's and adult family members' (parents' and/ or grandparents') anthropometric indices.*
- Adult family members' blood indices and blood pressure indices.*
- Children's and adults' behavioural indices on drinking, eating, physical activity and sedentary behaviours and determinants.**

Process evaluation:

- The degree and fidelity of implementation of the intervention at schools and counselling sessions were assessed via standardized, self-reported questionnaires, which were completed by the school teachers and the research assistants, respectively.

Cost-effectiveness:

- All costs related to the Feel4Diabetes-intervention were recorded by the research assistants and the teachers.
- Health economic modelling was used to estimate the cost-effectiveness of the Feel4Diabetes-intervention.

* *Were measured by rigorously trained research assistants, using standardized protocols and equipment that was calibrated before the start of the measurements (in each time period).*

** *Self-reported by parents via standardised questionnaires and physical activity monitors (either pedometers or accelerometers.*

Study design

- Cluster randomised control trial design with a standard care “control” group and a high intensity “intervention” group, using municipalities or school districts as clusters.
- Specific tools and procedures were developed and harmonized throughout intervention countries, to ensure comparability of the data collected among countries and researchers.

Key findings

- The applied systematic screening, using the school as the entry point to the community as well as the implemented lifestyle intervention managed to identify parents and families at high risk for type 2 diabetes and improve lifestyle behaviours and certain clinical indices, in an easy-to-apply, relatively low-cost, potentially scalable and sustainable way.
- The Feel4Diabetes-intervention is potentially cost-effective, especially in countries with a high overweight and obesity prevalence (i.e. Greece and Spain).
- Via the two-stage screening procedure implemented at school and community settings:
  - 3,153 parents were identified as high-risk and attended the medical check-up.
  - 23.2% of participants were identified having prediabetes.
  - 3% of participants were identified with diabetes.
  - 53.5% of the cases with diabetes were undiagnosed.
  - 18.6% and 14% of participants were identified having high normal blood pressure and hypertension respectively.
- Favourable lifestyle changes were achieved over the intervention period, such as a decrease in the consumption of sugary drinks and sweets (All countries), a decrease in screen time (all countries), an increase in breakfast and fruit consumption (Greece and Spain) and an increase in water intake (Belgium and Finland).
- The participants who benefitted most by achieving at least a 5% reduction in body weight, waist circumference and glycaemic indices were: those living in Southern and Eastern Europe, who received more intensive intervention, younger (<40 years old) adults, those who had >12 years of education, those who were unemployed and perceived their body weight to be higher than normal.

Suggestions for future research

- The existing variations among European countries with regards to socio-cultural values, environmental structures and lifestyle patterns imply that adaptation to the local needs is required.
- Primary care services in local communities and especially in South-East Europe should be strengthened and healthcare professionals should be trained, upskilled and possibly equipped with digital tools, in order to initiate and support such prevention strategies.
- By embedding the screening and the intervention procedures of the Feel4Diabetes-study into the local or national school and local primary healthcare systems, a systematic, continuous and organized prevention programme could be delivered at population level, potentially reaching all families in the community, ensuring equity and effective uptake.

9 Impact

Implementation research aims to drive change by generating findings that inform policy and practice improvements and enhance the health of people and communities. While broader societal impacts may take time to materialise, intermediate measures such as influencing policy and practice, fostering data sharing and collaboration, building research capacity, and disseminating research outputs can be used to assess a project's impact ('S' in *PEDALS*[24]).

Impact on policy and practice

An important part of bringing about change in healthcare involves having an influence on policy and practice in the field. The 14 diabetes projects reported whether their work made an impact on policy and practice, and how. Twelve out of the 14 projects reported impact, with the most common themes being strengthened national health systems to respond to the burden of diabetes, influence on national health programmes, strategies or guidelines, and programme scale up. It is worth noting that creating impact can take time and many of the diabetes projects have only recently been

Table 13 Types of impact reported by the 14 diabetes projects.

Project ID	Strengthened national health system to respond to the burden of diabetes					Influence on national health programmes, strategies, or guidelines				Programme scale up*
	Improved confidence and skills via training	Improved adherence to clinical guidelines	Support for intervention delivery	Improved referrals and communication	Increased resources	Improved policymaker and/or other stakeholder engagement	Better community engagement	Integration and inclusion of minority groups	Adapted national health programmes	Scale up (S), expansion (E) or further research (R)
DM01	✓	✓		✓	✓	✓		✓		E
DM02			✓			✓				
DM04					✓		✓		✓	S
DM07										S, R
DM08							✓	✓		R
DM10			✓		✓					
DM11	✓		✓		✓					R
DM13	✓			✓	✓	✓	✓	✓		S
DM14			✓		✓	✓				R
DM15					✓					S
DM16								✓		
DM17	✓	✓	✓						✓	S, E

* *Programme scale up refers to the project being taken further in three different capacities: 'scale up (S)' = project adapted to be implemented more widely, 'Expansion (E)' = same project implemented in different areas, 'Further research (R)' = different research projects taking place linked to this.*

completed. This leaves scope for future evaluation of project and programme impact. The top impact categories reported are explored in further detail below. **Table 13** summarises all the different types of impact reported by projects. For more detailed stories of impact, see the case studies on the GACD website.

Strengthened national health system to respond to the burden of diabetes

Several projects reported impacts on national health systems and improving the system's ability to respond to the burden of diabetes. Ways in which the health systems were strengthened included training government health workers and developing their skills, strengthening systems to support the delivery of effective interventions, specific resource allocation for diabetes, and strengthened referral systems. Improved communication between healthcare facilities and the integration of proposed interventions with existing health systems were particularly useful in facilitating these strategies, as well as feedback surveys from workshops. For example, DM11 provided training for healthcare professionals to help apply and integrate the multi-functional use of a new electronic records and management system. Similarly, DM17 created a 'Certificate of Health Promotion' for training which was formally recognised by the health sector who provided scholarships for 15 health personnel. They continue to train health personnel at a regional and state level in Meta Salud Diabetes, providing a promising outlook for future impact.

Influence on national health programmes, strategies, or guidelines

Building strong relations with local and national policymakers, prominent healthcare facilities, and other influential governing bodies has been pivotal in influencing national health programmes, strategies and guidelines. Those projects that reported influencing national health programmes were most effective when the evidence-based intervention was integrated within existing health systems. For example, in DM04 CHAP-P is being used as part of the Philippine Government's WHO package of essential NCD interventions (PEN) for primary health care in low-resource settings. Such integration requires very close working with the local and national government health authorities. See Section 4 for more information on stakeholder engagement.

Programme scale up and further funding

A key measure of impact is implementation at scale. Two of the diabetes projects – DM04 and DM13 – are being scaled up through GACD funding. DM04 (GACD Scale Up project ID: SU11) is being scaled up across an entire region of the Philippines, with hopes for a national scale up to follow. The Participatory Learning and Action community mobilisation strategies from DM13 are currently being scaled up in Faridpur, Bangladesh (GACD Scale Up project ID: SU16). Furthermore, DM13 has collaborated with project teams funded under the GACD Lung Diseases Research Programme to develop and secure a new UK National Institute for Health and Care Research-funded project which will investigate the association between diabetes and depression in Bangladesh and Pakistan. Further details about DM04 and DM13 can be seen in **Project spotlights 4** and **5**.

The DM15 project, which provides contextualised, tailored care, is being scaled out. This initiative has gained government support and secured funding from the National Heart Lung and Blood Institute at the National Institutes of Health.

DM17 has also been scaled out, with their project model being adopted by projects serving Mexican origin populations in numerous clinical and community settings in the United States.

Data sharing and collaboration within the GACD network

Effective knowledge, expertise, and data sharing are fundamental pillars for successful implementation of NCD programmes in LMICs. Knowledge sharing during the project – not just post hoc dissemination – strengthens research, avoids duplication of efforts, and ultimately improves outcomes. Ongoing knowledge sharing helps build trust with local communities and can help develop both immediate and long-term assets for research beneficiaries. When project teams collaborate on mutual goals, explore new approaches, share insights and push boundaries collectively, their united action helps move the field of implementation science forward.

All 14 projects reported knowledge sharing between teams over the course of their funding. Knowledge sharing activities included active participation in the GACD Research Network, contributing to GACD inter-project working groups, and in-person knowledge exchange visits.

GACD Research Network

Collaboration and networking among GACD project teams – via the GACD Research Network – is a crucial component of GACD achieving its mission. Inter-project knowledge sharing is expected to increase the impact of the research undertaken. The aims of facilitating the Research Network are to:

- Support project teams to work together effectively;
- Identify common approaches and areas of collective interest;
- Provide a platform for members to share knowledge and best practice; and
- Collaborate on joint initiatives and activities.

The GACD Research Network signifies a shift away from an antiquated 'fund and run' approach, with funding agencies actively supporting teams to interact and collaborate throughout the course of their projects. Project teams are invited to engage in two key mechanisms: election of Research Programme co-chairs and participation in the Annual Scientific Meeting.

Research Programme co-chairs

Each Research Programme elects two co-chairs from the community of GACD project teams – one from a HIC and one from a LMIC or a member of an Indigenous community. The primary objective of the co-chairs is to serve as a voice for the whole Research Programme. Other responsibilities include building a sense of trust, productivity, and camaraderie within their Research Programme and seeking out opportunities for project teams to share knowledge.

GACD were proud to announce Gina Agarwal (McMaster University, Canada) and Francisco Gonzalez Salazar (Universidad de Monterrey, Mexico) as the co-chairs of the Diabetes Research Programme.

Project spotlight 4

DM04 CHAP-P: Community Health Assessment Program in the Philippines

Aims

1 Adapt elements of Canadian-based Community Health Assessment Program (CHAP) to an LMIC setting and evaluate its effectiveness in prevention of T2D and its complications.

2 Foster uptake of findings from CHAP-P to other organisations and groups in the Philippines and other LMICs.

Location

Philippines – Zamboanga Peninsula Region.

Implementation strategies

- The Cardiovascular Health Awareness Program (CHAP) intervention model might be particularly suitable to low-income countries due to its low cost, implementability and focus on population-based health promotion and disease prevention.
- CHAP is a community-based, primary care-centred, volunteer-led, free, cardiovascular risk-assessment and blood pressure monitoring program combined with health education sessions for community dwelling older adults.
- A large community cluster randomized controlled trial demonstrated that the CHAP model resulted in a statistically significant 9% reduction in annual admissions at the population level due to stroke, heart failure, and heart attacks in people aged 65 and over in Canada.
- The CHAP program has been successfully expanded to include a diabetes risk assessment component in the Community Health Awareness of Diabetes (CHAD) program.
- The Community Health Assessment Program for the Philippines (CHAP-P) is the first adaptation of the CHAP program to an LMIC.
- Based on a formal partnership between universities in the Philippines and Canada, CHAP-P was developed through a multi-stage study in communities in Southwestern Philippines (Zamboanga Peninsula).

Research methods

- Community-based intervention using volunteer-led group sessions, with chronic condition assessment, blood pressure monitoring, and health education.

Study design

- Parallel cluster randomised controlled trial.
- Six months.
- 26 communities (13 intervention, 13 control).
- Three participant groups: 1) Random sample of community participants aged 40 or older; 2) Community members aged 40 years or older who attended at least one CHAP-P session; 3) Community health workers and staff facilitating sessions.

Key findings

- CHAP-P is adaptable to LMIC settings.
- CHAP-P is an acceptable and feasible community-based primary care programme to decrease cardiovascular disease (CVD) and diabetes risk.
- The effectiveness of the implementation strategy is dependent on the community type, rural more effective than urban.
- As a result, there was a significant reduction in HbA1c as well as greater improvement in secondary outcomes (perceptions and risk of behaviours surrounding CVD and T2D), in rural communities than urban.
- There was no significant HbA1c reduction in urban communities.

Suggestions for future research

Scale up* of this implementation strategy would be beneficial in rural settings, however in urban settings approaches need to be considered to increase participation.

** CHAP-P is currently being scaled-up, see Section 9.*

Project spotlight 5

DM13 The Bangladesh D-Magic Trial: Diabetes Mellitus – Action Through Groups or Information for Better Control?

Aims

1 To prevent intermediate hyperglycaemia and T2D and improve control of T2D in Bangladesh.

2 Evaluate impact of a) participatory community mobilisation intervention and b) an m-Health health promotion and awareness intervention on the prevalence of intermediate hyperglycaemia (= a combination of impaired fasting glucose and/or impaired glucose tolerance) and diabetes in rural Bangladesh.

3 To evaluate the effect of a) participatory community mobilisation intervention and b) an m-Health health promotion and awareness intervention on:

   a Two-year cumulative incidence of T2D among individuals with intermediate hyperglycaemia.

   b Chronic disease risk factors of high body mass index (BMI), hypertension and physical inactivity.

   c Blood glucose testing uptake, diabetic status awareness and service utilisation.

Location

Bangladesh – Faridpur district.

Implementation strategies

- Community mobilisation through facilitator-led monthly group meetings applying a Participatory Learning and Action (PLA) cycle focused on diabetes prevention and control.
- Twice weekly m-Health voice messages promoting awareness and behaviour change to prevent and manage T2D.

These strategies were delivered in separate arms of the study on different populations.

Research methods

- 96 villages across four sub-districts (upazillas).
- 10 months formative work (including baseline surveys).
- 18 months PLA + eight months post intervention analysis + concurrent process evaluation.
- Semi-structured interviews, photovoice, focus group discussions, quantitative surveys and implementation monitoring.

Study design

Cluster randomised controlled trial with concurrent process evaluation and economic evaluation.

Key findings

- PLA increased health literacy of individuals and communities.
- Capacity increased in community, household and individual levels.
- Community action enabled and strengthened agency.
- Increased opportunities for healthy behaviour.
- 21% absolute reduction in prevalence of T2D and intermediate hyperglycaemia in the general population.
- 9% absolute reduction in two-year cumulative incidence of T2D among individuals with intermediate hyperglycaemia.
- Community actions addressed lack of awareness about diabetes, gendered barriers to physical activity, and lack of access to blood glucose testing.
- PLA amplified change but there was limited engagement with macro level or 'state' barriers to healthy behaviours.
- m-Health messaging increased knowledge and awareness of T2D but had no detectable effect on the population prevalence of T2D and intermediate hyperglycaemia.

Suggestions for future research

- Measure health literacy and social networks in future interventions.*
- Recommend specific capacity strengthening to complement community-based interventions.
- Optimise exposure and engagement with m-Health messages by:
  - Sending identifiable messages from a trusted source.
  - Increasing population participation in design of intervention.
  - Participant interaction with an m-Health message to enable choice according to preferences.
- m-Health messaging should be implemented as part of a multi-component multi-sectoral approach to motivate and empower communities and create an enabling environment for behaviour change.

** D-Magic PLA component is currently being scaled-up, see Section 9.*

Annual Scientific Meetings

Every year, the GACD hosts its flagship event, the Annual Scientific Meeting. Exclusively for researchers and implementing partners working on GACD funded projects past and present, and funding agency representatives, the Annual Scientific Meeting is a major knowledge sharing and networking event. It is a unique opportunity for the GACD community to meet, share knowledge and best practice, develop new collaborations, and socialise. Unlike traditional conferences – which can end up being a unidirectional provision of information – the Annual Scientific Meeting creates an empowering learning environment.

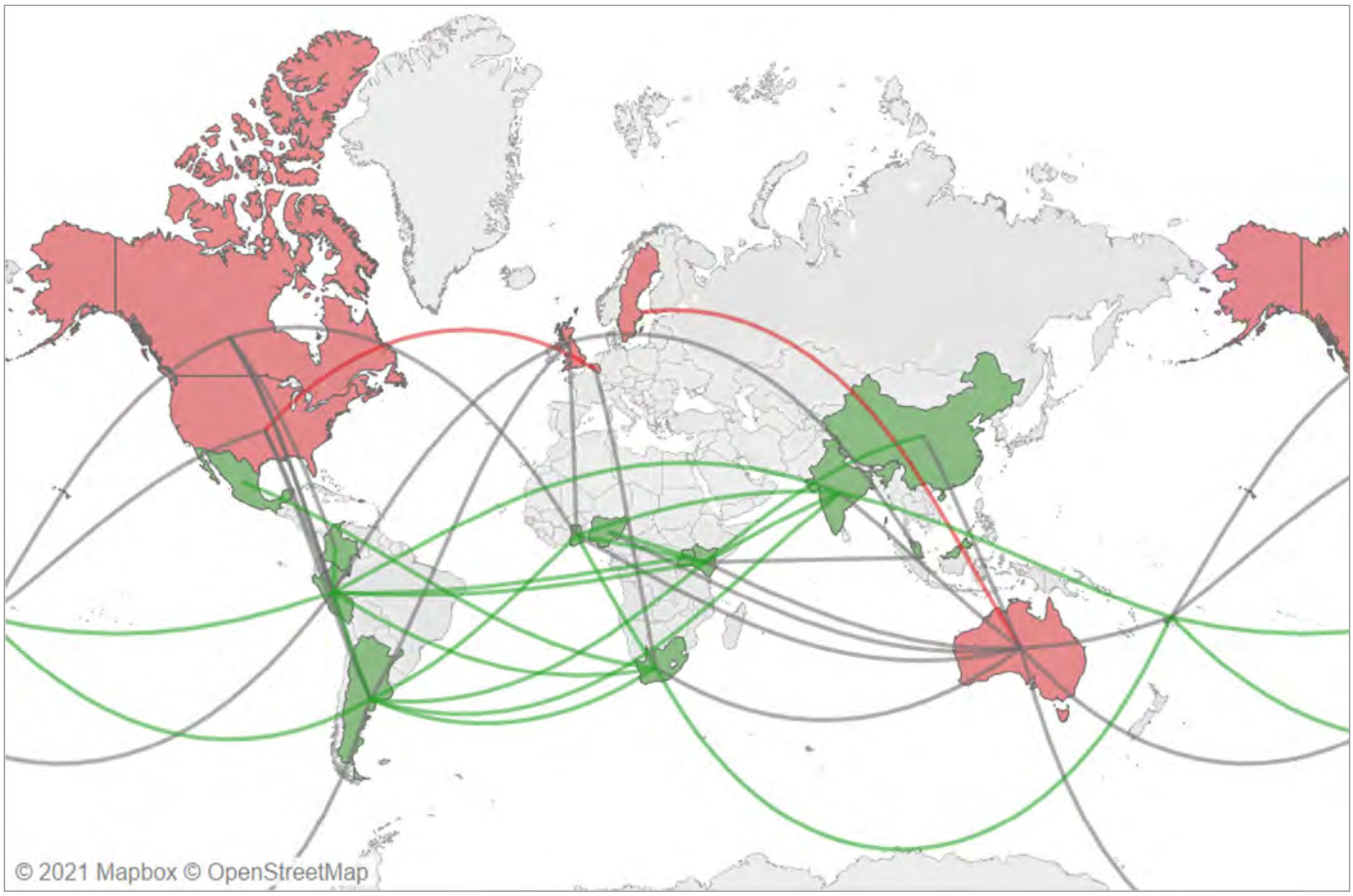
Since 2015, project team members from across the Diabetes Research Programme have actively participated in the Annual Scientific Meeting through presenting project progress, sharing pre-publication findings, leading discussions, and establishing joint activities.

International collaborative partnerships

An external evaluation in 2021 of GACD's activities examined how well the GACD encouraged collaboration between researchers in different countries.[52] The period of the inquiry (2014 to 2019) encompassed the majority of research activities undertaken by diabetes projects. The evaluators looked at the number of researcher pairs from different countries who had published at least two research papers together. This was done for both the GACD Research Network (focusing on implementation science) and the entire implementation science community (including both GACD and non-GACD researchers).

A comparison of these numbers demonstrated strong collaborations between GACD researchers compared to all implementation science researchers, for each pair of countries. **Figure 12** shows collaborations where the connection between GACD researchers was at least 2.5 times stronger than the overall connection in that same country pair. These are country-to-country links where researchers involved with GACD are co-authoring papers together at a much higher rate than other researchers in those countries. This suggests that being part of the GACD Research Network at the time the Diabetes Research Programme was active promotes collaboration, particularly between researchers from LMICs and either other LMICs or HICs.

Figure 12 Country-to-country networks fostered by GACD (2014–2019) – pairs of researchers having at least two co-publications aggregated by country (selected cases).



Income group
- LMIC
- HIC

Type of collaboration
- LMIC-LMIC
- LMIC-HIC
- HIC-HIC

Note: The links between each pair of countries are based on pairs of GACD researchers sharing at least two co-publications. Links between countries were filtered based on their strength relative to the overall implementation science network (including GACD and non-GACD researchers). Only links with relative strength greater than 2.5 are shown.

Source: Prepared by Technopolis (Anoushka Davé, Maike Rentel, Eva Woelbert, Robert King, Rebecca Babb, Reda Nausedaite, Rita Cimatti, David Campbell, Henrique Pinheiro, Etienne Vignola-Gagné, Peter Varnai) in 2021 using Science-Metrix using Scopus (Elsevier) data.

Inter-project working groups

GACD working groups facilitate sharing of knowledge and expertise on topics relevant to the overall strategic aims of GACD. Typically, working groups are conceived and driven forward by members of the Research Network to produce a collaboratively developed output (e.g., academic publication, policy brief, researcher statement, researcher resource). Through their joint efforts, the working group achieves one or more of the following:

- Contribute to the body of scientific knowledge.
- Serve as a resource for the Research Network and broader research community.
- Provide mentorship opportunities for GACD researchers within the working group contexts.

Members of diabetes project teams contributed to, or led on, nine working groups tackling diverse issues from data standardisation to context assessment to NCD multimorbidity.

Diabetes data standardisation working group
The aim of this working group was to develop a set of consensus measures to include in the GACD Data Dictionary. The Data Dictionary was initiated by members of the GACD Hypertension Research Programme and the work of the *Diabetes data standardisation working group* sought to build on this.

The core group consisted of 11 members from seven diabetes projects, chaired by Meena Daivadanam. A further 12 members contributed to the development and delivery of the working group.

A two-phase study (online survey, followed by a modified Delphi panel) identified 49 core measures from 11 domains.[53] The measures spanned several categories including demographics, medical history, medication adherence, health behaviours, anthropometric measures, biochemical measures, and quality-of-life-related issues. Such a dataset saves time, aids data collection decisions, and facilitates transnational comparisons, enhancing global diabetes implementation research.

Concepts and context working group
The aim of this working group was to describe the methods used to characterise and account for context in implementation research at different levels. The working group consisted of 37 members from 22 GACD projects (of which 12 were diabetes projects), chaired by Meena Daivadanam.

This joint activity explored the use of context-specific data from 20 GACD projects, targeting hypertension, diabetes, and lung diseases.[42] Analysis revealed project teams used diverse methods (formal/informal assessments, stakeholder engagement, local resources) to assess context across five levels (individual, community, healthcare setting, local/district, state/national).

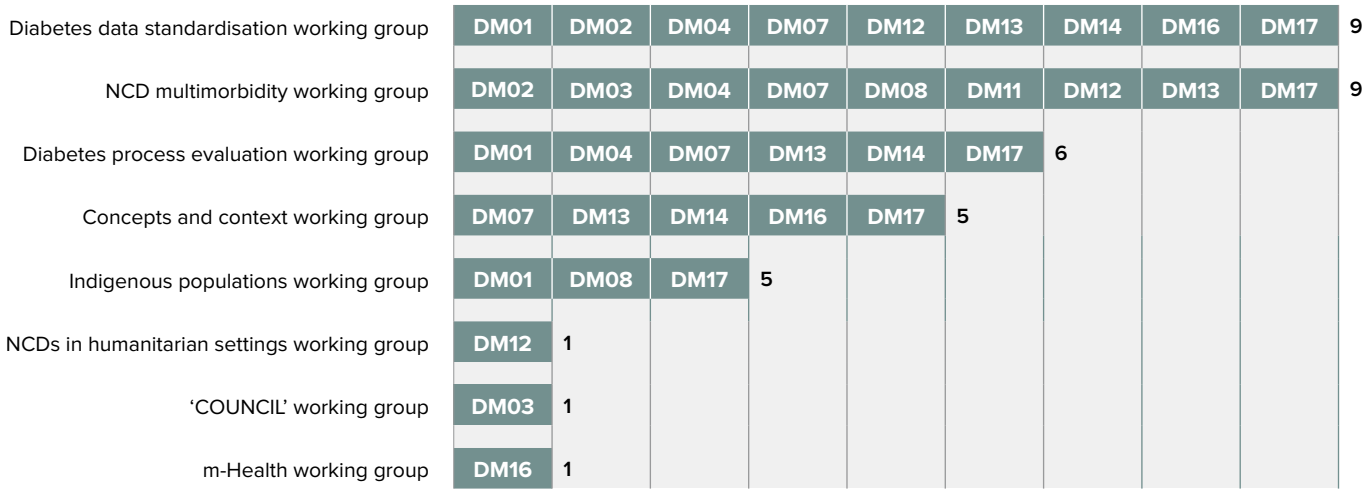
More detail on context assessment across projects can be found in Section 6.

NCD multimorbidity working group
At the 2017 Annual Scientific Meeting, researchers with different specialisms identified their common interest in going beyond 'their' NCD to address multimorbidity – the presence of two or more long-term health conditions and mental disorders – which is already affecting a large number of people in HICs and LMICs (by some estimates, around one third of the population), with figures set to rise further. This sparked the formation of the *NCD multimorbidity working group*. At its peak productivity, the working group consisted of 73 members from 42 GACD projects (of which all 14 diabetes projects were represented), chaired by John Hurst.

Since its establishment, the group has tackled a series of tasks:

- A joint statement and a policy brief to draw the attention of research funders and policymakers to the importance of multimorbidity research.[54]
- Development of a set of core outcomes measures for multimorbidity trials in LMICs, in consultation with LMIC stakeholders.[55] This work has since evolved into the COSMOS subgroup ('Core outcome sets for multimorbidity trials in LMICs'), building on the existing work of the *Diabetes data standardisation working group*. The COSMOS subgroup is developing a multimorbidity core

Figure 13 Contributions to GACD inter-project working groups by the 14 diabetes projects.



** COUNCIL, COntrol UNique to CVDs In Low- and middle-income countries.*

outcomes set through a process of a systematic literature review, interviews with people living with multimorbidity, a two-round Delphi survey, and consensus meetings.

- A research prioritisation exercise, consulting with GACD Research Network members to assemble a 'top ten' list of urgent questions linked to international health targets such as the UN Sustainable Development Goals.

The working group's efforts are galvanising the research community and preparing the ground for future multimorbidity research. They have already addressed one of the GACD funders' main concerns – a lack of robust multimorbidity outcome measures. As a result, the GACD Associate Members agreed and launched the 2024 joint funding call on management of multiple long-term conditions. Find out more on the GACD funding call webpages.

Other working groups

Other working groups that diabetes project teams contributed to included *Diabetes process evaluation, Indigenous populations, NCDs in humanitarian crises, COntrol UNique to CVDs In Low- and middle-income countries (COUNCIL)*, and *m-Health*; see **Figure 13**. Further details are available on the GACD working groups webpage.

In-person knowledge exchange visits

Several project teams initiated knowledge sharing activities beyond those of the GACD Research Network. Project team members from DM01 – based in Australia – visited the DM03 team based in Cape Town, South Africa. Additionally, the DM13 team collaborated with a GACD project under the Lung Disease Research Programme, leading to a site visit to Lima, Peru by the UK-based principal investigator. These exchanges where both parties bring valued perspectives and expertise illustrate the central importance of equity in Global North/Global South collaborations.

Representatives from DM07 and DM08 project teams funded by the European Commission were invited to Belgium mid-way through their funding cycle to participate in a broader European event on 'Key learnings from NCD prevention projects: discussing the future for research in Europe and potential policy initiatives' moderated by representatives from the WHO European Office, the International Diabetes Federation, the European Federation of the Associations of Dietitians, the European Association for the Study of Obesity, and the GACD secretariat. The presentations from DM07 and DM08 were integrated into the event programme alongside discussions on cross-cutting themes such as NCD prevention research priorities and bringing advocacy, policy, and research perspectives together.

Research capacity development

A central objective for GACD is to strengthen implementation science capacity and capability in relation to NCDs, globally. Embedded capacity development through mentorship, training, and peer learning opportunities is a core requirement of all GACD-funded research projects. By strengthening research capacity in diverse local contexts, each project contributes to a sustainable ecosystem for NCD research and implementation beyond the lifespan of the initial funding. This empowers local researchers to continue implementing and iterating diabetes programmes, to identify new challenges, and adapt system-wide interventions to ensure long-term impact.

Thirteen out of the 14 teams reported capacity development activities embedded into their projects. The most common activity was engaging with GACD training events. Initially a two-day workshop – linked to the Annual Scientific Meeting programme – served as an accessible, recurring opportunity to upskill team members in the fundamentals of implementation science. As GACD project numbers have increased, since 2018 GACD has offered a freestanding annual intensive Implementation Science School programme, which guides researchers through the theory and practice of implementation science; find out more on the GACD capacity strengthening webpages. In total, 25 researchers from 12 countries and 13 out of 14 diabetes projects attended workshops and School programmes between 2015 and 2019.

Furthermore, team members from three diabetes projects are now contributing to training events as members of the Implementation Science School Senior Faculty, where they co-develop GACD e-Hub content and co-deliver annual live sessions.

Mentoring within the project team (10 projects) and integrated PhD studentships (eight projects) were also common and reported by more than half of project teams; see **Figure 14**. Marginally less frequent (seven projects) was informal training activities within the project team – this included field visits, written feedback, and team presentations. Less common were project team members attending external training activities (four projects). One project reported using the GACD e-Hub. The GACD e-Hub was formally launched in 2021, by which time 11 of the projects had completed.

Outputs and dissemination

The dissemination of research findings, the act of sharing knowledge beyond the project team, is an essential step in maximising impact. By making research accessible, we empower others to build upon a robust foundation and past studies become stepping stones for future investigations.

Across all 14 projects, a total of 205 unique outputs have been produced, all accessible on the GACD publications portal. These range from peer reviewed journal articles and protocols to training manuals and health promotion materials (**Figure 15**). The vast majority of outputs are peer reviewed journal articles (179, 87%; this includes registrations of trials, protocols, and reviews published in peer reviewed journals). Although publications in peer reviewed journal articles are a key output for investigators, dissemination of information in more accessible formats (such as blogs, social media, policy briefs, and this report) is crucial for promotion and awareness.

High impact publications

The 179 peer reviewed journal articles published by GACD diabetes project teams spanned 80 journals. The journal with the most GACD diabetes publications was Nutrients (12 articles from three projects), followed by BMC Endocrine Disorders (11 articles from two projects) and BMC Public Health (11 articles from seven projects); see **Figure 16**.

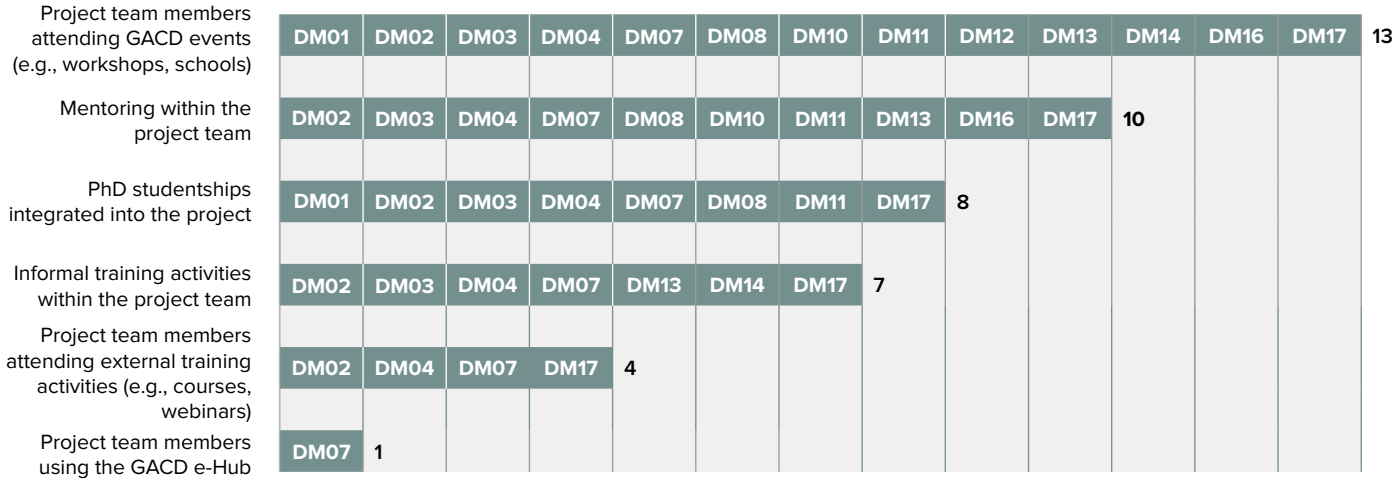
Citation counts and impact factors offer a quantitative way to assess a publication's influence. They can be helpful to gauge interest in a project or concept and for institutions to compare journals. However, such metrics do not distinguish between positive and negative citations, they can be skewed by field or by a few highly-cited papers in a journal, and do not consider

GACD's implementation science training landscape

GACD offers a diverse portfolio of training opportunities to cultivate the skills and knowledge of researchers and practitioners in the field of implementation science.

- **Two-day workshop (2014 to 2019):** As an adjunct to the broader Annual Scientific Meeting, GACD facilitated workshops to introduce early- and mid-career researchers to implementation science over a two-day programme. The workshops were instrumental in building the foundation for GACD's suite of standalone training events and resources.
- **GACD e-Hub programmes (since 2021):** These open-access, online modules provide self-guided learning through curated lectures and resources, equipping participants with targeted knowledge and skills based on specific learning objectives.
- **Thematic workshops:** In collaboration with the Research Network, GACD identifies and delivers topical workshops addressing critical themes in implementation science, such as digital health, planetary health, and context assessment.
- **Live training events:** Events which comprise live sessions with Senior and Junior Faculty, interactive learning, and team-based activities. Typically, live training events are delivered online and use a GACD e-Hub programme as the core learning material.
  - **School (since 2018):** This annual intensive programme caters to early-career researchers. Led by renowned global experts, the School employs a mix of lectures, small group work, facilitated discussions, and panel sessions to deepen participants' understanding of implementation science principles, methodologies, and networking strategies.
  - **Masterclass (since 2022):** Designed for mid-career researchers and programme implementers, the Masterclass focuses on developing expertise in scaling up interventions. This programme utilises an experiential learning approach, guiding participants through the development and refinement of a project concept.

Figure 14 Capacity development activities across the 14 diabetes projects.



non-traditional impact such as social media. Citation counts and impact factors are best used as a starting point, not a definitive measure of a publication's full impact and relevance. Noting this 'health warning' the top ten most cited articles (to date, May 2024) published from the 14 projects have been identified and are shown in **Table 14**. The most cited article (208) is DM08's narrative review on sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for T2D, published in 2020 in BMC Endocrine Disorders. DM13's article describing the results of the D-Magic cluster randomised trial in Bangladesh, while cited fewer times (107), was published in the higher impact journal, Lancet Diabetes and Endocrinology.

Dissemination beyond peer review journal articles

The dominance of peer reviewed journal articles amongst published outputs is perhaps unsurprising as this is the accepted route for sharing research findings within the scientific community. While academic publications are important, research dissemination goes far beyond them. In implementation science, actively engaging with various stakeholders before, during, and after the project is considered essential (see Section 4). Furthermore, with the exponential growth of academic publishing – perhaps influenced by the 'publish or perish' milieu[56] – researchers do not have the time to read every published article.

With these reasons in mind, researchers on GACD projects are encouraged to communicate their projects in alternative, more accessible ways – for the academic community and for broader stakeholder groups. This might include actively identifying opportunities to speak at national and international conferences, developing a website, presenting on webinars, sharing datasets, creating infographics, or tailoring policy briefs. Two projects (DM01 and DM11) used policy engagement

Figure 15 Types of outputs published by the 14 diabetes projects.

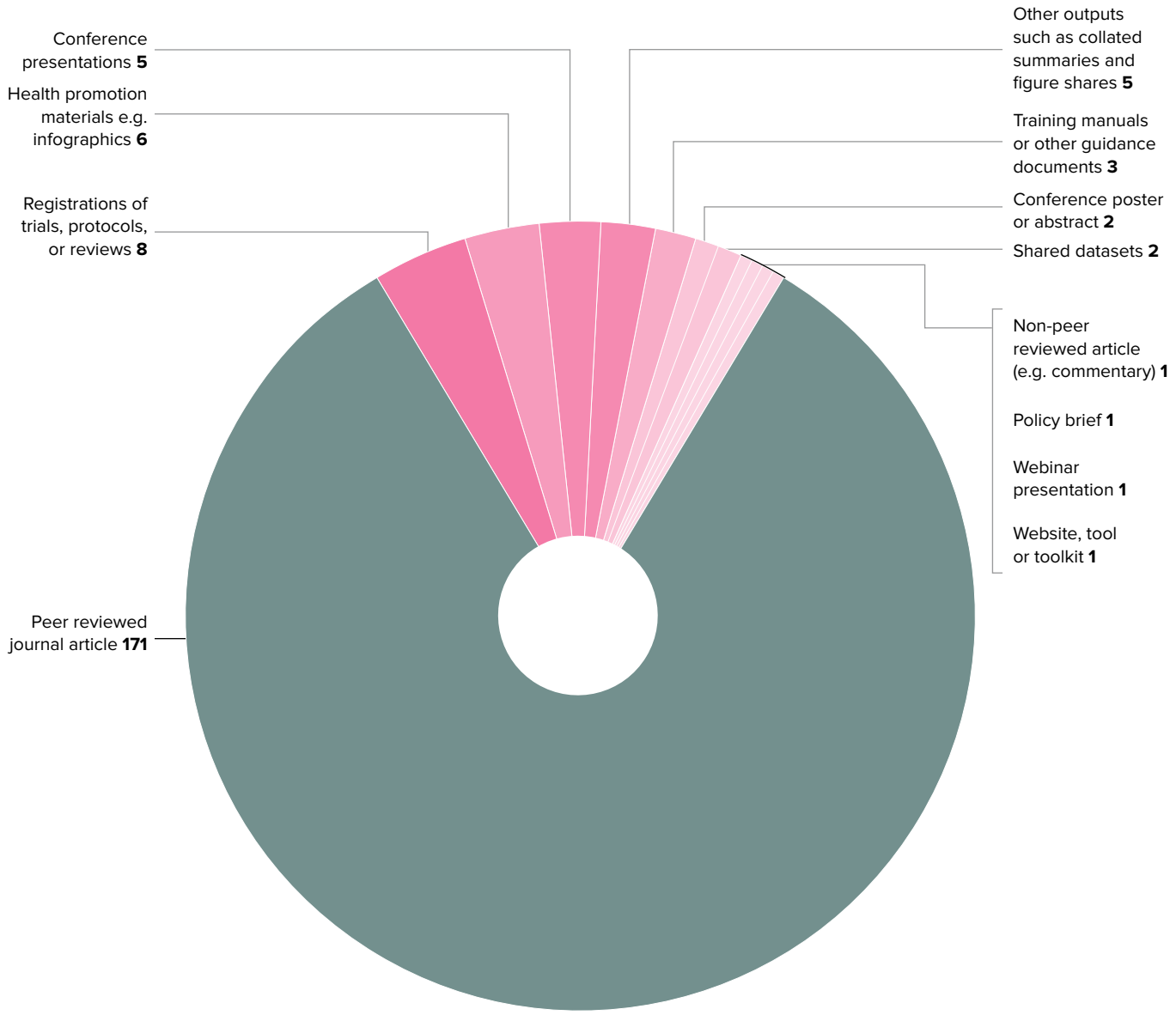
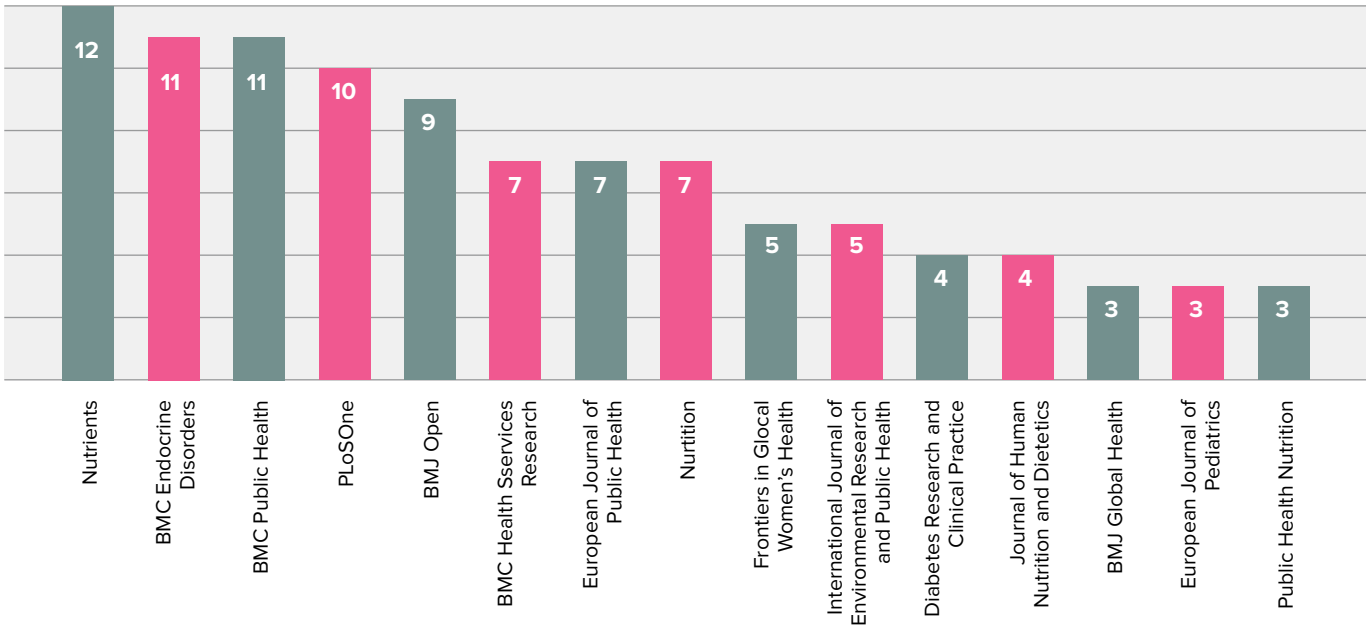


Figure 16 Peer reviewed journals with three or more publications from the 14 diabetes projects.



See also the journal listings on pages 82–83 .

forums for diabetes and research to reach their target audiences. These forums created opportunities for different stakeholders to come together and share ideas. The ability to communicate effectively with diverse groups is increasingly recognised as essential for the success of implementation science.[57]

Section 9 summary

- Impact on policy and practice fell into three main categories: strengthening national health systems to respond to the burden of diabetes, impact on national health programmes, strategies, or guidelines and programme scale up.
- Relevant stakeholder involvement, e.g. government officials and academic bodies, were found to be pivotal in enabling meaningful impact.
- The GACD Research Network encompasses and supports data sharing and collaboration through working groups, international partnerships, and the Annual Scientific Meeting.
- Research capacity strengthening is an important strategic objective of GACD, is expected and funded within projects, and is offered in training events and more recently through the online GACD e-hub.
- Filling the knowledge gap in implementation research requires dissemination of research and findings. The GACD publications portal showcases all outputs produced from the GACD Diabetes Research Programme.

Further reading

Please find below the most highly cited* publication from each project. To access all output from the Diabetes Research Programme, please go to the GACD publications portal.

DM01	Klein J et al. (2017) Diabetes Research and Clinical Practice 129:105-115.
DM02	Peiris D et al. (2016) Implementation Science, 11(1), 1-9.
DM03	Mutabazi JC et al. (2017) Public Health Reviews, 38(1):28.
DM04	Shirinzadeh M et al. (2019) Globalization and Health, 15:10.
DM07	Egbujie BA et al. (2018) PloS One 13:e0198424.
DM08	Kyrou I et al. (2020) BMC Endocr Disord 20(Suppl 1):134.
DM10	Aceves-Sánchez MJ et al. (2018) Salud Jalisco 4(2), 123-127.
DM12	Cooper S et al (2018) PLoS One 13(9): e0202413.
DM13	Fottrell E et al (2019) Lancet Diabetes Endocrinol 7(3):200-212.
DM14	Lazo-Porras M et al. (2016) Trials 17(1), 1-10.
DM15	Pastakia S D et al. (2016) Journal of Gen Internal Med, 1-9.
DM16	Tandon N et al. (2022) JAMA Netw Open 5(3):e220773.
DM17	Denman CA et al. (2014) Preventing Chronic Disease. 11:140218.

Journals with one publication from a GACD diabetes project team:

Preventive Medicine
AIDS
American Heart Journal
Australian and New Zealand Journal of Obstetrics and Gynaecology
Australian Diabetes Educator
BMC Globalization and Health
BMC Pregnancy and Childbirth
BMC Primary Care
BMC Women's Health
British Journal of Nutrition
Cells
Children (Basel)
Clinical Diabetes
Diabetes Management Journal
European Journal Clinical Nutrition
Global Health Research and Policy
Global Heart Journal
Global Public Health
Horizonte Sanitario
Implementation Science
International Journal of Epidemiology
International Journal of Gynecology and Obstetrics
International Journal of Medical Informatics
International Journal of Social Work and Social Sciences
ISRCTN Registry
JAMA Network Open
JMIR Research Protocols
Journal of Clinical Hypertension
Journal of Community Medicine and Health Education
Journal of Diabetes
Journal of Diabetes Sciences and Technology
Journal of Epidemiology and Community Health
Journal of General Internal Medicine
Journal of Mixed Methods Research

Table 14 Top ten most highly cited publications from the GACD diabetes projects.

Project ID	Publication title	Journal (impact factor*)	Year	Cited by**
DM08	Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2 diabetes: A narrative review with emphasis on data from Europe.	BMC Endocrine Disorders (1.994 in 2020)	2020	208
DM13	Community groups or mobile phone messaging to prevent and control type 2 diabetes and intermediate hyperglycaemia in Bangladesh (DMagic): A cluster-randomised controlled trial.	Lancet Diabetes and Endocrinology (44.5 in 2022)	2019	107
DM08	A school- and community-based intervention to promote healthy lifestyle and prevent type 2 diabetes in vulnerable families across Europe: design and implementation of the Feel4Diabetes-study.	Public Health Nutrition (4.539 in 2021)	2018	100
DM07	Role of community health workers in type 2 diabetes mellitus self-management: A scoping review.	PLoS One (3.7 in 2022)	2018	80
DM13	Distribution of diabetes, hypertension and non-communicable disease risk factors among adults in rural Bangladesh: A cross-sectional survey.	BMJ Global Health (8.1 in 2022)	2018	80
DM03	The impact of programs for prevention of mother-to-child transmission of HIV on health care services and systems in sub-Saharan Africa: A review.	Public Health Reviews (5.5 in 2022)	2017	71
DM08	Effective strategies for childhood obesity prevention via school based, family involved interventions: a critical review for the development of the Feel4Diabetes-study school-based component.	BMC Endocrine Disorders (1.994 in 2020)	2020	66
DM07	Patient and provider dilemmas of type 2 diabetes self-management: A qualitative study in socioeconomically disadvantaged communities in Stockholm.	International Journal of Environmental Research and Public Health (4.614 in 2022)	2018	62
DM07	Redefining diabetes and the concept of self-management from a patient's perspective: implications for disease risk factor management.	Health Education Research (2.221 in 2021)	2018	62
DM15	Impact of Bridging Income Generation with Group Integrated Care (BIGPIC) on hypertension and diabetes in rural western Kenya.	Journal of General Internal Medicine (6.473 in 2021)	2016	62

** Impact factor data collected from each journal's website in May 2024.*

*** Citation data collected via Google Scholar in May 2024.*

Journal of the American College of Cardiology
Lancet Global Health
Lancet Regional Health Southeast Asia
Nature Medicine
Pediatric Obesity
PLoS Medicine
Preventing Chronic Disease
Primary Care Diabetes
Public Health Reviews
Recent Patents on Endocrine, Metabolic and Immune Drug Discovery
Revista Iberoamericana De Ciencias De La Actividad Física Y El Deporte
Salud Jalisco
The Diabetes Educator
Transactions of the Royal Society of Tropical Medicine and Hygiene
Translational Behavioral Medicine
Wellcome Open Research
WHO South East Asia Journal of Public Health
Women and Birth

Journals with two publications from GACD diabetes project teams:

Appetite
BMJ Open Diabetes Research and Care
Diabetic Medicine
Global Health Action
Health Education Research
Health Promotion International
International Journal of Behavioral Nutrition and Physical Activity
International Journal of Integrated Care
Journal of Physical Activity and Health
Lancet
Lancet Diabetes and Endocrinology
Nutrition
Metabolism and Cardiovascular Diseases
Trials


JPOYOO
T90

10 Lessons learned

All 14 project teams reported on the lessons learned through their experiences investigating implementation research strategies for GDM and T2D in 19 countries. Observations ranged from the critical role of collaboration, to the use of technology, to integration with existing healthcare provision. Six core lessons learned are noted below, drawn from the project teams' reflections and more than 40 collective years of diabetes implementation research project experience. Table 15 summarises the lessons learned across all projects.

Six core lessons learned

Collaborate for success

Collaboration was a central learning across project experiences. Robust and mutually beneficial relationships with stakeholders, champions within the community or healthcare system, and leadership from target populations are crucial. More specifically, collaborating directly with patients and communities and empowering them through education and social support networks can improve diabetes outcomes. Equitable partnership working between researchers and actors across all aspects of the implementation process are essential for success.

Tailor implementation strategies to the local context

Successful implementation strategies identify, respect, and work with the 'real life' cultural norms, system infrastructure, staff capacity, prevailing health disparities, and the social determinants of health. This is achieved through due attention to the context across time, space, and levels of socioeconomics. Ultimately, implementation strategies must be tailored to the local context. This was particularly evident in the projects when comparing rural and urban communities, which have distinct needs in terms of healthcare access, resources, and social support.

Using technology as a tool, not a silver bullet

The role of digital technology in healthcare has intensified in recent years, fuelled by cloud computing, diagnostics and treatment supported by software, and an explosion of mobile apps.[58] Understandably, the use of technology in the implementation of healthcare programmes has similarly grown. Researcher experiences through the diabetes projects indicate that technology platforms used in implementation efforts must be user-friendly and adapt over time to the evolving preferences of the user communities. In addition, although many m-Health strategies have great promise for impact, often success is only seen when combined with other approaches for behaviour change. In the use of electronic data collection, the importance of interoperability between healthcare facilities is emphasised.

Address health inequities

Equitable access to diabetes care requires addressing social and economic barriers. While these deeply entrenched obstacles cannot be eliminated by a single project, each research team can contribute to dismantling them. Recognising this, the GACD diabetes funding call text explicitly required applicants to assess health inequities and integrate them into their implementation strategies; see the GACD diabetes funding call page for more detail.

Beyond following this directive, project teams' reflections highlighted that addressing health equity is not just a requirement, but a critical factor for successful implementation. One key learning involved the historical context of health inequities. For instance, when working with marginalised and underserved communities, such as First Nations women, addressing historical factors that contribute to current disparities is crucial, alongside tackling contemporary barriers.

The social dimension also emerged as important. Community-based approaches that empower individuals and strengthen social support networks can be effective mechanisms for addressing specific diabetes outcomes while concurrently tackling broader health disparities.

By carefully conducting implementation research, we can generate evidence that informs stronger policies and societal shifts towards achieving equitable access to diabetes care.

Consider sustainability from the start

From the outset of a project, implementation efforts should be designed for cost-effectiveness and integration into existing healthcare structures. However, such systems are not static. The project most likely to succeed will embrace the inevitability of change and factor in, where possible, future adaptability and resource limitations. Pilot studies and formative research can help identify existing and potential challenges, as well as assess health system capacity, and guide the refinement of implementation strategies.

One way to plan for the future is to strengthen capacity and capabilities in the existing workforce and primary healthcare systems. Training healthcare professionals and other providers was identified as a key implementation strategy for long-term sustainability.

Expect and plan for the unexpected

The COVID-19 pandemic was an unexpected and deeply

Table 15 Summary of the core lessons learned, grouped by region.

This table focuses on how project teams' reflections contributed to the identified key themes across all lessons learned. A checkmark (✓) indicates that a project's reported lessons learned contributed significantly to the overall themes identified. The absence of a checkmark does not necessarily mean that the project did not have any findings or reflections on this theme.

Region	Country	Target community	Project ID
Africa	Kenya	Adult Mabaraza (community group) participants; individuals with diabetes or at increased risk of diabetes; microfinance group members and clinic patients.	DM15
	Malawi	Adults living in Lilongwe diagnosed with T2D and taking diabetes treatment.	DM12
	South Africa	Women with GDM in current pregnancy in Cape Town and Soweto (Western Cape and Gauteng provinces).	DM03
		Adults at high-risk for or living with T2D (diagnosed <12 months ago).	DM07
		Adults living in Cape Town and Johannesburg diagnosed with T2D and taking diabetes treatment.	DM12
	Uganda	Adults at high risk of or living with T2D (diagnosed <12 months ago).	DM07
The Americas	Mexico	Adults living with T2D in Mexico.	DM10
			DM11
		Adults with T2D in self-help groups of the Mexican Health Ministry's centres.	DM17
	Peru	Adults with T2D at high risk of foot ulceration.	DM14
Asia	Bangladesh	Adults living with or at risk of type 2 diabetes in Faridpur district, Bangladesh (rural).	DM13
		Women in urban centres affected by GDM within the previous 18 months and diagnosed based on via OGTT between 24-34 weeks gestation.	DM16
	China	Adults with T2D from urban and rural communities.	DM02
	India	Women in urban centres affected by GDM within the previous 18 months and diagnosed based on via OGTT between 24-34 weeks gestation.	DM16
	Philippines	Adults aged 40 years or more from rural and urban communities in Zamboanga Peninsula (an Administrative Region).	DM04
	Sri Lanka	Women in urban centres affected by GDM within the previous 18 months and diagnosed based on via OGTT between 24-34 weeks gestation.	DM16
Europe	Belgium, Spain, Bulgaria, Finland, Greece, Hungary	Families in underserved groups experiencing health inequities in high-income countries.	DM08
	Sweden	Adults within underserved groups experiencing health inequities in high-income countries at high-risk for or living with T2D (diagnosed <6 months ago).	DM07
Western Pacific	Australia	Women in Australia's Northern Territory and Far North Queensland with diabetes in pregnancy, particularly First Nations women (Indigenous).	DM01

Contributions to core lessons learned across projects					
Collaborate for success	Tailor strategies to the local context	Technology as a tool, not a silver bullet	Address health inequities	Consider sustainability from the start	Expect and plan for the unexpected
	✓		✓	✓	
	✓		✓		✓
	✓		✓		✓
✓	✓	✓	✓		
	✓	✓	✓		✓
	✓	✓	✓		
✓		✓	✓	✓	
✓		✓	✓	✓	
✓		✓	✓	✓	
✓		✓	✓	✓	
✓	✓	✓	✓		
	✓	✓	✓		✓
	✓		✓		
	✓	✓	✓		✓
	✓		✓		
	✓	✓	✓		✓
✓	✓		✓	✓	
✓	✓	✓	✓		
✓			✓	✓	✓

disruptive event across the world. Its effects continue to be felt in all areas of society, especially healthcare. Unsurprisingly, COVID-19 impacted on the diabetes projects – for example, the DM13 team had to modify the study design of their scale up from a step-wedged cluster randomised trial to a waitlist trial design. Unexpected events also encompass political unrest and extreme weather – for example, the droughts in South Africa that impacted on delivery of the DM03 project. Unexpected events serve as a reminder that project plans rarely follow the intended path: although we might plan for the future, we cannot predict it. The key learning here is to have a plan but expect to take some detours.

Collated lessons from different regions and communities

Although the lessons learned through each project team's experiences are largely not geographically restricted, it may be valuable to collate key reflections under regional headings. The intention of doing so is to help identify trends or patterns that may not be apparent when looking at individual projects or the full cadre of projects together. Consideration of regional trends add to the pool of contextual information, which is pivotal for successful implementation research. Therefore, subsequent adaptations could lead to more nuanced research questions, help shape future research projects in the region, or inform regional policy strategies.

Lessons from projects in Sub-Saharan Africa

Important learnings from four project teams (DM03, DM07, DM12, and DM15) implementing programmes in four countries in Sub-Saharan Africa (South Africa, Uganda, Malawi, and Kenya) relate to the role of the prevailing local health system on implementation success. Project teams note how healthcare provision, organisation, and quality differed even within country, leading to challenges in developing implementation plans that would be equally effective across all regions or localities. In such varied contexts, one dimensional implementation strategies – such as SMS reminders – proved to be inadequate in improving glycaemic outcomes. This was further exacerbated through differences in target population needs, behaviours, and preferences – for example, women with GDM in one area preferring group discussions but women in another area preferring 1-to-1 sessions. Such lessons underscore the critical importance of assessing and truly understanding the local context of implementation and reassessing this throughout the research process.

Conversely, striving for perfection can hinder the implementation of beneficial changes. For instance, the DM07 project demonstrated that even modest healthcare system improvements, such as practitioner training, can significantly enhance diabetes management in settings with suboptimal care. Similarly, the DM12 project observed positive effects of SMS-based interventions on blood pressure and treatment goals, though the exact mechanisms driving these improvements are yet to be fully understood.

Various social, economic, and environmental factors significantly influence how individuals and communities experience and benefit from the national health system. The DM15 project team, who combined group medical visits and microfinance for people living with T2D or hypertension in Kenya report that incorporating the more distal determinants of health (social) with the more proximal (clinical care) had a positive impact – especially for individuals without health insurance or with lower baseline earnings. In particular, they note the impoverishing effects of out-of-pocket expenditure among people with T2D that must be integrated into the more traditionally narrow clinical perspective.

Lessons from projects in the Americas

Critical lessons from four project teams (DM10, DM11, DM14, and DM17) implementing programmes in two countries in the Americas (Mexico and Peru) relate to the use of technology as a tool, not a solution, and developing a good understanding of the project stakeholders.

Project teams using communication technologies in Mexico and Peru noted the central importance of continuous iteration working alongside the end-users. Indeed, the DM14 project team counsel the need to adapt to the reality of participants, rather than faithfully adhering to academic expectations of a context or group of people. Continuous iteration is vital as technology (and its application) continues to evolve. At the time most of the diabetes projects began, SMS was the typical communication channel used in Peru – and the project team planned accordingly. Fast forward to present times and most Peruvians use WhatsApp instead. Implementation researchers must plan, as far as possible, for ongoing technological developments.

The DM17 project team shared valuable learnings related to institutional level factors hindering their trained facilitators from delivering the support groups. Demanding workloads of the health centre staff, the lack of recognition of the work carried out in the intervention, and the current requirements for accreditation to the programme were cited as significant barriers. However, the meaningful partnerships established between academics, clinicians, and Ministry of Health staff were crucial in overcoming these barriers – academic partners learned to better understand the existing limitations of the clinical settings and problem solve with the local staff to adapt the intervention. The partnerships also facilitated the participation of clinical staff and leadership in a broader model of health promotion adapted to existing programmes.

Lessons from projects in Asia

Four diabetes projects (DM02, DM04, DM13, DM16) reaching across two WHO Regions (South-East Asia and Western Pacific) and implementing programmes in five countries (China, Philippines, Bangladesh, India, and Sri Lanka) reported key learnings related to differences between rural and urban settings, and barriers to behaviour change across all levels of the Socioeconomic Model.

Project teams implementing programmes in China (DM02) and Philippines (DM04) noted multiple differences between rural and urban settings in their respective settings, from needs, behaviours, community norms, preferences, and health system structure. Such differences impacted on the success of their quite different programmes. In China, the success of a digital health intervention in improving T2D risk factor control was particularly pronounced in rural communities. This was attributed to stronger relationships between patients and healthcare professionals, and greater support from family members. Similarly, greater success was observed in rural communities compared to urban communities in Philippines, where the CHAP-P lifestyle programme was implemented. Researchers should ensure that critical differences between rural and urban settings are assessed and used to inform adaptation of implementation plans.

Improving healthy behaviours in urban environments may be more appropriately addressed by implementing interventions further 'upstream'.[59,60] Such approaches were the subject of GACD's eighth funding call on implementation research targeting NCD risk factors associated with city and urban environments.

Although targeting different populations under the diabetes umbrella (DM13 – people at risk or living with T2D; DM16 – women with GDM), project teams working in the South Asian countries of Bangladesh, India, and Sri Lanka identified similar barriers to engaging with healthy behaviours. These included limited health literacy of the target populations, unhealthy lifestyle habits (including tobacco smoking, poor diet, and physical inactivity), and cultured gender norms adversely affecting women's engagement. The solutions, they posit, lie in multi-component, multi-sectoral approaches. The DM13 project team noted that the interaction between the individual, household, and community contexts amplified change. Based on the full experiences of their project, they recommend measuring health literacy and social networks. Furthermore, future implementation research projects might benefit from capacity strengthening to develop public accountability mechanisms and health systems strengthening to complement community-based interventions.

Lessons from projects working with underserved groups experiencing health inequities in HICs

Three projects worked with underserved communities experiencing health disparities in HICs: DM01 (First Nations women in Australia), DM07 (adults within underserved groups experiencing health inequities in HICs at high-risk for or living with T2D), and DM08 (families from low socioeconomic regions in six European countries). All three project teams noted the importance of having the right people, with the right skills, in the right place, at the right time. The DM01 project team worked with local 'champions' to influence clinical practice, who proved key to sustained implementation. DM07 emphasised the importance of training lay health workers to improve retention in care. The DM08 project team reported that primary care services in the communities they worked with should be strengthened through trained, upskilled healthcare professionals.

All teams also cemented learning on the significance of embedding implementation activities within existing health systems serving the target community. The DM08 project team were able to deliver a comprehensive diabetes screening and prevention programme, which they attribute to integrating their activities into the local schools and primary healthcare facilities. Beyond the activities themselves, integrating research priorities with health provider priorities was crucial. DM07 discussed how a more integrated training approach would improve the health outcomes within the existing systems. The DM01 project team reflected that the success of their implementation was at least in part due to ensuring that the approaches they designed were strategically aligned with priorities of the health services in which they were operating.

Successful integration cannot be achieved without strong connections between the implementation team and stakeholders. Beyond clinical understanding and research competencies, the project teams had to employ complex interpersonal skills to develop meaningful relationships between the team and the stakeholders, and facilitate and nurture relationships among different stakeholder groups involved in the project.

Section 10 summary

- Lessons learnt encompass six core areas: collaborating for success, tailoring to context, technology as a tool not a silver bullet, addressing health inequities, considering sustainability from the start, and expecting and planning for the unexpected.
- Lessons learnt were also collated by geographic region, highlighting common trends that can be considered when undertaking future research.

11 Conclusions

The GACD Diabetes Research Programme has demonstrated the transformative power of implementation research in addressing the global diabetes crisis.	Through rigorous testing of tailored implementation strategies, the programme has made substantial progress in addressing the recommendations of the Lancet Commission on Diabetes.[2] By bridging gaps in knowledge, practice, and data, the GACD-funded projects will continue to have growing impact on the worldwide diabetes burden.
A cornerstone of the programme's success has been its emphasis on multi-stakeholder collaboration.	By involving policymakers, healthcare professionals, communities, and beyond, the diabetes projects have ensured that interventions are aligned with local needs and priorities. Co-created and co-designed approaches foster the necessary support and commitment to implement evidence-based practices and translate research findings into actionable policies and scalable programmes.
The programme has achieved notable outcomes, particularly in improving healthcare professionals' knowledge and strengthening health systems.	These efforts have resulted in positive impacts on practice and policy in underserved communities. Several projects have successfully moved on to scale up their activities. Additionally, the significant knowledge generation and data compilation through the GACD Research Network have provided a strong foundation for future research and evidence-based policy and practice change.
While implementation science has evolved rapidly, challenges remain in standardising research methods and conducting comprehensive meta-analyses.	The diversity of projects within the programme makes it difficult to compare results directly. However, by using consistent measures and evaluation methods across studies, researchers can enhance the likelihood of reliable comparison. The GACD Research Network has played a crucial role in promoting collaboration, knowledge sharing, and the development of common tools and resources.
The COVID-19 pandemic highlighted the importance of flexible and resilient healthcare systems.	Lessons learned from the pandemic, such as the expansion of m-Health and decentralised care models, can inform future diabetes prevention and management efforts. By integrating flexible strategies into implementation research, healthcare systems can be better prepared for future health challenges.
Beyond traditional academic publications, the programme has embraced a variety of tailored dissemination outputs to ensure that findings are understood and actionable.	Training manuals, toolkits, policy briefs, workshops, and innovative media are being used to effectively communicate outcomes and drive readily actionable change.
Addressing health disparities and promoting health equity should remain central to diabetes research and implementation efforts.	Tailoring interventions and implementation strategies to meet the needs of affected populations, including low-income and marginalised communities, is essential for reducing inequities in diabetes outcomes. A social determinants of health approach that tackles underlying structural barriers is crucial for promoting inclusive and equitable healthcare delivery.
The future of diabetes implementation research lies in nurturing collaboration, embracing innovation, and leveraging data-driven insights to drive sustainable health outcomes.	By improving research methods, harnessing new technologies, engaging stakeholders, and promoting health equity, we can collectively accelerate progress towards reducing the global diabetes burden and improving health outcomes for all.

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The following people helped to shape the nature and core content of the report, from reviewing the initial data collection form to appraising the first draft.

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Data collators

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Names in bold: These researchers further contributed with helpful review of report drafts, providing clarification and insight.

DM01	**Improving the management of Diabetes in Pregnancy in Remote Australia**			
	Diana MacKay	PhD Candidate	Menzies School of Health Research	
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DM02	**SMART Diabetes – Systematic Medical Assessment, Referral and Treatment for Diabetes care in China using Lay Family Health Promoters**			
	Xuanchen Tao	Project Manager	The George Institute for Global Health – China	
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DM03	**IINDIAGO (Integrated INtervention for DIAbetes rIsk after GestatiOnal diabetes): An integrated health system intervention aimed at reducing type 2 diabetes risk in disadvantaged women after gestational diabetes in South Africa**			
	Naomi Levitt	Principal Investigator	University of Cape Town	
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DM04	**CHAPP: Community Health Assessment Program in the Philippines**			
	Ricardo Angeles	Co-Principal Investigator	McMaster University	
	Gina Agarwal	Principal Investigator	McMaster University	

DM07	**SMART2D: A people-centred approach through Self-Management and Reciprocal learning for the prevention and management of Type-2-Diabetes**			
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DM08	**Feel4Diabetes (Families across Europe following a hEalthy Lifestyle 4 Diabetes prevention): Developing and implementing a community-based intervention to create a more supportive social and physical environment for lifestyle changes to prevent diabetes vulnerable families across Europe**			
	Yannis Manios	Principal Investigator	Harokopio University Athens	
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DM10	**Desarrollo de una red social interactiva para el control metabolico de los pacientes con diabetes [Development of an interactive social network for metabolic control of patients with diabetes]**			
	Francisco Gonzalez Salazar	Principal Investigator	Universidad De Monterrey	

DM11	**Desarrollo y validación deun software ligado a un portal de internet que facilite el tratamiento médico y el empoderamiento del paciente con diabetes tipo 2, la interacción con el personal médico y la generación de un registro en tiempo real [Development and validation of software to provide medical treatment and patient empowerment to type 2 diabetics, through interaction with medical staff and real-time recording]**			
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DM12	**Mobile phone text-messaging to support treatment for people with type 2 diabetes in sub-Saharan Africa: a pragmatic individually randomised trial**			
	Andrew Farmer	Chief Investigator	University of Oxford	

DM13	**The Bangladesh D-Magic Trial: Diabetes Mellitus – Action Through Groups or Information for Better Control?**			
	Edward Fottrell	Principal Investigator	University College London	
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DM14	**Implementation of foot thermometry and SMS to prevent diabetic foot ulcer**			
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DM15	**BIGPIC: Bridging Income Generation with Group Integrated Care**			
	Jessica Gjonaj	Research Coordinator	NYU Grossman School of Medicine	
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DM16	**A lifestyle intervention program for the prevention of type 2 diabetes mellitus among South Asian women with gestational diabetes mellitus**			
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DM17	**Tools and Practices to Reduce CVD and Complications in Diabetics in Mexico**			
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	Maia Ingram	Co-Principal Investigator	University of Arizona	
	Jill de Zapien	Co-Principal Investigator	University of Arizona	
	Elsa Cornejo	Co-Principal Investigator	El Colegio de Sonora	

Accompanying outputs

Commentary

A commentary article written by GACD researchers reflecting on this report is in development.

Database

An online, interrogatable database containing information submitted by diabetes project teams. Content can be used for examination, exploration, and analysis at the project teams' interest and discretion. Only available to GACD project teams.

Key message flyers

Visual summaries of key messages in the report publicly available on the GACD website, tailored to specific audiences:

- Patients and the general public (without a science background)
- Researchers
- Funding agencies
- Healthcare providers and public health programme managers
- Policymakers
- Educators

Summary slide set

Ready-made slide set summarising report content. Primarily intended for researchers but available to all.

Social media toolkit

Visuals and text for social media posts related to report dissemination, available to all.

Whether you are a researcher, policymaker, or funding agency, all resources from this report are available on our dedicated webpage. Explore our database, download flyers, engage with tools and more to support your work:

www.gacd.org/our-impact/diabetes-report

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Annex: Details of context-specific barriers and enablers faced by projects

Context-specific barriers and enablers faced by projects from sunburst diagram in Figure 10, with further details. Barriers in orange, enablers in green, both in blue. Different shades of each colour correlate with each respective category and are the same for those used in Figure 10.

Contextual factors	Subcategory		Frequency across projects	Project IDs (barrier, enabler, both)
Community behaviours	Language barriers		3	DM04, DM07, DM12
	Cultural or religious beliefs inhibiting engagement		3	DM04, DM07, DM13
	Aging or isolated populations		2	DM02, DM07
	Technophobia among older patients		1	DM10
	Childcare obstacles		1	DM01
	Limited uptake of health seeking and maintenance behaviours and/or motivation	Reported low numbers of women presenting for preconception counselling	1	DM01
		Prioritising needs of family over women's own postpartum health	1	DM01
		Limited time or motivation for women to attend for postpartum care	1	DM01
		Patient health seeking/ monitoring behaviour	4	DM02, DM04, DM07, DM13
		Lack of routine care for GDM after childbirth	1	DM16
		Reduced priority for self-care among women with GDM	1	DM16
		Use of free time	1	DM07
	Uninformed perceptions of body image		1	DM13
	Tobacco smoking		1	DM13
Data collection, recording and referrals	Inconsistent access to electronic health records and/or poor data management		2	DM01, DM04
	Reliance on handheld medical records, which patient may not bring to appointments/record keeping		2	DM01, DM07
	Poor communication and/or referral system between primary and secondary care		1	DM01
	Incompatibility of electronic data management platforms with existing systems		1	DM11
	Inconsistent internet and media access		3	DM04, DM07, DM12
	Inconvenience of engaging population for data collection		1	DM15
	Patient drop-out		2	DM07, DM15
Health systems and structure	Inconsistency in local guidelines		1	DM01
	High staff mobility in primary care		1	DM07
	Long waiting times		2	DM01, DM07
	Fragmented and/or duplicative health systems		3	DM01, DM03, DM12
	Poor career development for healthcare professionals		1	DM02
	Short consultation times and/or lack of evaluation and follow-ups		1	DM14
	Licensure gap between urban and rural doctors		1	DM02

Contextual factors	Subcategory		Frequency across projects	Project IDs (barrier, enabler, both)
Knowledge and education	Low patient education levels		5	DM02, DM04, DM07, DM13, DM14
	Limited uptake of health literacy	Low perceived future risk of T2DM amongst women	1	DM01
		Lack of understanding/ misinformation	3	DM02, DM07, DM13
		Poor knowledge related to GDM care among pregnant women	1	DM16
Natural disasters and emergencies	COVID-19		4	DM01, DM03, DM12, DM16
	Weather changes (e.g., drought)		2	DM03, DM07
	Altered farming patterns		1	DM07
Access to healthcare facilities or medication	Lack of transportation		1	DM01
	Poor physical infrastructure, including roads and buildings		3	DM04, DM07, DM15
	Long distance to travel to health facility		3	DM01, DM04, DM07
Systemic factors	Gender inequality		2	DM03, DM13
	Pervasive poverty and inequality		3	DM03, DM04, DM15
	Pervasive impacts of colonisation leading to systemic inequities		1	DM01
Human resources	Aging doctors in rural compared to urban settings		1	DM02
	Lack of quality control measures		1	DM07
	High staff turnover		1	DM01
	Lack of staff and/or overburdened		1	DM02
	Insufficient involvement of medical specialists		1	DM01
	Small Aboriginal workforce		1	DM01
Practitioner trust, confidence and/or expertise	Lack of clarity of healthcare professionals' roles		1	DM01
	Inconsistent care provision		1	DM01
	Lack of confidence in care delivery		2	DM01, DM02
	Unsafe environments for healthcare professionals		1	DM04
Economic status	Low availability of health budgets and/or finances for patients		2	DM04, DM08
	High cost of food		2	DM01, DM13
	Pay gap between urban and rural settings		1	DM02
Political climate	Violence		1	DM03
	Migration and informal settling		1	DM07
Stakeholder Involvement	Inconsistent legislation and lack of political power		1	DM04

Contextual factors	Subcategory	Frequency across projects	Project IDs (barrier, enabler, both)
Stakeholder involvement	Stakeholder support	5	DM01, DM03, DM08, DM12, DM17
	Local government or council involvement and initiatives	2	DM03, DM04
Knowledge and education	Existing educational or community health programmes to link intervention to	2	DM01, DM03
	Introduction of health-related activities for general population	1	DM02
	Introduction of self-help groups	1	DM17
	Media-driven health promotion strategies	1	DM04
	Use of educational facilities to reach families and communities	1	DM08
Practitioner trust, confidence and/or expertise	Strong relationship building between patients and clinicians	1	DM01
	Strong relationship building between healthcare staff and research team	2	DM03, DM12
	Healthcare professionals' knowledge of GDM	1	DM16
Human resources	Good availability of doctors	1	DM04
	Positive existing partnership and healthcare professionals in rural areas	1	DM15
Inclusivity	First Nations women's connection to culture, family and country	1	DM01
	Prioritisation of marginalised groups	1	DM04
Economic status	Availability of health insurance	2	DM02, DM04
Access to healthcare facilities or medication	Convenient location of healthcare facilities	1	DM04
	Availability of m-Health strategies	1	DM02
Community behaviours	Motivation to improve own health during pregnancy, in interest of baby	1	DM01
Community behaviours	Efficacy of stress management	1	DM13
	Fear of healthcare services or sickness	2	DM13, DM14
	Dietary habits	2	DM13, DM16
	Exercise habits	2	DM13, DM16
	Perceptions about livelihood with disease status	1	DM07
	Service user support from family, community and/or religious leaders	6	DM13, DM08, DM02, DM04, DM14, DM16
	Service user engagement	3	DM07, DM12, DM14
Knowledge and education	Availability of NCD and/or diabetes workshops	4	DM02, DM03, DM13, DM04
	Availability of onsite technical guidance, visits by hospital chief experts and/or staff training	3	DM02, DM07, DM17
Access to healthcare facilities or medication	Availability of and/or access to medical equipment and medicines	5	DM02, DM04, DM12, DM13, DM15
Practitioner trust, confidence and/or expertise	Patients' faith in practitioners' ability	3	DM04, DM07, DM13
Health systems and structure	Healthcare professionals' job satisfaction and/or motivation to work	2	DM02, DM04

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