

WESTERN SYDNEY
UNIVERSITY



DIABETES, OBESITY AND METABOLIC HEALTH

2018



MISSION STATEMENT

Our vision is for a world without diabetes or its complications. Our mission is to create new knowledge, skills and technology, easily accessible to the relevant people, to work towards preventing diabetes and improving the management of its complications.

To achieve our mission, we will harness research across several diverse and interrelated disciplines to develop, trial and, where appropriate, implement new scalable and sustainable health interventions. We will work in partnership with communities, health services, industry, and/or policy makers, to:

- prevent and reduce diabetes, obesity and metabolic disease (DOM)
- prevent the effects of DOM during pregnancy
- prevent and reduce long-term complications from DOM
- develop more personalised approaches to the diagnosis and management of type 1, type 2 and rarer forms of diabetes, that fully embrace enabling technologies and are tailored for the individual, their journey and the family and community around them
- create new, integrated, clinically cost-effective models of care across the healthcare system and with community.

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EXECUTIVE SUMMARY

Diabetes is at epidemic levels and is continuing to rise. This is primarily due to soaring obesity rates, driving increases in type 2 diabetes and gestational diabetes. Type 1 diabetes and rarer forms of diabetes are also on the rise, but for reasons that are still not fully clear. Western Sydney University is involved in translational research in diabetes, obesity and metabolic disease in Greater Western Sydney and beyond. The purpose of this white paper is to report on the activity underway, and provide a vision of how Western Sydney University will support health services, communities, industry and policy makers to address the greatest epidemic of our time. Our vision is a world without diabetes or its complications. Our mission is to create new knowledge, skills and technology, easily accessible to the relevant people, to work towards preventing diabetes and improving its management.

ACRONYMS

CABG	coronary artery bypass grafting
CALD	culturally and linguistically diverse
CAG	Clinical Academic Group
DOM	diabetes, obesity and metabolic disease
DOMTRU	Diabetes, Obesity and Metabolism Translational Research Unit
GDM	gestational diabetes mellitus
GWS	Greater Western Sydney
SPHERE	The Sydney Partnership for Health, Education, Research and Enterprise
SWS	South-Western Sydney

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INTRODUCTION

Diabetes is one of the most prevalent, costly, life-threatening, and growing diseases in Australia. Affecting 1.7 million Australians, diabetes costs \$14.6 billion each year, and a new patient is diagnosed every five minutes [1].

With its multi-factorial nature, including links to obesity and metabolic disease, addressing the diabetes epidemic requires a coordinated approach, integrating multidisciplinary, cutting-edge research to provide sustainable solutions.

At Western Sydney University (Western), our vision is for a world without diabetes or its complications. Our mission is to create new knowledge, skills and technology, easily accessible to the relevant people, to work towards preventing diabetes and improving the management of its complications.

To achieve our mission, we will harness research across several diverse and interrelated disciplines to develop, trial and, where appropriate, implement new scalable and sustainable health interventions. We will work in

partnership with communities, health services, industry, and/or policy makers, to:

- prevent and reduce diabetes, obesity and metabolic disease (DOM)
- prevent the effects of DOM during pregnancy
- prevent and reduce long-term complications from DOM
- develop more personalised approaches to the diagnosis and management of type 1, type 2 and rarer forms of diabetes, that fully embrace enabling technologies and are tailored for the individual, their journey and the family and community around them
- create new, integrated, clinically cost-effective models of care across the healthcare system and with community.



1. THE CHALLENGE

THE PREVALENCE AND ECONOMIC BURDEN OF DOM

Diabetes, the epidemic of the 21st century, leads to extensive, but largely avoidable, hospitalisations, healthcare costs, and wider public health, inter-sectoral and economic impacts. The number of people with diabetes is rising: 9.4% of the New South Wales (NSW) population had diabetes or a high blood glucose in 2014, up from 6.4% in 2002 [2, p.3]; and it is expected that three million Australians over the age of 25 will have diabetes by the year 2025 [3, p.4]. Diabetes is unevenly distributed across the population, with those of lowest socio-economic status [4, p.95], those from ethnic minority groups [5], people residing in rural areas [6, p.3], and individuals with mental health conditions being most affected by the condition [7, p.9]. Approximately 12% of total health expenditure is on patients with diabetes [8], even though they only account for approximately 5.1% of the population [9, p.2]. In total, the annual direct cost of 'diabesity' (diabetes and obesity) in Australia is \$35.6 billion [10, 11]. Hence there is a need to target prevention of the different types of diabetes in the first instance, and prevent the progression of complications in those with diabetes [9].

Soaring obesity rates are a major contributor to the epidemics of type 2 diabetes and gestational diabetes mellitus (GDM). Eliminating obesity from the population can reduce the incidence of type 2 diabetes by over 40% [3, p.5]. Obesity is associated with far broader harms than type 2 diabetes, including obstructive sleep apnoea, hypertension, various cancers, arthritis and several other conditions. Obesity during pregnancy increases the chance of adverse pregnancy outcomes, additive to the effects of diabetes. It is increasingly appreciated that to prevent GDM requires weight to be optimised prior to pregnancy, but successful strategies remain elusive.

Rates of type 1 diabetes are also increasing in many countries worldwide, including Australia [3, p.5], and we are increasingly recognising

the importance of diagnosing rarer forms of diabetes. The reasons for increasing rates of type 1 diabetes are less clear than for type 2 or gestational diabetes, which are primarily the result of poorer lifestyle behaviours and the rising obesity epidemic. As with type 2 diabetes, poorly managed type 1 or rarer forms of diabetes result, over the longer term, in diabetes complications (e.g., cataracts, amputations, blindness, kidney failure, myocardial infarction and stroke); and, during pregnancy, cause harm to babies and mothers.

Cost-effective, time-saving, preventative and integrated care (where all of those involved are able to work closely together), including social activation, is needed as a matter of urgency in order to reduce the clinical, social, and financial burden of diabetes and obesity. It is increasingly understood that there are multiple genetic, epigenetic, behavioural and pathophysiological contributors to the development of diabetes and obesity and their complications, necessitating the development of more personalised care, tailored to the needs of the individual. With established infrastructure and expertise, universities such as Western are well placed to partner with key stakeholders to develop and deliver tailored personalised care to people with diabetes. The widespread use of technology (including mobile devices) in an increasingly digitally connected society provides opportunities to explore new cost-effective, sustainable and scalable personalised care models.

GREATER WESTERN SYDNEY: AN EXEMPLAR IN PREVENTING AND BETTER MANAGING DOM IN AUSTRALIA

Greater Western Sydney (GWS) has some of the highest rates of obesity, cardiovascular disease and diabetes in Australia [12, p.5]. South-Western Sydney (SWS) has one of the highest prevalences of diabetes in NSW, with 6.6% of the population diagnosed with diabetes, against the state average of 5.1%

[13]. Individuals with diabetes in GWS are over-represented in hospitalisations – with the death rate and hospitalisations due to diabetes particularly high in parts of SWS, such as Fairfield [14, p.6]. Recent data indicates that of the ten diabetes hotspots in NSW, seven were located in Sydney's west, with Liverpool taking the top position [15, p.8]. Further, six of the ten postcodes with the highest rates of GDM occurrence in NSW are also in SWS, with Liverpool and Campbelltown being in the top three [14, p.32]. Local data indicate that 14% of all infants born in the last two years in SWS were born to mothers with GDM, compared to between 5.5% and 8.8% across Australia [16].

The 'diabesity' tsunami and its associated impacts are fast approaching. Western is at the heart of the GWS region and is well equipped to work towards stemming this tide. Inter-sectoral approaches are imperative to prevent future diabetes cases and to improve the management and wellbeing of people already living with the condition. To tackle disease progression and develop greater understanding of the phenotypes and genotypes of patients with type 1 and rarer forms of diabetes, mechanistic studies by basic scientists are required. Capitalising on the clinical and scientific expertise available at Western, and associated institutes such as the Translational Health Research Institute and the MARCS Institute for Brain, Behaviour and Development – and with the state-of-the-art infrastructure including biochemistry, biomedical engineering, microbiology, imaging and biomechanical facilities – it is anticipated that simple strategies can be developed and translated into clinical practice. This bench-to-bedside translational approach is aligned with the current research priorities of major research funders and health providers.

The proportion of the population with DOM is now so large that strategies limited to health care are no longer sufficient to contain this epidemic. Instead, we require novel approaches based on public policy and community action. Our work in these areas, particularly in regards to community action, reflects the heart of

Western as: a university of international standing and outlook, achieving excellence through scholarship, teaching, learning, research and service to local and international communities, beginning with the people of Greater Western Sydney.

While we continue to work nationally and globally and grow our collaborations, we look forward to building DOM translational research programs across our GWS heartland.

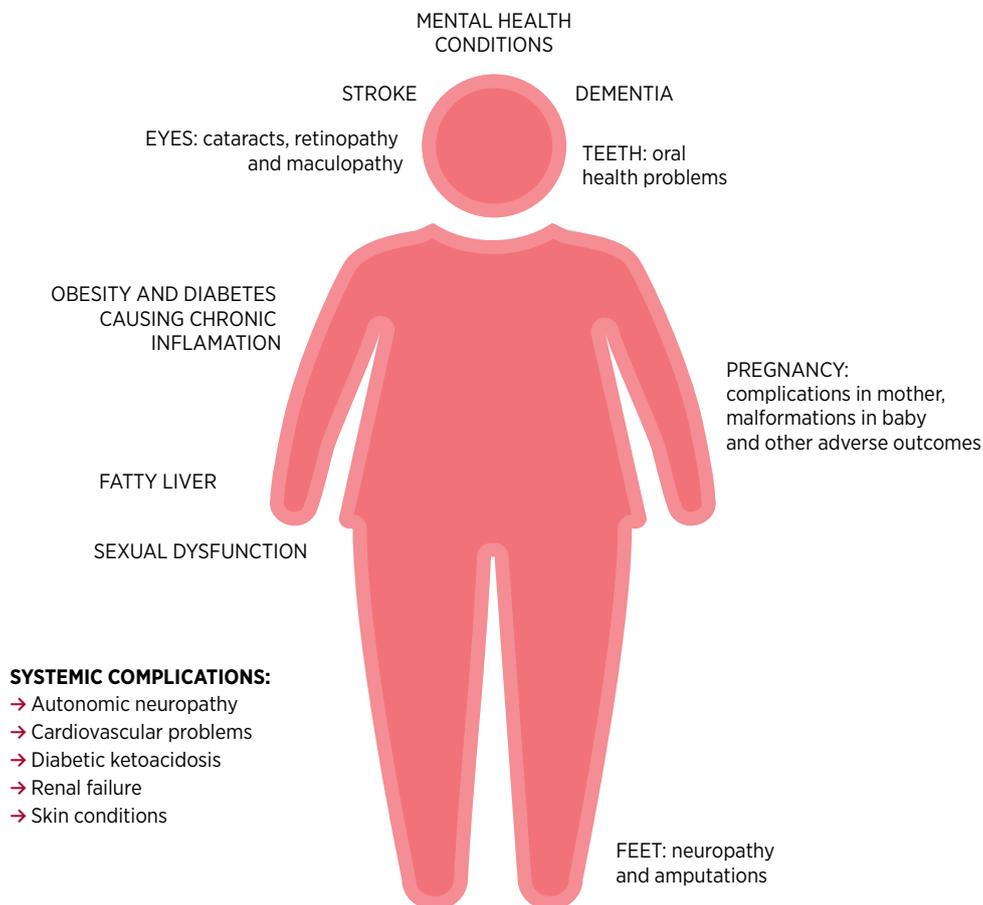
THE MULTIDIMENSIONAL HEALTH BURDEN OF DIABETES

Diabetes and obesity are caused by a range of genetic, intra-uterine and environmental factors. The simplistic belief that obesity is due to psychological ‘weakness’ rather than a complex network of genetic, endocrine, metabolic, psychological, behavioural and environmental factors (e.g., government and community policies, marketing, the built environment, and control of content and availability of food products), has delayed the development of more complex policy, public and personal health interventions [17, 18]. In the case of type 1 diabetes, several theories exist as to why rates are rising, relating to environmental influences such as exposure to organic pollutants [19], weight gain during

youth [20], and development of the immune system in response to bacteria and infection exposure [21]. The recent recognition that even those with type 1 diabetes often have functioning beta cells (the insulin-producing cells) for many years has led to new concepts regarding ways to protect the beta cells from autoimmune destruction [22].

Every type of diabetes affects every part of the body that receives a blood supply (Figure 1). Obesity is associated with widespread inflammation and metabolic dysfunction, and both obesity and diabetes are associated with a range of mental health conditions.

Figure 1: Impact of diabetes

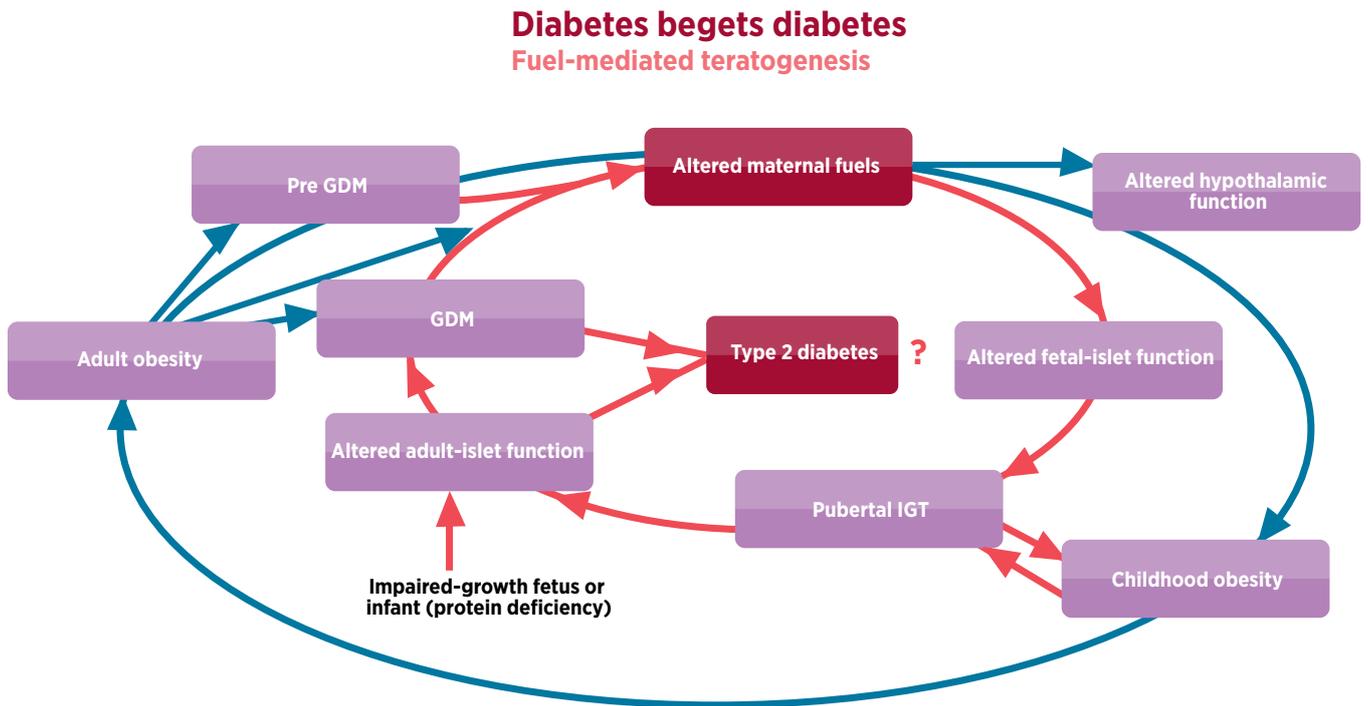


Beyond these personal morbidities, DOM not only affect the person with diabetes, but the family and community around them. While type 2 diabetes and GDM are more common with increasing age, onset at younger ages is increasing. Type 1 diabetes does not only affect children, but also often goes unrecognised in the elderly. Meanwhile, we

now identify rarer forms of diabetes including those that are caused by a single gene mutation and are associated with different risks and management strategies. There is growing evidence that foetal exposure to hyperglycaemia in utero may lead to an increased risk of diabetes in the offspring: the so-called 'vicious cycle' (Figure 2).

It is clear that with so many different manifestations of diabetes and obesity across so many people, with so much variation by age, gender and ethnicity, that multiple strategies need to be developed, tested and validated – a major challenge needing innovation, deep knowledge and broad skills, flexibility and multiple perspectives. We believe Western is well placed to develop, test and validate new strategies across the life course.

Figure 2: Diabetes – the vicious cycle

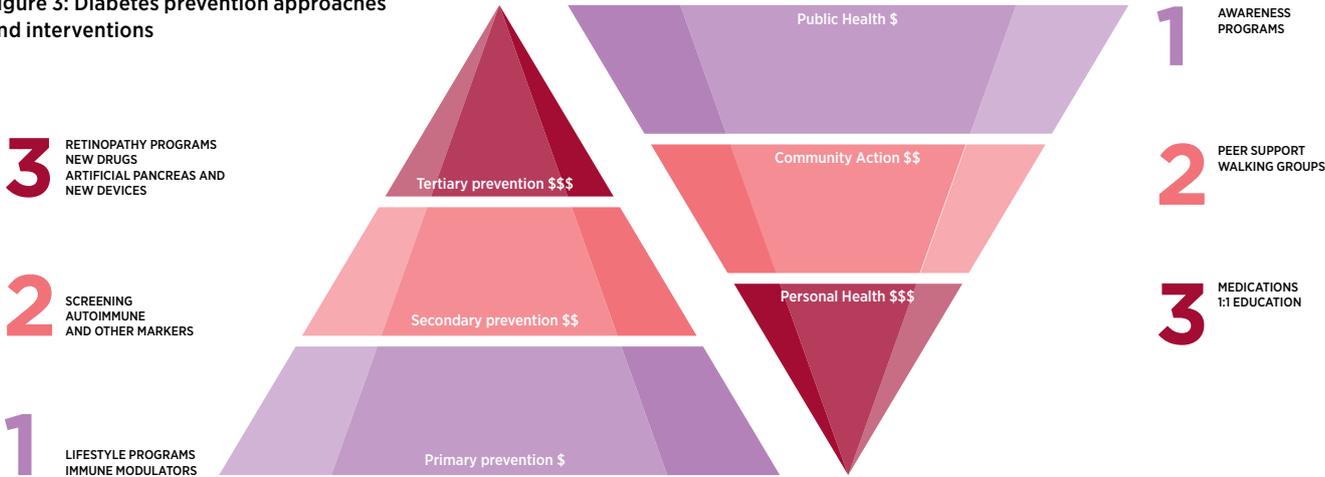


2. BACKGROUND: STRENGTHS AND LIMITATIONS OF EXISTING APPROACHES IN THE SECTOR

PREVENTION APPROACHES FOR OBESITY AND DIABETES

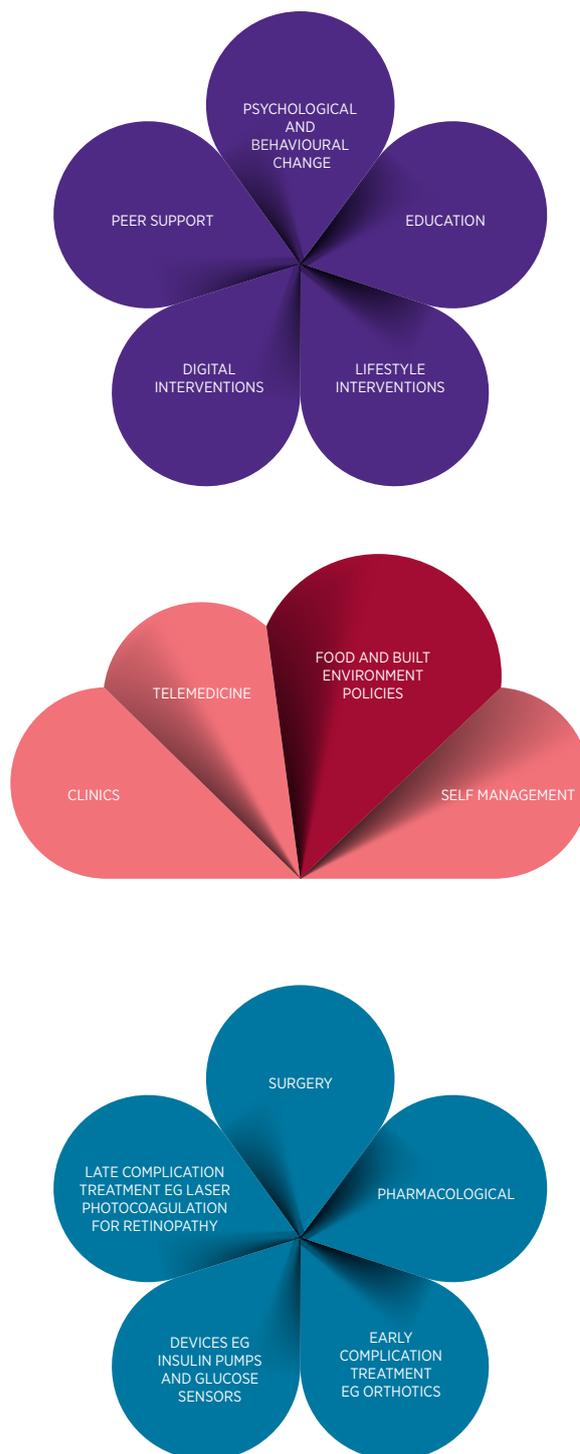
Existing prevention strategies for DOM range from primary (preventing the condition in all people) to secondary (screening/early detection) to tertiary (preventing complications). Each strategy can be implemented through a range of public health, community action and personal health interventions, as shown in Figures 3 and 4.

Figure 3: Diabetes prevention approaches and interventions



(\$-symbol provides indication of per-person cost of each approach; boxes include examples of interventions for each prevention approach.)

Figure 4: Intervention types



INTERVENTION TYPES

One of the weaknesses of Australia's 'health system' is that it is mostly focused on the individual (e.g., personal health, including largely fee-for-service approaches in ambulatory care). Elsewhere in the world, whole-system approaches (e.g., inter-sectoral approaches incorporating health systems; including primary and secondary care, school systems, and regulation and policy in other areas, involving many disciplines with supporting technology and governance) have been successful in, for example, halving childhood obesity (in Finland, using a multi-sectoral approach) and reducing blindness from retinopathy (in the UK, by introducing national screening). Table 1 shows the strengths and weaknesses of contemporary and potential primary, secondary and tertiary prevention approaches. Our team has expertise spanning all three levels of approach.

Table 1: Strengths and weaknesses of prevention approaches for obesity and diabetes: Contemporary and potential approaches

PREVENTION APPROACH	PUBLIC HEALTH EXAMPLES	COMMUNITY ACTION EXAMPLES	INDIVIDUAL HEALTH EXAMPLES	STRENGTHS/WHAT IS KNOWN	LIMITATIONS/WHAT IS NOT KNOWN	ADDITIONAL SUGGESTIONS FOR HARD-TO-REACH GROUPS
Tertiary	Structured population-based approaches to retinal screening Implementation of guidelines for diabetes care (e.g., NHMRC)	Diabetes peer support Community exercise programs	High-risk foot clinic Retinal photocoagulation	Many good trials showing efficacy Can be cost-effective but with high cost impact	Too late for some people Costly approaches Approaches not completely effective Approaches often have side-effects	→ Peer support facilitators from the hard-to-reach group (to build relationship with community)
Secondary	Screening for diabetes in all emergency presentations at all public hospitals Social media campaigns to raise awareness of diabetes symptoms	Community screening at community events Community group education sessions on diabetes symptom awareness	Opportunistic screening of diabetes by GPs Identification of non-attenders to antenatal care at pregnancy ultrasound appointments, and GP visits for referral to oral glucose tolerance testing	Some evidence of benefit for some approaches Can be low cost	Participation in approaches can be low Works poorly if unstructured Structure requires organisation Can be high-cost	→ availability of multilingual health resources through local community and health service providers (e.g., flyers, websites) → faith-based approaches to screening → delivering messages appropriate to culturally and linguistically diverse populations
Primary	Policy (e.g., sugary drink tax, active transport strategy) Public advertising campaigns to raise awareness of risks associated with sedentary behaviour	Community-based 'lifestyle' prevention programs Pre-natal education programs aimed at reducing caesarean section rates (to decrease likelihood of type 1 diabetes in baby)	Pharmacological Bariatric surgery One-to-one lifestyle interventions (e.g., conducted at home visits or in family-based structures) Antibody screening of relatives with type 1 diabetes and entry into trials	Cost-effective but with high cost impact Needs proper organisation	What works over time is unclear Approaches are often highly complex Personal risk (e.g., genetic)	→ language translation of healthy eating information → utilising community leadership and building capacity within community

LIMITATIONS IN CURRENT APPROACHES AND GAPS IN KNOWLEDGE

There is evidence to suggest that in some localities and communities, the current epidemics of diabetes and obesity are starting to plateau [23, 24]. However, in other communities, the prevalence of overweight and obesity remains high (e.g., 90–95% in some Pacific communities [25]) and continues to increase. Any effective intervention at primary, secondary or tertiary level will have an impact on populations with such high rates. Unfortunately, the new 'normal' in terms of overweight and obesity is associated with an unacceptable level of morbidity and premature mortality. This highlights important limitations about some population-wide approaches to prevention and management of DOM. For

example, medication or offer of surgery to a large proportion of the population (particularly from an increasingly young age, in the case of type 2 diabetes) seems costly and unfeasible [26]. Obesity is already extremely costly to the healthcare system, and with rapidly increasing rates, this will create further financial strain [10]. Additionally, these treatment methods do not address the complexity of the causes of obesity [10]. Likewise, increasing health or other workforce capacity to provide the level of personal care needed – for example, to deliver one-to-one lifestyle education and support (not only to lose weight, but to maintain weight loss) – is also a costly and therefore unfeasible approach.

Within the current evidence-base, we do not have the breadth and depth of affordable technological, behavioural and clinical

interventions that can be tailored to individuals to maximise effect and minimise cost. There is also currently insufficient evidence to significantly influence the wider environment or community to implement supportive policies and other public health measures. Further, there remains much to be understood regarding the pathogenesis of all type of diabetes and their complications, obesity, and associated diseases in both the physical (including molecular biological, biochemical, physiological and endocrinological) and mental health domains.

At Western we are building on existing evidence in regard to the prevention of obesity, diabetes and complications, and addressing weaknesses in the field; and testing new strategies in order to make an impact within our local community and beyond.



3. THE OPPORTUNITY: NEW APPROACHES

The gaps in our knowledge around DOM generate enormous opportunities for new approaches in the field, including both social/community/public health and clinical/personal health translational research; which provide further opportunities for articulation with clinical and basic research. Often those most in need of intervention are not targeted or effectively reached. For example, those of low socio-economic status or of Aboriginal or CALD background have the least access to resources to prevent and manage DOM [27], and often have low engagement levels in interventions [28].

However, Western is a community-oriented university, where we not only undertake clinical research, but also recognise new ways of thinking that harness the power of social and community action and the potential to utilise this in our interventions. By working together across our broad disciplinary areas (see Table 2, below), our synergistic collaboration is more able to target the multi-layered complexity of DOM head on.

INNOVATIONS IN DIABETES CARE: TECHNOLOGY, DRUG DISCOVERIES

Researchers are starting to test new ways to prevent progression of the autoimmune process in type 1 diabetes. Our academics are partners in TRIALNET, a global network aimed at better understanding the natural history of type 1 diabetes before diagnosis, and testing new drugs before and soon after diagnosis. Technologies and new drugs are being developed to improve glucose control

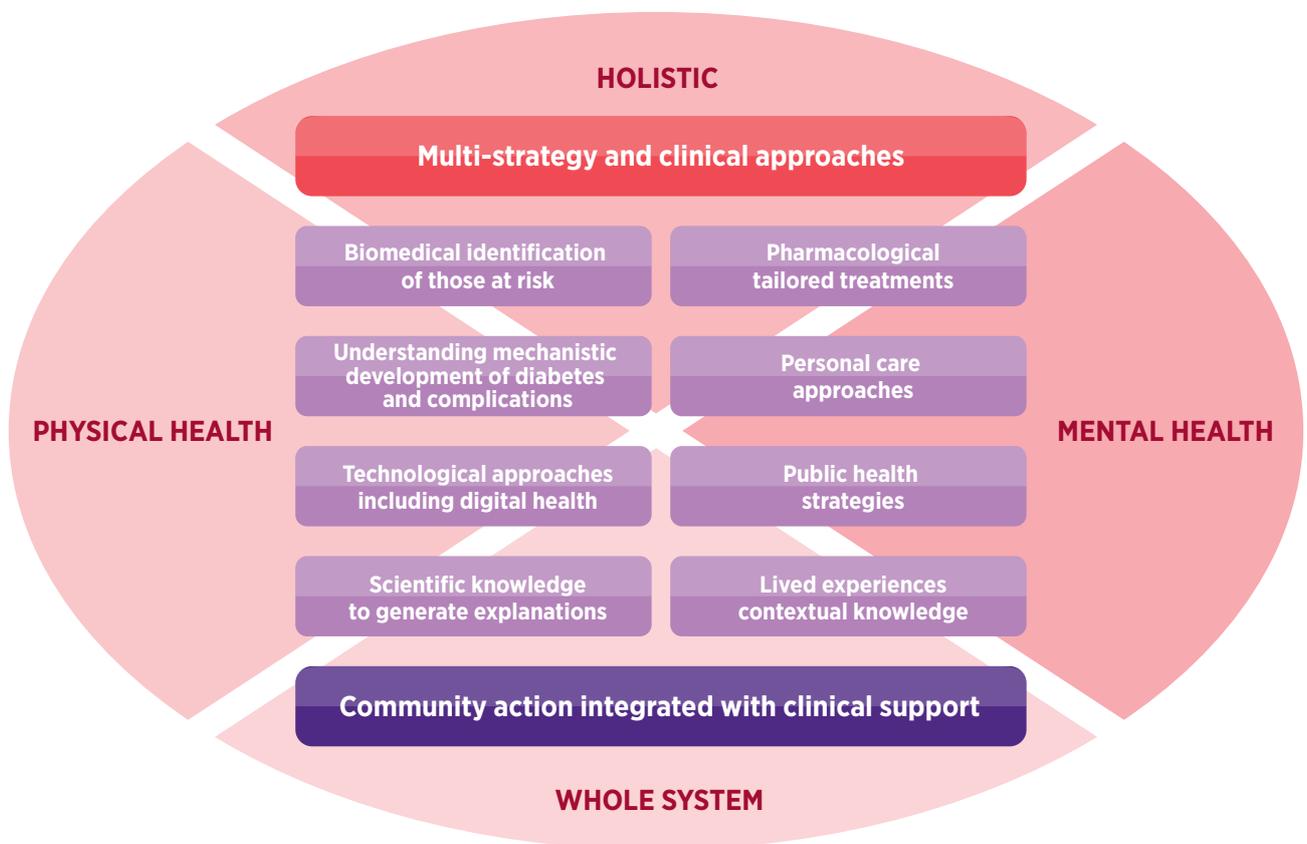
and assist self-management among people with diabetes (e.g., glucose sensors and new insulin delivery devices). Inherited and acquired differences in diabetes (including variants and rare forms of diabetes), its complications and response to medications, remain areas of developing research.

NEW APPROACHES TO DIABETES CARE: A MULTI-STRATEGY APPROACH

From the clinical and health-services perspective, new approaches are needed to integrate primary and secondary care, including primary preventative approaches, to ensure that the person (and those around them) with, or at risk of, any type of diabetes, obesity or metabolic disease can maximally self-manage and be (mutually) supported. In order to deal with a problem of such magnitude, involving so many agencies, communities and individuals, we need not only a clinical or health-service agency response, but a social/community response as well.

New multi-strategy approaches are needed that not only incorporate the ongoing availability of daily lifestyle and diabetes management support, social and emotional support, and linkage with clinical care; but also meet new challenges arising regarding diabetes prevention and management. Approaches must be multi-, trans- and interdisciplinary, as well as cross-sector (Figure 5).

Figure 5: Multidisciplinary approaches to a whole-system approach to diabetes care



As shown in Figure 5, approaches must:

- be biomedical, identifying those at risk of type 1 and rarer forms of diabetes early to prevent development or progress of the condition
- be pharmacological, in cases where biological testing allows for better tailored treatment of type 1 and rarer forms of diabetes as well as complications via identification of inflammatory markers
- be mechanistic, understanding the reasons why diabetes and its complications occur (e.g., development of cataracts or microvascular foot complications), in order to facilitate further research
- incorporate personal, technological (including digital health) approaches, and community and public health strategies
- integrate community activation and clinical support
- address the whole system and whole community as well as the individual
- incorporate co-design and different forms and sources of knowledge, from scientific explanations to lived experience
- commence from a holistic perspective, spanning both mental and physical health
- be cost-effective, scalable, sustainable and easy for people to access.

Innovative built-environment approaches are also required to explore new urban designs and how they can support healthy lifestyles; this is important not only for prevention but also management of all types of diabetes, as well as obesity. Further, translation of multi-strategy approaches is necessary to ensure that research has impact; to this end, we need to explore how interventions work and understand the barriers to implementation, particularly in regard to the nature of relationships (e.g., professional-to-professional and family-to-professional). The design of multi-pronged, concerted approaches needs to recognise the role of government, the private and not-for-profit sectors, culture, and socio-economic dimensions.

The Wollondilly Diabetes Programme is

an example of an innovative, integrated approach to diabetes care and prevention, led by Western, that is linking primary care with secondary care and community-based peer support. The program has introduced multidisciplinary diabetes care in this semi-rural shire of SWS, which was previously unavailable in the area (patients had to travel outside the Wollondilly Shire). Another strand of this work has been to engage with healthcare professionals and community from Wollondilly to gather feedback on their built environment needs, to assist in supporting healthier lifestyles across the region. This information will be conveyed to the local council and housing developers to aid in guiding future infrastructure development.

New approaches focusing on the pre-pregnancy, antenatal and postnatal/perinatal periods are particularly important, considering the extremely high rates of complications in babies and their mothers with all type of diabetes and/or obesity in pregnancy. Western is currently facilitating the rollout of the first Australian pre-pregnancy service for those with diabetes, across the SWS district. This multi-strategy service provides support to women planning pregnancy, to reduce the risk of pregnancy complications and malformations in babies.

Additional approaches are necessary where hard-to-reach populations are targeted, such as culturally sensitive tailoring. For example, Le Taeao Afua is a church-based diabetes prevention project for Samoan communities currently being evaluated in SWS. To ensure a culturally appropriate intervention, a Samoan community reference group meets regularly to guide the development, rollout and evaluation of the intervention. Additionally, two Samoan coaches hired by Western have ensured that intervention information is amended to appeal to the Samoan community, and these coaches deliver the intervention to the community.

Western is leading many such multi-strategy

projects moving towards these new directions, with only a few examples highlighted above. Bringing together researchers across multiple specialties and health disciplines, instead of working as stand-alone researchers, we are able to more effectively target DOM. Many of our researchers are also clinicians, providing us with opportunities to share best practice and enhance existing clinical services in a timely manner. Through our multi- and interdisciplinary collaborations, Western's work is truly translational, extending not just from 'bench-to-bedside,' but from 'bedside-to-bench-to-bedside.'

OUR EXPERTISE

Western includes broad areas of expertise across GWS (Figure 6). Table 2 below lists the specific types of expertise, resources and infrastructure available through the university and its networks, which span Europe, the USA, Australasia and Oceania.

Figure 6: Western's expertise in DOM

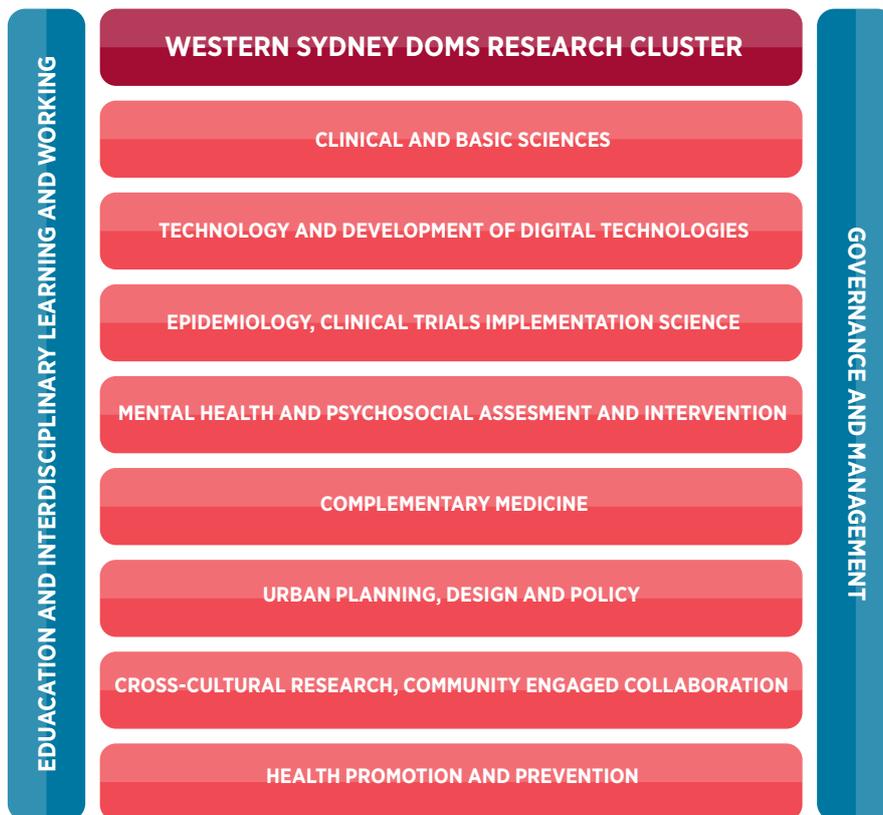


Table 2: Areas of expertise in DOM, and resources and infrastructure available at Western

AREA OF EXPERTISE	EXPERTISE/RESOURCES/INFRASTRUCTURE AVAILABLE THROUGH WESTERN
Aboriginal and Torres Strait Islander health	<ul style="list-style-type: none"> → Collaborative relationships with local Aboriginal communities. → Engagement of Aboriginal community Elders towards the development of health education and translational research and dissemination. → Two-way capacity-building in education and research based on Aboriginal epistemologies of health and wellbeing
Biostatistics and analytical epidemiology	<ul style="list-style-type: none"> → Diabetes, obesity, cardiovascular disease, CABG/angioplasty stenting projections; and predicting eating disorder and comorbid obesity, transitions/trajectories (all long-term). → Multi-factorial modelling of cardiovascular disease and all-cause mortality risk, with a focus on reducing/preventing obesity and diabetes through policy modelling. → Epidemiological/biostatistical methods (e.g., advanced multivariate statistics, Markov modelling, risk stratification). → Optimal study design, sample size estimations and methods to analyse observational and randomised studies. → Modelling population interventions. → Priority-setting and decision analysis (including future requirement appraisal in treatment allocation using evidence, expert opinion, value judgements (e.g., for future CABG or stenting angioplasty requirements in a population)).
Clinical trials	<ul style="list-style-type: none"> → Behavioural, clinical, service delivery and pharmacological diabetes trials.
Complementary medicine	<ul style="list-style-type: none"> → Research expertise in complementary medicine interventions (especially herbal medicine) for diabetes and metabolic syndrome. → State-of-the-art facilities to evaluate mechanisms of action. → Access to integrative clinical facilities to assess clinical outcomes of complementary medicine. → Access to facilities for research and development, including drug discovery.
Cultural and ethnic diversity	<ul style="list-style-type: none"> → Training for allied health and medical workers in the areas of cultural responsiveness, safety and competence. → Community liaison experience with African, Asian, Arabic and Muslim CALD communities.
Diabetes education for patients and healthcare professionals	<ul style="list-style-type: none"> → Development and evaluation of online, audiovisual, face-to-face and paper patient-education materials and programs. → Development and evaluation of online, audiovisual, face-to-face and paper healthcare-professional education materials and programs.
Diabetes in pregnancy	<ul style="list-style-type: none"> → Management trials in GDM, type 1 and type 2 diabetes in pregnancy (including pharmacological). → Studies into pathophysiology and management of GDM. → Epidemiology of diabetes in pregnancy. → Quality and policy initiative development in diabetes in pregnancy, including GDM screening and diagnosis.
Digital health	<ul style="list-style-type: none"> → Digital knowledge development. → Ecosystems to empower users with actionable information, including a system to manage diabetes. → In-depth research experience in developing mobile-phone-based systems for empowering users and reinforcing positive behaviours. → Leading the stream, 'Consumer Empowerment and Positive Behaviour', in the proposed Digital Health Cooperative Research Centre. → Major contributor to development and refinement of the Australian Refined Diagnosis Related Group classification system (see https://www.ihsa.gov.au/admitted-acute-care/ar-drg-classification-system).

AREA OF EXPERTISE	EXPERTISE/RESOURCES/INFRASTRUCTURE AVAILABLE THROUGH WESTERN
Epidemiology	<ul style="list-style-type: none"> → Expertise in research design. → DOM clinical epidemiology. → Diabetes care quality evaluation, including databases and benchmarking. → Diabetes information management. → Diabetes guideline and policy development and intervention.
Exercise science	<ul style="list-style-type: none"> → Exercise, neuromuscular and cardiorespiratory testing laboratory. → Basic and clinical exercise sciences expertise (including type 2 diabetes and peripheral vascular disease).
Health economics	<ul style="list-style-type: none"> → Economic evaluation (e.g., cost effectiveness, cost benefit) of health sector and non-health interventions (individual and population). → Epidemiological/statistical methods (e.g., risk stratification). → Optimal study design and methods to analyse natural experiments. → Modelled projections of long-term outcomes and costs. → Translation/implementation (e.g., population level scaling, return on investment). → Priority-setting and decision analysis (e.g., option appraisal in resource allocation using evidence, expert opinion, value judgements).
Health service management	<ul style="list-style-type: none"> → Design and implementation of positive organisational scholarship in health care (POSH); video reflexive ethnography (VRE); and impact and process evaluation, particularly for evaluation of programs and organisational change efforts. → Lexical analysis using Leximancer. → Development and evaluation of new services in diabetes and obesity. → Diabetes service redesign (including diabetes integrated care).
Mental health and community psychology	<ul style="list-style-type: none"> → Delivery of mental health services to marginalised and vulnerable communities including young mothers, migrants, refugees and people with disabilities. → access to specialist clinics and extensive databases of longitudinal and cross-sectional population studies.
Midwifery and maternity care	<ul style="list-style-type: none"> → Qualitative and quantitative evaluation of consumer experience. → Service redesign, including implementation of integrated systems. → Participatory research to improve service delivery. → Training and support for midwives.
Oral health	<ul style="list-style-type: none"> → Experience in improving oral health service delivery to disadvantaged and migrant communities. → Expertise in reducing health inequalities by linking oral health with systemic health (e.g., obesity, diabetes, cardiovascular health). → Mixed-methods and qualitative research with a multidisciplinary focus. → Expertise in capacity building with health professionals to reduce the burden of chronic diseases.
Podiatry	<ul style="list-style-type: none"> → Podiatry academics with expertise in biochemistry, biomechanics and imaging. → Access to state-of-the-art labs, a clinical facility, portable ultrasound machines and almost \$1million worth of gait equipment, which is of limited availability across NSW.
Public health, health promotion and diabetes prevention	<ul style="list-style-type: none"> → Development, implementation and evaluation of interventions; including systematic reviews, mixed methods research and cultural tailoring of interventions. → Community and personal interventions for DOM prevention. → Research driven by community reference groups for community engaged research. → Extensive experience in health measurement tools, including objective measurement of physical activity and mixed-methods approaches for comprehensive evaluations. → Supporting community lead approaches to health promotion and diabetes prevention.

AREA OF EXPERTISE	EXPERTISE/RESOURCES/INFRASTRUCTURE AVAILABLE THROUGH WESTERN
Regenerative medicine	<ul style="list-style-type: none"> → Use of stem cells to develop a world-first technology that produces tens of thousands of light-focusing human lenses for research. → This technology is beginning to enable investigation of the causes of human diabetic cataract; with the aim of identification of potential treatments for diabetic cataract, and establishment of human stem-cell-derived organoids to identify molecular mechanisms of diabetic complications and related risk factors. → Biomarker discovery and validation through transcriptomics, proteomics, etc.
Rural health	<ul style="list-style-type: none"> → Research into access to care related to geography and culture in rural areas. → Research into rural workforce and strategies to overcome limitations due to reduced economies of scale and distance.
Sexual and reproductive health	<ul style="list-style-type: none"> → Practical delivery, evaluation and reporting on community services and engagement. → Mixed-methods and qualitative research with a multidisciplinary focus.
Urban planning, design and policy	<ul style="list-style-type: none"> → Expertise in urban geography, design and planning, including 'food deserts', walkable cities, and links between built environment and health. → Urban policy expertise in health-based innovation precincts.





4. WORKING TOGETHER FOR CHANGE: PARTNERSHIPS AND STAKEHOLDERS

Academics at Western already lead and/or collaborate on DOM-related work across the University and with multiple external researchers, health and community services and community organisations.

OUR PARTNERS

Partnerships therefore already exist with a range of organisations and communities, as summarised in Figure 7.

Figure 7: Partnerships with Western Sydney University DOM Researchers



Some of our current major partners in DOM projects are:

- the South Western Sydney Local Health District funded DOM Translational Research Unit (DOMTRU)
- The Sydney Partnership for Health Education, Research and Enterprise (SPHERE) funded DOM Clinical Academic Group (CAG)
- all six major GWS Hospitals, three Adelaide hospitals, Monash Medical Centre (Vic), Canberra Hospital and Vienna Hospital (and associated universities), in the NHMRC-funded Treatment of Booking Gestational Diabetes Mellitus (TOBOGM) multi-institute agreement
- the University of Melbourne, Alfred Hospital, and multiple health services across the Goulburn Valley, in the NHMRC-funded 'Crossroads II: Longitudinal study of health, disease and access to care in rural Victoria' project.

We are also partners in several major trial networks including the following.

- The Metformin in Type 2 Diabetes in Pregnancy (MiTY) trial. Western is the lead Australian site, and other collaborators include four Australian hospitals and multiple Canadian Hospitals (funded by Canadian Institutes of Health Research).
- The type 1 diabetes TRIALNET trial. Multiple hospitals across Australia and the world are involved (funded by the US National Institutes for Health and the Juvenile Diabetes Research Foundation).
- The EXPECT study: Insulin degludec in type 1 diabetes in pregnancy. Western is the lead Australian site, and other collaborators include two additional Australian sites and multiple sites globally (funded by Novo-Nordisk).

To achieve our vision, Western's DOM academics need to continue to work closely with the above and other organisations, as well as communities and individuals; and to ensure that research questions are properly formulated, research and its design are implemented, and research findings are put into practice.

Industry partnerships already exist within DOMTRU and SPHERE, and we will continue to grow external partnerships within these frameworks. Our partners include organisations that are required to effectively translate policy and research evidence into practice – these include Local Health Districts, NSW Health and Diabetes Australia. We also work directly with communities through reference groups. Within our SPHERE and DOMTRU collaborations, we also work with Aboriginal and Torres Strait Islander, culturally and linguistically diverse, and industry reference groups. These groups – which span GWS, Australia and the globe – provide vital input for appropriate and tailored interventions.

OUR STAKEHOLDERS

Following are some examples of existing DOM stakeholder involvement.

- SPHERE's DOM CAG works closely with a stakeholder group comprising Aboriginal community members; Aboriginal medical services; and the New South Wales Health Aboriginal Health Service, which is guiding a prevention program in youth and young adults.
- SPHERE's DOM CAG also has a CALD people's stakeholder group with members from across the community, which is guiding a program for preventing malformations in pregnancies among women with pre-existing diabetes.

- DOMTRU conducts translational research projects for the prevention of diabetes in the Samoan community (Le Taeao Afua) in partnership with members of the Samoan community including church and community leaders, as well as a number of Primary Health Networks and a Local Health District.
- DOMTRU has implemented an integrated care project for the prevention of diabetes and its complications in Wollondilly under the Wollondilly Health Alliance, a partnership between SWS Local Health District and SWS Primary Health Network and Wollondilly Local Government.
- DOMTRU has introduced a step-up/step-down diabetes foot clinic to prevent foot ulceration and re-ulceration in vulnerable individuals, and to provide training to healthcare providers to screen feet at a community level.
- DOMTRU is already Australian lead, or a study site, for a number of trials run by international organisations and pharmaceutical companies.

As evidenced above, partnerships and stakeholder engagement within our DOM collaboration are already in place with a range of organisations and communities. We welcome new collaborations to target DOM, and encourage interested stakeholders to contact us.



5. THE OUTCOMES: IMPACTING HEALTH AND WELLBEING IN GREATER WESTERN SYDNEY AND BEYOND

Working towards a world without diabetes, Western is focused on preventing, treating and managing DOM by earlier detection and better biomedically tailored treatment, promoting healthy lifestyles and improving health care. To forge a path forward, the following sections demonstrate the expected outcomes, as they relate to policy, practice, knowledge, and community action.

POLICY

We will conduct research that has a strong impact on changing policy that will ultimately assist with preventing diabetes and reducing complications. As a 'wicked problem' [29, p.1] the eradication of DOM is likely to require different ways (rather than a different way) of working. As such, Western will work with representatives of the government, private and not-for-profit sectors, including patient advocacy groups, to co-design and test:

- different governance arrangements that promote healthy lifestyles, as well as prevent, treat, and manage DOM
- policies that support those governance arrangements that prove to be effective and efficient.

PRACTICE

The translational focus of Western's work will inform changes in practice for all our stakeholders: clinicians; patients, families and carers; the community; health services; local, state and federal government; pharmaceutical, device and food companies; urban and rural planners; and the lifestyle industry. We will work together with our community partners to build strategies that are feasible and sustainable, and will use implementation science to identify effective ways to change clinicians' practice to support our vision of a world without diabetes.

KNOWLEDGE

Western's work will lead to a significant expansion of the body of knowledge on diabetes prevention and how to improve the quality of life of people living with diabetes. This knowledge will include new discoveries in basic science and the mechanisms of diabetes-related complications; identification of novel candidate therapeutics; clinical sciences; public health; information and communications technology; and health and community organisation and policy. We will utilise a coordinated, whole-systems approach to building this body of knowledge, incorporating our strengths in culturally sensitive research. We will work in partnership to:

- co-construct new knowledge of DOM to better understand how it is studied, diagnosed, monitored, understood, experienced and managed; personally, socially and organisationally
- co-design and test different ways to coalesce this knowledge to inform policies and guidelines that have the elasticity required to accommodate the complexity of DOM.

COMMUNITY ACTION

We work with communities from the early stages of development of our research, to ensure appropriate and acceptable approaches are co-created. Examples of community engagement throughout the research process are the holding of regular community reference group meetings; community visits to present on progress and to gather community feedback and suggestions for future direction; and hiring of community members to work as part of our research teams. For example, as part of the Le Taeao Afua project, community coach/facilitators have been heavily involved in intervention development, translation for the Samoan community, and delivery of the intervention.

WORKFORCE DEVELOPMENT

At Western, we provide research-led education: we have access to high-quality undergraduate and postgraduate health and clinical science students who work on research projects and will build a strong future workforce capable of meeting the challenges of DOM. Our focus is on research training, identification of talent at all levels of higher education and provision of appropriate mentorship, through our extensive clinical networks and multidisciplinary, authentic training.

We also focus on capacity building of the current workforce. For example, under DOMTRU, we have developed a diabetes professional development program for healthcare professionals (AUSCDEP), practical research skills development workshops (e.g., on conducting systematic reviews and qualitative and quantitative research) and educational diabetes workshops (e.g., on use of injectables).

6. FUTURE DIRECTIONS

Western already has a number of groups of researchers working on the pathogenesis, prevention and management of DOM, across a wide geographic range.

- DOMTRU provides a framework for working in SWS.
- SPHERE provides a partnership framework across SWS, South-Eastern Sydney, and the St Vincent's and Sydney Children's Hospital networks catchment areas.
- Several of our projects (e.g., Le Taeao Afua, TOBOGM and MiTY) already involve DOM work across the South-Western, Western and Nepean Blue Mountain areas.

We now wish to bring all of these areas together to form a group within Western, working across, and where possible beyond, these localities.

Our work already has a framework as outlined early in this white paper, defined through DOMTRU and SPHERE:

- prevent and reduce DOM
- prevent the effects of DOM during pregnancy
- prevent and reduce long-term complications from DOM
- develop more personalised approaches to the diagnosis and management of type 1, type 2 and rarer forms of diabetes; that fully embrace enabling technologies and are tailored to the individual, their journey and the family and community around them
- create new, integrated, clinically cost-effective models of care across the healthcare system and with community.

This is supported by research into cross-cutting themes:

- technological research including information/communication technology and devices
- laboratory research into the pathogenesis of DOM and its complications; including molecular biology, 'omics', physiology and biochemistry for a variety of complications (including eye complications)
- mental health, including depression, anxiety, psychosis and eating disorders (including binge eating)
- policy, culture and socio-economic determinants (including health literacy)
- education for individuals and families affected by DOM, healthcare professionals, communities, and health policy makers
- evaluation and implementation methodology and tools.

We have a large number of current projects (examples provided in section 4) and intend to grow these through different approaches (e.g., research grants, other funding), clinical and non-clinical trials, evaluated service development, and postgraduate and undergraduate projects.

Only by working together can we stem the 'diabetes' tsunami.

For anyone interested, please contact:
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