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## RESEARCH ARTICLE

## Setting the agenda for diabetes research in the state of Qatar

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## Abstract

**Background:** The burden of non-communicable diseases, including diabetes, is high in the Middle East and North Africa (MENA) region. Qatar (a MENA country) has a high prevalence of diabetes (16.7%). Over the past 20 years, Qatar has made significant investment to establish a biomedical research infrastructure. This article documents the processes adopted for the development of a national diabetes research agenda for Qatar.

**Methods:** To develop the diabetes research agenda, a three-step process was adopted. First, a bibliometric analysis of diabetes-related research publications was conducted to understand current research and funding patterns. Second, through in-depth interviews and a national consultative workshop, the challenges associated with diabetes research and their potential solutions were documented. Third, an expert team assimilated the recommendations to finalise the diabetes research agenda for the State of Qatar.

**Results:** A steadily increasing number of diabetes research publications and collaboration with researchers from 48 different countries was noted. Aetiological research (49%), mainly from cohort studies, dominated research publications. The national diabetes research agenda prioritised five research areas focused on diabetes prevention, early detection, reversal, treatment development and evaluation and system research for improved outcomes. Under each area, a set of research questions were identified to guide the research community to align their research interests with high-priority research in diabetes.

**Conclusion:** The national research agenda development process has uncovered some important knowledge gaps and outlined the most impactful areas for diabetes research. Achievement of the objectives of the research agenda requires enhanced collaboration among the research community, sustained research funding and enabling a robust regulatory framework.

## KEYWORDS

diabetes mellitus, non-communicable diseases, Qatar, Middle East and North Africa, research agenda

## INTRODUCTION

The prevalence of diabetes mellitus (DM) and prediabetes has increased significantly in adults worldwide over recent decades [1, 2]. In 2017, around 451 million people were estimated to be living with DM globally, and these numbers were expected to

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increase to 693 million by 2045 [3]. The rising burden of DM is a major healthcare concern resulting in higher cost of care, reduced quality of life and increased mortality [4]. In 2019, DM was directly attributed to an estimated 1.5 million deaths globally [5].

The prevalence of DM in the Middle East and North Africa (MENA) region is 16.2% [6]. With a prevalence of 16.7%, Qatar is among the countries with a high diabetes burden [7]. Qatar has a 24% prevalence of newly detected DM in pregnancy, and of this, about 89.6% is gestational DM [8]. Diabetes prevalence is increasing in Qatar at an alarming rate at younger ages. Qatar also suffers from a higher prevalence of obesity, physical inactivity, smoking and unhealthy dietary habits [9, 10].

The increasing diabetes prevalence globally is associated with rapid urbanisation and dramatic changes in lifestyle [11]. To address the high burden of diabetes in the MENA region, there is a major need for region-specific impactful research because of the differences in biology, demography, sociocultural factors and financial context between MENA and western countries. Several countries in the MENA region have, therefore, invested significantly in the establishment of biomedical research centres in their academic institutions with an initial focus on basic science and rather less attention to population and clinical research [12]. Despite this investment, the MENA region has been reported to significantly lag in impactful research compared to western countries [13–15].

In line with Qatar's National Vision (QNV) 2030, Qatar has been increasing its biomedical research capacity through targeted investment. However, much of the research is driven by individual investigators and is not necessarily aligned with the national research needs. The Qatar National Diabetes Strategy (QNDS) has identified these gaps and recommended a plan to promote DM research through a national diabetes research agenda. This article documents the participatory process adopted for the development of national diabetes research agenda and analyses the key patterns and trends in DM research output by exploring the landscape and scope of the published research projects from Qatar.

## METHODS

The national diabetes steering committee, the apex body for implementation of the QNDS, constituted a research sub-committee in March 2019 with the objective to identify and prioritise DM research. The sub-committee brought together clinicians, the research community, patient advocates and policymakers to facilitate the development of national diabetes research agenda. The authors of this article included members of the sub-committee on DM research and were engaged with the research agenda development process.

## Study design

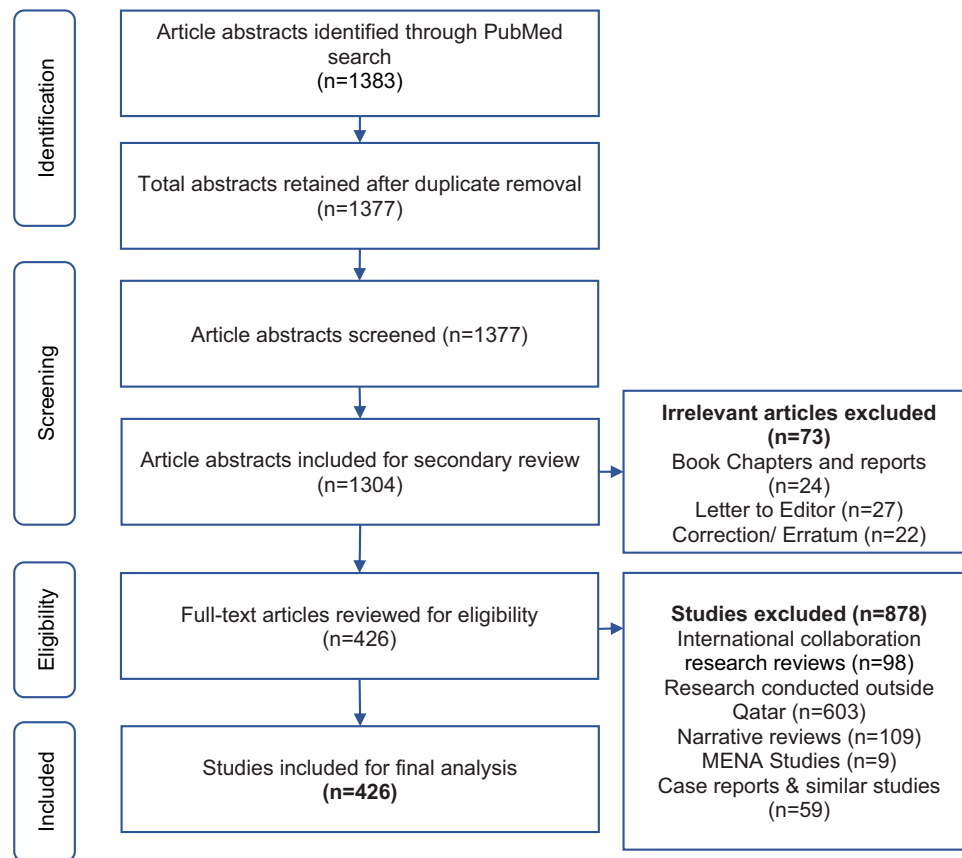
In the first step of this exploratory study, a comprehensive review of the published DM research from Qatar was conducted to understand the current research areas and trends. Moreover, an analysis of policy and strategy documents and research projects of Qatar's Ministry of Public Health (MoPH), and other major health service providers, and academic and research institutions in Qatar was conducted to identify and collate current research activity, research interest and funding patterns for DM research. In the second step, nine purposive in-depth key informant interviews were conducted with nominated researchers, administrators, regulators, healthcare providers and members of the funding agency to document the research interest and understand associated challenges. This was followed up by a national consultative workshop to collect feedback from diverse stakeholders and to identify potential solutions to research challenges. In the third step, the feedback was reviewed and analysed by two experts from the research sub-committee to finalise the national research agenda for DM.

## Data sources

For the comprehensive review of research activity, a PubMed search was conducted along with the review of the websites of MoPH, Hamad Medical Corporation (HMC), Primary Health Care Corporation (PHCC), SIDRA Medicine, Weill Cornell Medicine Qatar (WCM-Q), Hamad Bin Khalifa University (HBKU), Qatar Biomedical Research Institute (QBRI), Qatar Biobank (QBB) and Qatar University (QU). Stakeholders' views on research conduct, policy, funding, collaboration, capacity building and regulation were obtained through interviews and a national consultative workshop.

## Data collection and processing

PubMed was searched in January 2021 using following search strategy: '(Diabetes) AND Qatar' [MeSH Terms] to retrieve all publications written in English that included information on DM research in Qatar from beginning until December 2020. A



**FIGURE 1** Flow chart of the process of selecting articles reporting diabetes research in Qatar for inclusion in this analysis.

**TABLE 1** Type of stakeholders participated in national consultative workshop for diabetes research.

Stakeholders	Description	Number of participants (%)
Government	Senior officials from Ministry of Public Health and National Diabetes Committee	12 (27)
Healthcare organisations	Endocrinologists, specialist physicians, primary care physicians, dietitians, nurses, diabetes educators from Hamad Medical Corporation (HMC), Primary Healthcare Corporation (PHCC) and Sidra Medicine	12 (27)
Academic institutions	Academic and research staff from Weill Cornell Medicine Qatar (WCM-Q), Qatar University (QU) and Hamad Bin Khalifa University (HBKU)	11 (25)
Funding agency	Representatives from Qatar National Research Fund (QNRF) and Qatar Foundation (QF)	3 (7)
Non-government organisations	Representatives from Qatar Diabetes Association (QDA)	3 (7)
Research Institutions	Researchers from Qatar Biobank (QBB), Qatar Biomedical Research Institute (QBRI), and Qatar Computing Research Institute (QCRI)	3 (7)

total of 1383 publications were retrieved and reviewed to collect information about the name and number of authors, affiliated institution and country, year of publication, research areas and sources of funding. All diabetes-related research publications and systematic reviews from Qatar and the MENA region where Qatari nationals were included as study participants were collated. A total of 426 articles were included in final analysis (Figure 1).

Two researchers conducted nine in-depth interviews with key stakeholders and documented their responses. During the national consultative workshop, findings from comprehensive review and the interviews were presented to gain feedback and explore possible solutions with a diverse group of 44 stakeholders (Table 1). Participants in this workshop were randomly divided into four groups, and each group was assigned a moderator to facilitate the discussions and summarise the identified priority research areas and record suggestions for strengthening the diabetes research ecosystem in the State of Qatar (Table 2).

**TABLE 2** Key diabetes research priorities and research ecosystem gaps identified by stakeholders.

Domain	Themes	Key findings
Priority research areas identified	Diabetes prevention	–Diet, food supplements and their impact on diabetes –Childhood obesity and its role in diabetes
	Early identification	–Genetic studies to identify at risk population –Community-based screening for diabetes and risk factors –Use of biomarkers for early identification of diabetes –Screening for risk factors in school age children
	Diabetes treatment	–Behavioural and lifestyle interventions for diabetes prevention and treatment –Clinical trials for assessing the effectiveness of complementary and alternative medicine (CAM) on diabetes –Cell therapy and novel treatment interventions –Precision medicine
	Quality of life and Mental Health	–Studies on quality of life of diabetic patients –Understanding the complications of diabetes –Mental health issues associated with diabetes
	Economic evaluation	–Cost–benefit analysis of early disease detection and interventions
	Policy research	–Impact of legislation and regulation on people friendly infrastructure – roads, walkways, sports facilities –Regulation of salt and refined sugar in food
Gaps in research ecosystem	Gaps in research impact optimisation	–General lack of collaboration amongst researchers for sharing research data, best practices and resources –Difficulty in accessing patient-level clinical datasets for research –Lack of research orientation of clinicians and limited incentives to conduct research –Lack of engagement of patients and their care providers in research prioritisation
	Gaps in research translation	–High focus on researcher driven laboratory and basic science research –Limited avenues to disseminate research findings –Lack of incentives for translation of clinical findings into clinical practice –Limited opportunities to conduct large-scale clinical trials
	Gaps in funding	–Inadequate funding for diabetes and risk factors research compared to overall diabetes burden in the country –Lack of flexible grants to support junior researchers and proof of concept studies
	Regulatory challenges	–Lack of researcher friendly flexible guidelines and support –Need to regularly review guidelines to accommodate innovations in research

## Data analysis

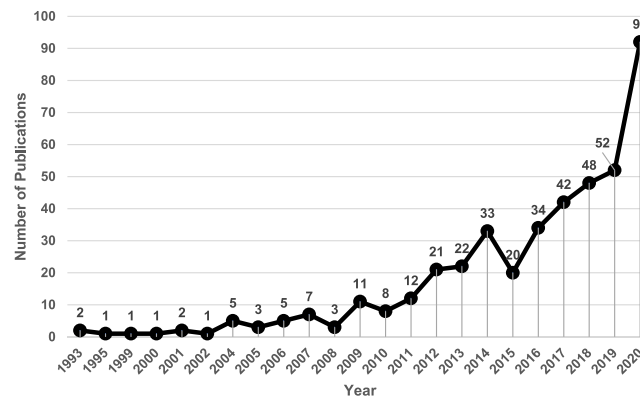
Bibliometric data was analysed using MS Excel (2019), and for the purpose of this study, all countries affiliated with publication authors were grouped into regions as per the World Bank's list of economies published in June 2020 [16]. The Health Research Classification System (HRCS) published by the UK Clinical Research Collaboration in 2018 was used to classify all selected studies into following eight research areas: underpinning research, aetiology, prevention of disease and conditions and promotion of well-being, detection, screening and diagnosis, development of treatments and therapeutic interventions, evaluation of treatments and therapeutic interventions, management of diseases and conditions and health and social care service research [17]. Selected studies were further classified based on study type, study population, first author institutional affiliations and funding status.

For responses received during in-depth interviews of key stakeholders, a thematic analysis was conducted to identify and group related research interest into priority research areas and challenges into research ecosystem gaps. Feedback received from the national consultative workshop was used to further refine the themes. These, along with the recommendations received from stakeholders, were used as input to the national diabetes research agenda development process.

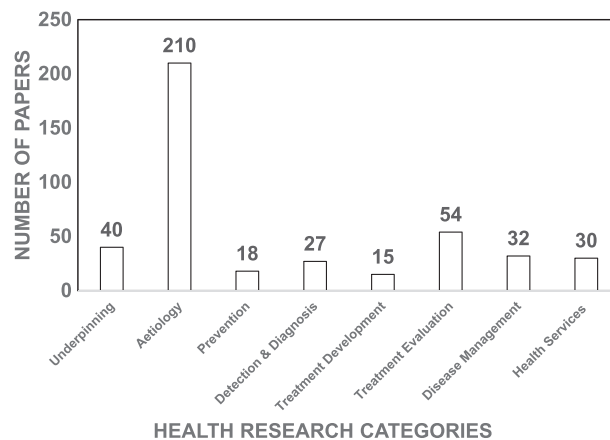
## RESULTS

### Diabetes research trends in Qatar

The bibliometric analysis indicated that the DM-related research publications started to emerge from Qatar from 1993 with the total number of articles published each year increasing steadily, particularly from 2016 to 2020 (Figure 2). Cohort studies



**FIGURE 2** Annual number of articles listed in PubMed reporting diabetes research in Qatar between 1993 and 2020.



**FIGURE 3** Number of diabetes research articles from Qatar (1993–2020) by health research category defined by the UK Health Research Classification System.

(43%) were the most common type of publication from Qatar, followed by cross-sectional (24%) and case-control (9%) studies. Around 8% of studies were systematic reviews ( $n = 21$ ) and randomised control trials ( $n = 11$ ). The remaining articles (16%) were other types of studies, such as case reports, formative research, epidemiological modelling, laboratory and ethnographic studies. Most studies focused on the adult population (75%) with both men and women as study participants. Childhood and adolescent diabetes accounted for 6% of articles, whereas 3% articles studied all age groups; 16% articles did not mention specific age group or gender.

We classified all articles based on the research categories as identified by HRCS. Under HRCS, research studies are classified into eight categories based on the primary objective of the study to assess and compare the allocation of research funds and outputs of different research areas. We used the HRCS to understand overall diabetes research landscape in Qatar (Figure 3) and identify gaps. In our analysis of diabetes research publications, we identified that close to half of the publications from Qatar on diabetes (49%) researched aetiology, followed by the evaluation of treatment (13%), underpinning studies (9%), disease management research (8%) and health services research (7%). Research related to detection and diagnosis (6%), diabetes prevention (4%) and treatment development (4%) were reported in the fewest number of articles.

## Research institutions and collaborations

Qatar has eight international university branch campuses and two national universities (QU and HBKU) running several health research centres and programmes. These institutions and research centres have facilitated the increase in biomedical research publications [18]. For example, from 2012 to 2020, the QBRI published 405 articles [19], WCM-Q published 1013 articles (2010–2018), SIDRA Medicine published 575 articles (2019–2020) [20], HMC published more than 3000 articles and 38 peer-reviewed publications were facilitated by data from the QBB [21].



This increase in the number of biomedical research publications was also reflected in DM research, and according to our bibliometric analysis, from 1993 to 2020, a total of 3305 authors participated in the publication of 426 DM-related articles in 231 journals with an average of 15.2 articles per year. Over time, the number of authors per article has increased with the mean number of authors increasing from seven per article in 1993 to nine in 2020. Fifteen articles published between 2014 and 2020 reported more than 20 authors indicating increased collaboration among researchers. Researchers in Qatar have collaborated with researchers from 48 different countries for about 58% of the publications. These include 19 European and Central Asian countries, 17 Middle East and North African countries, 5 East Asia and Pacific countries, 3 South Asian, 2 North American countries and 1 each from Latin America and the Caribbean and Sub-Saharan African country (Table S1). However, individually, researchers from the United States (20%) and the United Kingdom (12%) have contributed the highest number of articles. From MENA countries, researchers from the United Arab Emirates contributed to 11% articles followed by researchers from Oman (10%), Egypt (9%) and Bahrain (9%).

## Research funding

The Qatar National Research Fund (QNRF) was the principal funding agency under Qatar Foundation (QF) offering various funding opportunities. Of 785 medical research projects funded by QNRF in 2020, the top recipients were QU (33%), WCM-Q (25%) and HMC (13%) followed by SIDRA Medicine (6%), HBKU (4%) and others (19%) [22]. Bibliometric analysis also indicated QF as the major source of funding for diabetes-related publications, which supported 29% of studies. Moreover, about 11% of articles acknowledged study funding support from domestic or external public sector institutions. The private sector contributed funding support to studies that were reported in 6% of articles, and 6% of articles reported joint funding from both the public and private sectors. In about 48% of publications, no research funding was listed. Thirty-seven publications reported multi-centre multi-national cohort studies and phase IV post-marketing studies funded by eight global pharmaceutical companies.

## Findings from in-depth interviews and national consultative workshop

Diabetes prevention, early identification, treatment development, quality of life, cost–benefit analysis and policy research were identified as the main research priorities for Qatar. Insufficient funding, limited research impact optimisation and translation into clinical practice and inconsistent research regulatory framework were identified as major gaps in DM research. Stakeholders recommended incentivising researchers to share their data with the research community to enhance collaboration. Also, the development of a diabetes registry, a patient awareness programme focusing on clinical trials, collaboration with international research organisations and sustainable funding were recommended as potential solutions for addressing the current challenges.

## National diabetes research agenda

The national diabetes research agenda development process uncovered major knowledge gaps and untouched priorities, which can impact the care and prevention of people with DM in the State of Qatar. The agenda was developed to guide scientific investigators and funding agencies alike to focus on five key priority research areas as described below (Figure 4).

**Prevention of type-2 diabetes (T2D):** Lifestyle interventions have helped in the prevention of diabetes in multi-ethnic populations in China, USA, Finland, Japan and India [23–27]. Recent evidence also suggests that the benefits from lifestyle interventions, such as reductions in diabetes incidence, cardiovascular events, microvascular complications and all-cause mortality, accrue over longer period of time [28]. There is no singular approach to the prevention of T2D and multiple factors at community and population-level influence prevention [29]. The research agenda prioritises research on individual and population level prevention strategies that work best in the local context for DM prevention.

**Early detection:** DM is a slow progressive disease and many studies have indicated that the true biochemical onset of DM may be 3–5 years before the point of clinical recognition [30, 31]. This suggests a window of opportunity in which the disease is detectable by screening and can be managed optimally with benefits outweighing the disbenefits [32]. The research agenda proposes for a research programme into strategies of the early detection of diabetes along with coordinated research for detailed phenotyping of newly diagnosed diabetes individuals as a basis for personalised medicine.

**Diabetes reversal:** Although it is well known that healthy lifestyle habits are the cornerstone of the prevention of T2D, they are also effective to potentially reverse T2D. This approach is empowering for both patients and clinicians by providing alternative choices to treatment and control of hyperglycaemia. Therefore, the research agenda intends to create a programme of research into strategies for intensive early therapy aimed at DM reversal.

## QATAR NATIONAL DIABETES RESEARCH AGENDA

**Purpose:** To provide research roadmap for diabetes and risk factors prevention, treatment, and reversal.

### TYPE-2 DIABETES PREVENTION

Target group: Individuals and population sub-groups  
Research Priorities: Diabetes prevention in high-risk individuals; community and population-level determinants of key health behaviors.  
Milestone: Integrated screening and high-risk prevention program; community and population level interventions.

### TREATMENT

Target group: Diabetic individuals.  
Research Priorities: Set up diabetes clinical research network to offer all patients with diabetes a chance to participate in on-going behavioral, pharmacological and health system trials.  
Milestone: Recruit 50% of all newly diagnosed patient with diabetes into observational studies or trials.

### TYPE-2 DIABETES REVERSAL

Target group: Type-2 diabetic individuals.  
Research Priorities: Strategies for intensive early therapy for diabetes reversal.  
Milestone: Initiate diabetes reversal therapy.

### EARLY DETECTION

Target group: individuals above 18 years of age.  
Research Priorities: strategies for early detection of diabetes; phenotyping of newly diagnosed individuals.  
Milestone: integrated screening and high-risk prevention program; personalized diabetes treatment initiatives.

### SYSTEMS AND OUTCOMES

Research Priorities: Establish a program of health systems research aimed to investigating the system level determinants of effectiveness of risk identification and early detection.

**FIGURE 4** Diabetes research priorities for Qatar as identified by national diabetes research agenda.

**Treatment development:** Qatar is making significant investment in early diagnosis and phenotyping of people suffering from prediabetes and diabetes. This will eventually facilitate the sub-classification of disease and further sequential evaluation of various treatment regimen would help to know what works best for whom. The research agenda proposes to offer all patients with DM a chance to participate in on-going behavioural, pharmacological and health system clinical trials with an aim to recruit at least half of all with newly diagnosed DM into observational studies or clinical trials.

**Systems and outcomes:** Prevention and control of DM at population level is affected by the organisation and delivery of the care by health system, such as the use of innovative care models, increased pharmacist involvement in care delivery and education programmes led by healthcare professionals [33]. Moreover, patient-reported outcomes (PROs) influence in clinical care and research in DM, which are directly reported by patient, without interpretation of the patient's response by a clinician or anyone else [34]. PROs and health systems research would be prioritised to investigate the system level determinants for diabetes risk identification, early detection and care in the State of Qatar.

## DISCUSSION

Bibliometric analysis shows that the research efforts in DM are growing in the State of Qatar with an increase in the number of publications over time, and trends that are consistent with DM-related research publications globally and from Arab countries [35–37]. Although there are research output gaps in key areas, such as disease natural history, DM prevention and treatment development and responses, the past research on diabetes prevalence, complications and risk factors in Qatar has facilitated the development of Qatar's National Diabetes Strategy, respective national clinical guidelines for the management of diabetes and an action plan for nutrition and physical activity.

The current research agenda for diabetes aligns with the World Health Organization (WHO) Eastern Mediterranean Region's framework for action on diabetes prevention and control [38] and the national diabetes research priorities of the United Kingdom [39], Canada [40] and Australia [41]. This research agenda also proposes to address emerging research areas, such as omics research and precision medicine. Qatar has tremendous diversity in terms of the ethnicity of the population, and the implementation of research agenda is not without challenges. The most immediate challenge is ensuring the commitment and continuity of funding for diabetes research. Biomedical research usually takes time to translate into clinical outcomes, and sometimes it becomes difficult to justify continued funding. Like any other country with a developing research ecosystem, research in Qatar is investigator-initiated, and the country has put a greater focus on laboratory research in the past. This needs to evolve, and the country needs to bring forth a mechanism to actively promote and fund most relevant and impactful DM research. This requires institutions to discuss and share their research priorities with other institutions and align their programmes to meet the national needs. This will be a major cultural shift for institutions and researchers as compared to today when they are working in isolation and competing for research funding with each other. A new approach necessitates greater transparency and a platform for research community to collaborate. Acknowledging this challenge, the DM research sub-committee has organised bi-weekly DM research webinars to facilitate interaction and knowledge sharing among researchers in Qatar. This, however, is an initial step, and a larger framework needs to be put in place for researcher community to collaborate.



Another major challenge is ensuring the availability of right skill mix for diabetes research. Conquering DM requires an extensive collaboration of expertise from molecular and cell biology to behavioural and social sciences [42]. Bringing in different expertise and reskilling existing researchers would require the implementation of a comprehensive capacity-building programme. Funders may be persuaded to initiate more innovative funding programmes for the skill building of researchers. Moreover, a dedicated clinician–scientist training programme and national clinical trial unit need to be set up to build research capacities and strengthen research infrastructure. Qatar established a multi-institutional Academic Health System (AHS) in 2011 to facilitate collaboration among local institutions. Similar collaboration with other international AHS will facilitate in multi-centre clinical studies and innovations. Most researchers in Qatar are expatriates and creating opportunities for career progression for them will facilitate in the retention of skilled resources in long run.

The Ministry of Public Health in Qatar has recently reformed research regulations, set up a governance mechanism and established a clinical trials registry. Institutional review boards in Qatar have also facilitated in the conduct of scientific research in accordance with international ethical standards. A continuous dialogue with the research community will further help to improve research regulation based on future needs and innovations.

The Qatar Research Development and Innovation (QRDI 2030) was introduced in 2020, providing direction for research and innovation for the next decade in Qatar and intends to address high prevalence diseases through precision medicine and omics research. This is very advanced and complex research, and balancing these with the current research needs would require a calibrated approach. The Gulf Cooperation Council (GCC) countries largely have similar ethnic backgrounds and face similar healthcare challenges, and this provides an opportunity for the research community in these countries to collaborate and align their research to address common challenges associated with the DM in the region.

It is important to acknowledge the limitations of this agenda and approach adopted for its development. This agenda was developed to provide high-level guidance for research in specific areas and does not specify specific research projects, which need to be further defined. The research agenda does not address how DM research would be funded in future or any mechanism for the rationalisation of funding to support DM research. The agenda was developed by collecting feedback from patient advocacy organisations and not directly from the patients. A greater plan for the engagement of patient community into research needs is planned. Even with these limitations, it is expected that this agenda has great potential to benefit diabetes care and research ecosystem in Qatar.

## CONCLUSION

The State of Qatar has an extensive plan for building strong research and innovation ecosystem in healthcare. Investment in research on diabetes had greatly benefitted many developed countries to reduce diabetes incidence and long-term complications. To generate evidence in local context, a national diabetes research agenda was prepared with the participation of diverse stakeholders in Qatar. The agenda needs to be adopted by all stakeholders, and funding needs to be ensured for priority diabetes research. Collaboration among different stakeholders, committed funding and strong governance support will facilitate in the achievement of objectives of the research agenda.

## AUTHOR CONTRIBUTIONS

*Conception and design:* Shahradd Taheri, Nicholas Wareham, Abdul Badi Abou-Samra and Amit Mishra. *Data analysis:* Amit Mishra, Suresh Babu Kokku and Shahradd Taheri. *Drafting the article or revising it critically:* Amit Mishra, Shahradd Taheri, Nicholas Wareham, Abdul Badi Abou-Samra, Suresh Babu Kokku, Ioanna Skaroni, Kholoud Ateeq Al Motawaa and Mohammed Al-Thani. All authors approved the final version submitted.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## FUNDING INFORMATION

No funding was received for this work. There was no input from any funding source in the work presented.

## DATA AVAILABILITY STATEMENT

Any data used within this work will be available from the corresponding author upon reasonable request.

## ETHICS STATEMENT AND CONSENT TO PARTICIPATE

The work did not require ethical approval or consent.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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