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Type 2 Diabetes Mellitus in Brunei Darussalam – Present Situation and Future Considerations

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Abstract

Diabetes mellitus remains a critical non-communicable disease challenge globally and within Brunei Darussalam. While public health initiatives are ongoing, the rising prevalence and associated costs of disease complications continue to pose significant systemic hurdles. This report evaluates the continuum of diabetes care in Brunei, which includes prevention, early detection and clinical management. Furthermore, it identifies systemic barriers and proposes future strategic interventions aimed at flattening the prevalence curve and reducing the health economic burden of diabetes.

Keywords: Diabetes mellitus; Non-communicable diseases; Policies; Management

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic condition underpinned by insulin resistance and impaired insulin secretion. It is associated with a number of microvascular and macrovascular complications, and metabolic disorders such as hypertension, hyperlipidaemia, obesity and metabolic dysfunction-associated steatotic liver disease (MASLD). The global prevalence of diabetes is rising alarmingly with an estimated surge of 45% from 588.7 million people with diabetes in 2024 to 852.5 million by 2050.[1] Within the Western Pacific region, there is an expected rise in prevalence of 18% from 215.4 million people with diabetes in 2024 to

253.8 million by 2050.

National population-based surveys indicate a rising burden of diabetes in Brunei Darussalam, with prevalence increasing from 9.7% in 2016 to 15.0% in 2022.[2,3] In contrast, unpublished data (**Figure 1**) from the national electronic medical record system, Brunei Darussalam Healthcare Information and Management System (BruHIMS), identified 44,046 adults aged ≥18 years with diagnosed T2DM in 2024, corresponding to a prevalence of 10.4%. The mean age was 57 years (±13), with a similar distribution between males and females. This lower estimate likely represents diagnosed or treated prevalence and excludes individuals with undiagnosed diabetes captured in population-based surveys, suggesting a substantial burden of undiagnosed disease. Diabetes is the third leading cause of death with an age standardised mortality rate of 54.9 per 100,000 population in 2019.[4]

Diabetes imposes a substantial socioeconomic burden, driven by high financial costs and the escalating demands of long-term care. The increasing complexity of diabetes management has contributed to greater healthcare utilisation over time. In Brunei Darussalam, the average annual cost of diabetes care was estimated at USD 816 per person in 2024.[1] When extrapolated nationally, diabetes-related expenditure for adults with T2DM accounts for approximately 8.4% of the total national health budget for the 2024-2025 fiscal year.[5]

In the following sections, we review the current landscape of diabetes care in Brunei Darussalam, highlighting population- and patient-level initiatives and strategies that have been implemented to address diabetes (**Table 1**). We also discuss existing challenges and future considerations to strengthen national efforts aimed at curbing the rising prevalence of diabetes and mitigating its associated health and economic burden.

National policies

In 2011, the Health Promotion Blueprint 2011-2015 was introduced to align with the Ministry of Health's strategic plan to halt the growth of Non-Communicable Diseases (NCDs) and advance towards a healthy nation. This marked the beginning of Brunei Darussalam's concerted efforts to strengthen NCD prevention and control, culminating in the development and implementation of the Brunei Darussalam National Multisectoral Action Plan for the Prevention and Control of Non-Communicable Diseases (BruMAP-NCD) 2013-2018.[6]

Building on this foundational roadmap and informed by recommendations from the joint evaluation of BruMAP-NCD 2013–2018 conducted by the World Health Organisation (WHO), the Ministry of Health advanced its efforts through the second iteration, BruMAP-NCD 2021–2025. This action plan aims to deliver a coordinated national strategy grounded in a whole-of-government and whole-of-society approach to strengthen the prevention and management of NCDs in Brunei Darussalam.[7,8]

The BruMAP-NCD 2021-2025 framework outlines four key strategic objectives and serves as a guiding structure for achieving both global and national targets

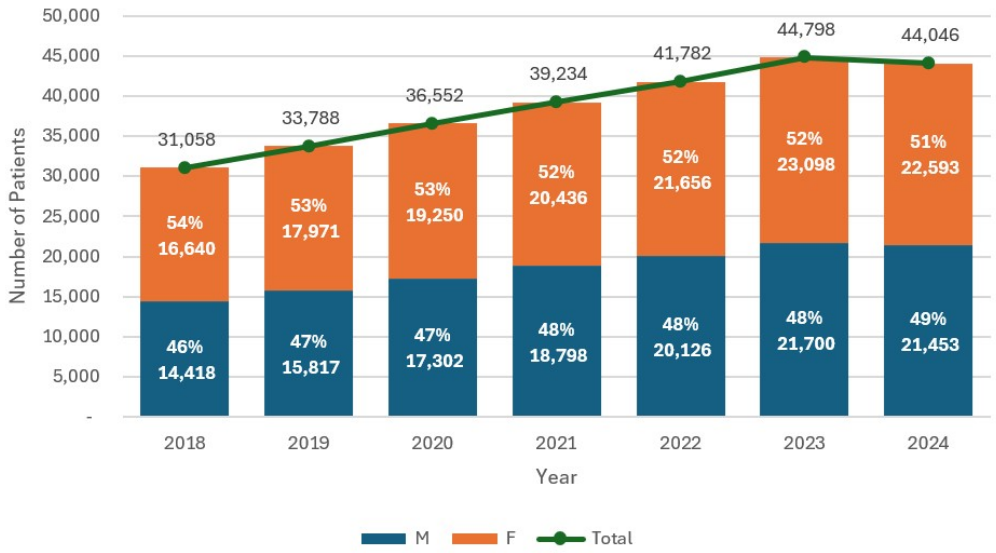

Figure 1: Yearly trend on the number of patients with T2DM between 2018 and 2024 (unpublished obtained from BruHIMS).

[1,5] Derivation of diabetes-related expenditure is based on the national health budget of BND 573,064,540 for the 2024-2025 fiscal year, and the total estimated cost of diabetes care was BND 48,161,658.24 for 44,046 adults with T2DM.

Table 1: Timelines of public health initiatives and diabetes services in Brunei Darussalam.[6,8]

Years	2000-2005	2006-2010	2011-2015	2016-2020	2021-2025
Public Health Initiatives	Guidelines on School Feeding Schemes 2000 Health Promoting School Initiatives 2002 Tobacco Order 2005	Tobacco Regulations 2007 Guidelines on Food and Drinks Served or Sold in Workplaces 2010	Health Promotion Blueprint 2011-2015 National Physical Activity Guidelines 2011 Tobacco Order Amendments 2012 Brunei Darussalam National Multisectoral Action Plan for Prevention and Control of NCDs 2013-2018	Bandar Ku Ceria – Car-free Sundays 2016 Sugar-Sweetened Beverage Tax 2017 Nutrient Criteria of Foods and Beverages with the Healthier Choice Logo Guidelines 2017 School Canteen Guidelines 2018 National Health Screening Programme 2019 Workplace and Health (WAH) Screening 2019 Happy Environment and Lifestyle (HEAL) Programme 2019 National Dietary Guidelines for Health Eating 2020 (revised)	Brunei Darussalam National Multisectoral Action Plan for Prevention and Control of NCDs 2021-2025 National Physical Activity Guidelines 2011 (2nd Edition) Health Promoting School Initiatives 2022 BN-On-The-Move 2024
Diabetes Services	Diabetes Centre RIPAS Hospital 2002 High Risk Clinic (Antenatal Diabetes Care) 2003 Diabetes Nurse Educator Training Programme 2004	Clinical Practice Guidelines in Diabetes Mellitus 2007	Adolescent Diabetes Clinic 2012 Insulin Pump Service 2013 Chronic Disease Clinics (Primary Care) 2013	Multidisciplinary Diabetes Foot Service 2016 Endocrine Centre RIPAS Hospital 2018 Diploma in Diabetes Nurse Education 2019	Young Diabetes Clinic SSB Hospital 2023 Forum for Injection Technique – Brunei Darussalam (FIT-BN) Clinical Guideline 2023 AI-powered diabetes retinal screening 2024

RIPAS – Raja Isteri Pengiran Anak Saleha; SSB – Suri Seri Begawan

on the prevention and control of NCDs. The implementation of BruMAP-NCD 2021–2025 is overseen by the Multisectoral Taskforce for Health, chaired by the Minister of Health and members comprising Permanent Secretaries from relevant government ministries. This governance structure ensures effective multisectoral collaboration and facilitates the efficient and coordinated implementation of policies and initiatives nationwide.[8]

Prevention strategies

Population-level prevention strategies focus on inculcating healthier lifestyles and reducing risk factors for diabetes, particularly smoking and obesity. A number of national initiatives and strategies have been implemented to tackle the rise of diabetes. Notably, Brunei Darussalam has successfully enforced comprehensive tobacco control measures, including a ban on the sale of tobacco products under the Tobacco Order 2005 and Tobacco Regulations 2007.[9]

In addition to the introduction of the Sugar-Sweetened Beverage Tax in 2017, several measures have been implemented to improve the national food environment. These include initiatives to reduce sugar-sweetened beverage consumption among adolescent school children, lower population salt intake, and policies aimed at limiting saturated fat consumption. Nutrition-focused to promote healthier food choices in schools and among the general population include the Guidelines on School Feeding Scheme in 2000, the Nutrient Criteria of Foods and Beverages with the Healthier Choice Logo Guidelines in 2017, and the revised National Dietary Guidelines for Health Eating in 2020.[8]

To promote physical activity nationwide, multiple programmes have been introduced, including the Health Promoting School Initiatives (2002), *'Bandar Ku Ceria'* (a car-free Sunday in designated areas in Brunei Darussalam 2016), the Workplace and Health (WAH) Screening (2019), and the Happy Environment and Lifestyle (HEAL) Programme (2019).[8] The WAH and HEAL Programmes led by the Ministry of Health, under a public-private partnership with Gleaneagles JPMC were established in 2019 to promote healthier lifestyles through education and physical activity interventions increasing efforts to reduce NCDs. As part of the digital

health ecosystem in Brunei Darussalam, *'BN-On-The-Move'* was introduced to the Bruhealth app (a national patient health mobile application) in 2024. The initiative utilises gamification strategies and enhanced user engagement to drive physical activity and foster greater community health participation.

Early detection strategies

Of concern, an estimated 44.7% of individuals with diabetes in Brunei Darussalam remain undiagnosed, representing nearly 20,000 adults nationwide.[10] Early detection and diagnosis are important to ensure timely intervention and delay the onset of complications associated with T2DM. In the early stage of diabetes, symptoms may be absent, however persistent hyperglycaemia causes progressive damage to blood vessels and the nervous system, leading to cardiovascular, renal, neurological and eye complications.[11] Early identification and treatment can significantly reduce these risks. In addition, those with prediabetes have a 35-50% risk of developing diabetes within 5 years.[12]

The Ministry of Health launched the National Health Screening Programme (NHSP) in 2019, which provides screening for NCDs, including diabetes for those aged 40 years and above. The public can access the NHSP on the BruHealth app through which appointments for health screening can be scheduled. In parallel, the WAH Programme supports early detection strategies by facilitating health screening for civil servants and healthcare workers since 2019.

Diabetes treatment and technology

Universal healthcare is provided for citizens and permanent residents of Brunei Darussalam. Pharmacological therapies for the management of T2DM available locally include a wide range of oral glucose lowering agents, glucagon-like peptide-1 receptor agonists (GLP -1RAs), and both human and analogue insulins. Glucose monitoring technologies, including capillary blood glucose monitoring and continuous glucose monitoring (CGM), are not included under the national free healthcare coverage and therefore require out-of-pocket payment. The associated costs may be prohibitive and can contribute to reduced uptake of self-monitoring of blood glucose.

To support self-management, a digital diabetes lifestyle management programme has been developed, integrating diabetes education with self-tracking features to record blood glucose readings, dietary intake, physical activity and medication schedules. This mobile health application is anticipated to enhance diabetes health literacy through the provision of readily accessible digital health educational information and personalised diabetes management plans.[13,14]

Diabetes services

Brunei Darussalam is geographically divided into 4 four districts: Brunei-Muara, Belait, Tutong, and Temburong. Nationwide, there are 14 health centres and one hospital in each district. Diabetes care is delivered across primary care, secondary and tertiary levels of care. The majority of patients with T2DM are managed within primary care settings, while selected patient groups are referred for specialist management.

Specialist diabetes services in Brunei Darussalam have advanced significantly over the past few decades, guided by a series of strategic developments. A major milestone was the establishment of the Diabetes Centre at Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital in July 2002. Prior to this, diabetes care was delivered through the Physician Clinic, with limited infrastructure to support multidisciplinary management. The establishment of the Diabetes Centre marked a pivotal shift toward integrated, patient-centred care, bringing together endocrinologists, diabetes nurse educators, dietitians, podiatrists, and retinal screening services. This integrated model laid the foundation for a more coordinated and accessible approach to managing diabetes nationwide.

The evolution of the Diabetes Nurse Educators (DNE) service began in the late 1990s and expanded in response to increasing service demand. In 2004, a formal recruitment and training programme was initiated at the Diabetes Centre to equip nurses with specialised diabetes management skills. Outreach services commenced in 2007 with weekly diabetes nurse assistant clinics at Muara Health Centre and were subsequently expanded in 2010 to all health centres within the Brunei -Muara District. A formal Level 5 Diploma in Diabetes Nurse Education, developed collaboratively by the Ministry of Health and Politeknik Brunei, was established in 2019. By 2020, the DNE programme had developed into a full nationwide service, with trained nurse educators providing structured diabetes education and support across all districts. To date, eighteen nurses have successfully completed the diploma programme, with an additional eight nurses currently enrolled.

Additional milestones followed in rapid succession. In March 2003, the Endocrine High-Risk Clinic was established within the Obstetrics and Gynaecology Department at RIPAS Hospital to provide multidiscipli-

nary care for patients with gestational diabetes. The first national Clinical Practice Guidelines in Diabetes Mellitus was published in November 2007 formalising a commitment to standardised, evidence-based care. In February 2012, the Adolescent Diabetes Clinic was introduced to address the specific needs of young people with diabetes, followed by the introduction of the Insulin Pump Service in March 2013 providing access to advanced therapeutic technologies for selected individuals with Type 1 diabetes.

In response to the high prevalence of diabetic foot complications in Brunei Darussalam, a multidisciplinary diabetic foot ward round was established in January 2016. This initiative brought together a core multidisciplinary team comprising an endocrinologist, podiatrists, an orthopaedic surgeon, and a microbiologist, with additional input from a vascular surgeon, diabetes nurse educator, orthotist, occupational therapist, and physiotherapist. The service was complemented by a dedicated outpatient podiatry clinic that conducted routine diabetic foot screening and management of diabetic foot ulcers. Following a reform of the diabetic foot service in January 2026, the multidisciplinary diabetic foot clinic and ward rounds were suspended, with individual specialties assuming responsibility of care.

In December 2018, diabetes care was consolidated at the Endocrine Centre within RIPAS Hospital, where most services continue to operate except the Adolescent Diabetes Clinic, which was integrated into general diabetes clinics. To ensure continuity of care for younger patients, a dedicated Young Diabetes Clinic was established at Suri Seri Begawan Hospital in 2023. Led by an endocrinologist from RIPAS Hospital, this initiative provides specialised management and support tailored to the needs of adolescents and young adults living with diabetes.

Recognising the increasing number of individuals requiring insulin and other injectable therapies as part of treatment intensification, the Ministry of Health introduced the Forum for Injection Technique – Brunei Darussalam (FIT-BN) Clinical Guideline in March 2023. FIT-BN workshops are held periodically for healthcare professionals including diabetes educators, nurses, dietitians, pharmacists and medical practitioners, to enhance knowledge and skills in safe and effective administration of injectable therapies. Continuing its adoption of digital innovation, the Ministry of Health launched its first AI-powered diabetes retinal screening using SELENA+ across hospitals and health centres in 2024.[15,16] This initiative strengthens early detection of diabetic retinopathy, ensuring prompt treatment to prevent vision loss while delivering services in a cost-effective manner.

Collectively, these developments reflect a sustained commitment to building a robust diabetes care infrastructure, underpinned by clinical excellence, professional training, and patient empowerment.

Challenges and Future Considerations

Despite universal healthcare coverage for citizens and permanent residents in Brunei Darussalam, barriers remain in accessing medical care beyond financial cost. For instance, the uptake of the NHSP remains low, often due to lack of awareness or engagement. Systematic review from other contexts, such as England, highlight similar barriers including limited understanding of preventive health screening, fear of results, time constraints, and difficulty obtaining appointments.[17] Further studies are needed to identify barriers specific to Brunei Darussalam. The Asian population has a higher rate of diabetes compared with the Caucasian populations highlighting the need for a reliable diabetes risk score in identifying individuals at risk of developing type 2 diabetes.[18] A national diabetes risk assessment tool would enhance the NHSP, which currently targets adults aged ≥40 years, potentially missing younger at-risk populations.

The challenge to a successful prevention or detection strategy lies in its implementation and ability to sustain such measure. Barriers such as socioeconomic disparities, lack of awareness, and limited access to healthcare services hinder effective diabetes prevention and management. Addressing these challenges requires a coordinated and collaborative approach which involve healthcare providers, policymakers, and more importantly, community organisations. Culturally appropriate interventions and digital technology, including mobile health applications and telemedicine, may improve adherence to preventive measures though these tools may disadvantage populations with low digital literacy.

Although overall literacy in Brunei Darussalam is high, health literacy remains suboptimal. A study of patients with T2DM attending routine diabetes appointments at the Endocrine Clinic found that 70% had inadequate knowledge of their diabetes with education level and monthly income correlating with knowledge.[19] Poor health literacy is associated with worse glycaemic control, increased risk of complications and reduced quality of life.[20]

Strengthening health literacy is therefore critical to

improving self-management and patient outcomes. In 2024, the Health Promotion Centre led a health literacy masterclass, utilising tools such as the Conversational Health Literacy Assessment Tool (CHAT) to guide healthcare providers in assessing patients' health literacy strengths and challenges.[21] More research into increasing health literacy is necessary to strengthen diabetes self-management and improve patient outcomes.

Continuous glucose monitoring (CGM) has significantly improved the way diabetes is managed, offering real-time tracking of glucose levels. Compared with conventional capillary blood glucose testing, CGMs offer a convenient and less intrusive option. Studies have demonstrated that CGM use in T2DM resulted in HbA1c reduction, less hypoglycaemic episodes, and improved treatment satisfaction.[22-26] However, CGMs are paid out-of-pocket, posing financial barriers to self-management and treatment intensification. This gap in care provision highlights the need for policy consideration regarding government subsidies.

In Brunei Darussalam, higher rates of obesity and sedentary lifestyles compared with other countries in the region contribute substantially to the burden of T2DM.[27,28] Brunei Darussalam has the highest national rate of obesity in South East Asia, where 65.7% of adults 18-69 years of age are overweight (BMI ≥25kg/m²), and 32.4% are obese (BMI ≥30kg/m²).[2] Childhood obesity is equally alarming, as excess weight in early life commonly tracks into adulthood, markedly increasing lifetime risk of T2DM (Global School-Based Health Survey 2019).[29] Tackling obesity is still a major challenge and an Obesity Taskforce has been established in 2024 to address this burden. In parallel with these efforts, improving access to effective pharmacological therapies is essential. While liraglutide is currently available locally, access to newer incretin-based therapies, such as semaglutide and tirzepatide, should be prioritised, as these agents have demonstrated substantial improvements in glycaemic control and clinically meaningful weight loss in large randomised trials, including the STEP 1 trial and the SURPASS-2 trial, with the potential to transform the management of both diabetes and obesity and reduce long-term cardiometabolic burden.[30-31]

Health Service Delivery and Integration

Diabetes care is patient-centred with a comprehensive network of health services ranging from primary care to specialist care. Primary care is strategically distributed across the country's health centres that ensures the ease of access to services. However, patients with chronic diseases are not assigned to a named general practitioner which may disrupt continuity of care and impact on doctor-patient rapport. Benefits of continuity of care in the management of chronic illnesses such as T2DM include reduced use of outpatient specialist services,[32] improved patient satisfaction,[33] improvement in glycaemic control and reduced mortality.[34] A review of primary care structures is warranted to optimise chronic disease management.

Integrated models of diabetes care where primary care services work closely with specialist teams in a coordinated and cohesive manner have been shown to improve patient outcomes and potential cost-savings.[35] Although referral pathways between primary, secondary and tertiary care are established, coordination across the diabetes care continuum could be further strengthened. The development and implementation of a formal integrated diabetes care model in Brunei Darussalam should therefore be explored to enhance continuity, efficiency, and quality of care nationwide.

Brunei Darussalam has been undergoing significant digital health transformation over the past decade with the digitisation of healthcare records BruHIMS in 2013, and the launch of the BruHealth mobile application in 2020. BruHIMS has enabled improved coordination of care by allowing instant access to patient records across primary and secondary care settings, improved patient safety through reduced transcription errors, and improved legibility of clinical documentation and medication prescriptions.

Despite the availability of BruHIMS, comprehensive national data on the burden of diabetes remain limited. To address this gap, collaborations with EVYD Technology through the EVYDENCE analytics platform have facilitated large-scale analysis of routinely collected clinical data, supporting evidence-based policy development, optimisation of clinical care, and research initiatives. Through the use of EVYDENCE, large volumes of routinely collected clinical data can be analysed to generate useful insights for national diabetes care planning, inform clinical decision-making, and support the develop of innovative solutions through research. A national diabetes clinical registry is under development with planned research to better characterise the burden of diabetes. These initiatives will be crucial to policy-makers and service leads in the strategic planning and delivery of diabetes care nationwide.

Following its initial development as a pandemic management tool, BruHealth has evolved into a national patient health portal. The application enables users to access healthcare services where they can engage in

health screening, schedule appointments for selected clinical services, access personal health records, participate in health promotion activities, track health behaviours and utilise educational materials related to diabetes self-management. These functionalities are intended to facilitate personalised care, enhance patient experience, and improve health literacy and self-management capabilities. However, digital literacy remains a limiting factor in the effective utilisation of digital health services, and strengthening digital literacy across the population should be prioritised.

Reliable access to accurate health information is fundamental to effective diabetes prevention and management. In sociocultural contexts where informal word-of-mouth prevails, proactive strategies to counter misinformation are required to counter health misinformation. The Health Promotion Centre actively engages the public through multiple platforms, including television and radio programmes, as well as social media with potential integration of AI chatbots to provide real-time, evidence-based guidance and to address misinformation proactively.

The establishment of a diabetes patient advocacy group is pivotal in empowering individuals living with diabetes, supporting peer engagement, and advocating for policies that improve access to diabetes care. Patient champions may play an important role in addressing misinformation and provide trusted avenues for accurate health information. In addition, the formation of a professional diabetes society is currently underway and is expected to provide a platform to support patient advocacy, professional development, and the dissemination of evidence-based practice.

Workforce and Capacity

At present, there are six endocrinologists/diabetes specialists at based RIPAS Hospital, the national tertiary hospital located in the Brunei-Muara District. A total of 17 DNEs are assigned nationwide: comprising six hospital-based and five community-based DNEs in the Brunei-Muara District, three hospital-based and one community-based DNE in the Belait District, one hospital-based DNE in the Tutong District, and one hospital-based DNE in the Temburong District.

With an estimated population of 455,500 in 2024, the number of full-time equivalent (FTE) endocrinologists/diabetes specialists is approximately 1.3 per 100,000 population nationwide. Since all six endocrinologists/diabetes specialists are based at RIPAS Hospital, the estimated figure is 1.8 FTE per 100,000 population in the Brunei-Muara district. However, this estimation is closer to 1.5 FTE per 100,000 population when accounting for additional clinical and administrative responsibilities of these clinicians.[36] The current ratio of DNEs is approximately 0.39 per 1,000 people with diabetes. Overall, the existing workforce appears insufficient to meet the demands of comprehensive diabetes care delivery nationwide.

Although there is no universally accepted benchmark for optimal staffing levels in diabetes care, international data provide useful reference points. Reports from the United Kingdom, Spain and Australia suggested a requirement of approximately 1.4-2.5 FTE endocrinologists/diabetes specialists per 100,000 population.[37-39] In addition, a 2019 survey from TREND-UK reported a ratio of 0.58 FTE diabetes nurse specialists per 1,000 individuals with diabetes in the UK.[40] Drawing from these comparisons, and anticipating future service expansion, we propose a target of at least 2.0 FTE endocrinologists/diabetes specialists per 100,000 population (equivalent to a minimum of eight consultants nationally) and 1.0 FTE DNE per 1,000 individuals with diabetes, corresponding to an estimated requirement of 45 DNEs.

Engagement in international collaboration is vital to strengthen diabetes care through shared learning, exchange of expertise, and the development of research partnerships. Brunei Darussalam is a member of the Diabetes and Ramadhan International Alliance (DAR), which aims to support individuals with diabetes to fast safely. The Ministry of Health continues to collaborate with the World Health Organisation to support its efforts to address NCDs, including a recent evaluation of national diabetes care to identify service gaps and inform the development of a future diabetes roadmap. It is also crucial to continue building on our research capacity through collaborations with academic institutions both locally and internationally, to support sustainable improvements in diabetes outcomes.

CONCLUSION

Brunei Darussalam has achieved significant milestones in diabetes care at both population and patient levels. Strengthening existing programmes, addressing gaps in workforce and service delivery, and prioritising capacity-building remain essential to ensuring sustainable, high-quality diabetes care. This overview highlights current achievements, ongoing challenges, and potential strategies to advance diabetes management in the country.

References

1. International Diabetes Federation. IDF Diabetes Atlas, 11th edn. Brussels, Belgium: 2025. Available at: https://diabetesatlas.org (Accessed 2025 Aug 2).
2. Ong SK, Lai DTC, Wong JYY, Si-Ramlee KA, Razak LA, Kassim, N, *et al.* Cross-sectional STEPwise Approach to Surveillance (STEPS) Population Survey of Noncommunicable Diseases (NCDs) and Risk Factors in Brunei Darussalam 2016. Asia Pac J Public Health. 2017;29(8):666-677.
3. Brunei Darussalam STEPS Survey 2022/2023 Fact Sheet. Available from: https://moh.gov.bn/wp-BRN-2023_Factsheet_18-Nov-24_15-36-39-FINAL_140425.pdf (Accessed 2026 Feb 1)
4. World Health Organization and Ministry of Health, Brunei Darussalam. Country Fact Sheet: Public Health Data at a Glance 2020, Brunei Darussalam. Available from: https://www.who.int/docs/default-source/wpro---documents/countries/brunei-darussalam/fact-sheet-brunei-darussalam.pdf?sfvrsn=b91eddf4_5 (Accessed 2025 Sep 8).
5. Othman A. MOH allocated over BND573M. Borneo Bulletin 2024 Mar 20. Available from: https://borneobulletin.com.bn/moh-allocated-over-bnd573m/ (Accessed 2025 Dec 15).
6. Brunei Darussalam National Multisectoral Action Plan for the Prevention and Control of Noncommunicable Diseases (BruMAP-NCD) 2013-2018. Available from: https://www.iccp-portal.org/sites/default/files/plans/BRN_2013_NCDs.pdf (Accessed 2025 Aug 10).
7. Ministry of Health, Brunei Darussalam and World Health Organization. Brunei Darussalam National Multisectoral Action Plan for the Prevention and Control of Noncommunicable Diseases (BruMAP-NCD) 2013-2018: Joint Evaluation. 2021. Available from the Ministry of Health, Brunei Darussalam.
8. Brunei Darussalam National Multisectoral Action Plan for the Prevention and Control of Noncommunicable Diseases (BruMAP-NCD) 2021-2025. Available from: https://moh.gov.bn/wp-content/uploads/2024/10/BRUMAP-NCD-2021_compressed.pdf (Accessed 2025 Aug 10).
9. Brunei Darussalam Tobacco Order 2005. Attorney General's Chambers 2005 Jun 28. Available from: https://www.agc.gov.bn/AGC%20Images/LAWS/Gazette_PDF/2005/EN/s049.pdf (Accessed 2025 Aug 1).
10. International Diabetes Federation. Brunei Darussalam Diabetes country report 2011-2050. Available from: https://diabetesatlas.org/data-by-location/country/brunei-darussalam/ (Accessed 2025 Aug 10).
11. Ali MK, Pearson-Stuttard J, Selvin E, Gregg EW. Interpreting global trends in type 2 diabetes complications and mortality. Diabetologia. 2022;65(1):3–13.
12. Mutie PM, Pomares-Millan H, Atabaki-Pasdar N, Jordan N, Adams R, Daly NL, *et al.* An investigation of causal relationships between prediabetes and vascular complications. Nat Commun. 2020;11(1):4592.
13. Chan HN, Lim HS, Chong PL, Yung CK, Abd Mulok M, Wei Y, *et al.* Development and Exploration of the Effectiveness and Feasibility of a Digital Intervention for Type 2 Diabetes Mellitus (DEsireD): Protocol for a Clinical Nonrandomized Pilot Trial in Brunei Darussalam. JMIR Res Protoc. 2022;11(12):e43208.
14. Tey J, Lam J, Yung CK, Abd Mulok M, Mat Salleh N, Yong AML, *et al.* Evaluation of the BALANCE Program as a Digital Therapeutic Solution for Type 2 Diabetes Management: Protocol for a Prospective Lifestyle Intervention Study. JMIR Res Protoc. 2025;14:e73964.
15. Ting DSW, Cheung CY, Lim G, Tan GSW, Quang ND, Gan A, *et al.* Development and Validation of a Deep Learning System for Diabetic Retinopathy and Related Eye Diseases Using Retinal Images From Multiethnic Populations With Diabetes. JAMA. 2017;318(22):2211-2223.
16. Nova MSC. National AI Diabetic Retinopathy Screening Project showcased at Civil Service Day, Brunei Darussalam. 2025. Available from: https://www.nova-hub.com/announcements/national-dr-screening-project-showcased-at-civil-service-day-brunei-darussalam (Accessed 2026 Mar 15).
17. Harte E, MacLure C, Martin A, Saunders CL, Meads C, Walter FM, *et al.* Reasons why people do not attend NHS Health Checks: a systematic review and qualitative synthesis. Br J Gen Pract. 2018;68(666):e28-e35.
18. Hu PL, Koh YL, Tan NC. The utility of diabetes risk score items as predictors of incident type 2 diabetes in Asian populations: An evidence-based review. Diab Res Clin Pract 2016;122:179- 189.
19. Mohidin A, Chong PL, Teo SP, Zulkipli I. Health Literacy Among Patients With Diabetes In RIPAS Hospital, Brunei. Brunei Int Med J. 2020;16. 36-41.
20. Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, *et. al.* Association of health literacy with diabetes outcomes. JAMA. 2002; 288(4):475-82.
21. O'Hara J, Hawkins M, Batterham R, Dodson S, Osborne RH, Beauchamp A. Conceptualisation and development of the Conversational Health Literacy Assessment Tool (CHAT). BMC Health Serv Res. 2018;18:199.
22. Martens T, Beck RW, Bailey R, Ruedy KJ, Calhoun P, Peters AL, *et al.* MOBILE Study Group. Effect of Continuous Glucose Monitoring on Glycaemic Control in Patients with Type 2 Diabetes Treated with Basal Insulin: A Randomized Clinical Trial. JAMA. 2021;325(22):2262–2272.
23. Beck RW, Riddlesworth TD, Ruedy K, Ahmann A, Haller S, Kruger D, *et al.* DIAMOND Study Group. Continuous Glucose Monitoring Versus Usual Care in Patients with Type 2 Diabetes Receiving Multiple Daily Insulin Injections: A Randomized Trial. Ann Intern Med. 2017;167(6):365–374.
24. Yaron M, Roitman E, Aharon-Hananel G, Landau Z, Ganz T, Yanuv I, *et al.* Effect of Flash Glucose Monitoring Technology on Glycemic Control and Treatment Satisfaction in Patients with Type 2 Diabetes. Diabetes Care. 2019;42(7):1178–1184.
25. Haak T, Hanaire H, Ajjan R, Hermanns N, Riveline JP, Rayman G. Use of Flash Glucose-Sensing Technology for 12 months as a Replacement for Blood Glucose Monitoring in Insulin-treated Type 2 Diabetes. Diabetes Ther. 2017;8(3):573–586.
26. Haak T, Hanaire H, Ajjan R, Hermanns N, Riveline JP, Rayman G. Flash Glucose-Sensing Technology as a Replacement for Blood Glucose Monitoring for the Management of Insulin-treated Type 2 Diabetes: a Multicenter, Open-Label Randomized Controlled Trial. Diabetes Ther. 2017;8(1):55–73.
27. Norhammar, A., Bodegård, J., Nyström, T., Thuresson, M., Eriksson JW, Nathanson D. Incidence, prevalence and mortality of type 2 diabetes requiring glucose-lowering treatment, and associated risks of cardiovascular complications: a nationwide study in Sweden, 2006–2013. Diabetologia. 2016;59(8):1692–1701.
28. Wei J, Fan L, He Z, Zhang S, Zhang Y, Zhu X, *et al.* The global, regional, and national burden of type 2 diabetes mellitus attributable to low physical activity from 1990 to 2021: a systematic analysis of the global burden of disease study 2021. Int J Behav Nutr Phys Act. 2025;22(1),8.
29. Ministry of Health, Brunei Darussalam and World Health Organization. Global School-Based Health Survey 2019 – Brunei Darussalam Fact Sheet. Available from: https://cdn.who.int/media/docs/default-source/ncds/ncd-surveillance/data-reporting/brunei-darussalam/brunei-darussalam-2019-fact-sheet.pdf?sfvrsn=d9615bcc_1 (Accessed 2025 Aug 1).
30. STEP 1 trial Wilding JPH, Batterham RL, Calanna S, Davies M, Van Gaal LF, Lingvay I, *et al.* Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med.* 2021;384:989–1002.
31. Frias JP, Davies MJ, Rosenstock J, Pérez Manghi FC, Fernández Landó L, Bergman BK, *et al.* Tirzepatide versus semaglutide once weekly in patients with type 2 diabetes (SURPASS-2). N Engl J Med. 2021;385:503–515.
32. Hansen AH, Johansen, ML. Personal continuity of GP care and outpatient specialist visits in people with type 2 diabetes: A cross-sectional survey. PloS One. 2022;17(10):e0276054.
33. Gulliford MC, Naithani S, Morgan M. Continuity of care and intermediate outcomes of type 2 diabetes mellitus. Fam Pract. 2007;24(3):245-52.
34. Chan KS, Wan EYF, Chin WY, Cheng WHG, Ho MK, Yu EYT, *et al.* Effects of continuity of care in health outcomes among patients with diabetes mellitus and/or hypertension: a systematic review. BMC Fam Pract. 2021;22:145.
35. Zarora R, Immanuel J, Chivese T, MacMillan F, Simmons D. Effectiveness of Intergrated Diabetes Care Interventions Involving Diabetes Specialists Working in Primary and Community Care Settings: A Systematic Review and Meta-Analysis.

Int J Integr Care. 2022;22(2):11.
36. Department of Economic Planning and Statistics, Brunei Darussalam. Report of Population Estimates 2024. Available from: https://deps.mofe.gov.bn/population-social-statistics/ (Accessed 2026 Jan 2026).
37. Diabetes Federation of Ireland. Diabetes Care: Securing the Future. Report of the Diabetes Service Development Group 2002. Available from: https://www.diabetes.ie/wp-content/uploads/2011/06/dsdg-report.pdf (Accessed 2025 Sep 13).
38. Santamaria J, Bretón I, Fernández A, Hanzu F, Luque R, Pinés P, *et al.* RECALSEEN 2021. Resources and quality in the Endocrinology and Nutrition units of the National Health System of Spain. Endocrinol Diabetes Nutri (Engl Ed). 2023;70(7):459-467.
39. Australian Government Department of Health. Endocrinology: 2016 Factsheet. Available from: https://hwd.health.gov.au/resources/publications/factsheet-mdcl-endocrinology-2016.pdf (Accessed 2025 Sep 8).
40. Survey reveals 1,800-plus diabetes specialist nurses in England. Diabetes Times 2019 Oct 30. Available from: https://diabetestimes.co.uk/survey-reveals-1800-plus-diabetes-specialist-nurses-in-england/#:~:text=Latest%20figures%20from%20Diabetes%20UK%20suggest%20there,nurses%20for%20every%201%2C000%20people%20with%20diabetes (Accessed 2025 Sep 6).