BRIEF COMMUNICATION

Rapid increase in continuous glucose monitoring use among adults with type 1 diabetes admitted to hospital: a Melbourne multicentre observational study

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Abstract

Continuous glucose monitoring (CGM) technology is transforming community diabetes management. Interest in the utility of CGM during hospitalisation is increasing. This multicentre retrospective observational study found that, among adult inpatients with type 1 diabetes, the proportion with inpatient CGM glucose data in hospital-linked CGM software accounts increased from 3.2% in 2021 to 20.5% in 2023. This study highlights the need for hospital-based clinicians to familiarise themselves with CGM technology.

The prevalence of diabetes mellitus among hospitalised adults in Australia is currently 24%–34% and has increased significantly over the last five decades.[1–3] Models of care for inpatient glucose management can improve patient outcomes and lower the incidence of hospital-acquired complications.[4] A key component to optimising diabetes management in hospital pertains to having ready access to glucose measures in hospital.

In the modern hospital era, blood glucose monitoring has been performed by point-of-care (POC) finger prick capillary blood glucose measurements. However, the recent availability of government-subsidised continuous glucose monitoring (CGM) technology is changing the landscape for glucose measurements in a variety of healthcare settings.[5,6] In Australia, CGM use has significantly increased following the introduction of the National Diabetes Services Scheme (NDSS) subsidy in 2017 initially for people <21 years of age with type 1 diabetes (T1D), with gradual subsequent expansion, finally

reaching universal coverage for all people with T1D in 2022.[7–9]

The latest generations of CGM are small devices that measure interstitial fluid glucose every 1–5 min to provide a near-continuous estimate of blood glucose levels. These CGM devices are accurate enough for people with diabetes to use for insulin dose calculations, in many cases without the need for finger prick capillary blood testing. CGM glucose data can be linked via web-based software to a health care provider or health service, and utilised by people living with diabetes as well as their healthcare providers to adjust diabetes medications and improve glucose management.

Given the increasing incidence and prevalence of T1D,[10] along with increasing CGM use in the community,[7–9] we hypothesised that an increasing number of people with T1D admitted to hospital would use CGM glucose and hence have CGM glucose data available for assessment during their hospital admission.

We conducted a multicentre retrospective observational study to determine the proportion of people with T1D admitted to hospital over the last 3 years who had software-linked CGM data available for assessment

during their hospital stay. We screened adult patients with T1D (using medical record coding data with ICD-10 codes for T1D (E10*) at Eastern Health and Peninsula Health, and SNOMED CT-AU codes for T1D at Melbourne Health) who required multi-day acute hospital admissions during the years 2021–2023, inclusive, across three health services in Victoria, Australia, ranging from inner-city to outer suburban hospital settings: Eastern Health, Melbourne Health (The Royal Melbourne Hospital) and Peninsula Health. Patients using a FreeStyle Libre or Libre 2 (Abbott Diabetes Care Inc., Victoria, Australia), Medtronic Guardian 3 or 4 (Medtronic, MN, USA) or Dexcom G5 or G6 (DexCom Inc., CA, USA) CGM linked to their health service's web-based CGM software accounts (LibreView, Medtronic Carelink or Dexcom Clarity respectively) were included if any CGM glucose data were available from the web-based account during their acute hospital admission period. This occurred if patients had previously consented to sharing their CGM data with their respective health service, with automatic uploads from respective smartphone CGM apps or via manual uploads with Reader/Receiver devices. Patients admitted under paediatric, obstetric, palliative care, psychiatry and subacute units were excluded. Ethics approval was obtained prior to study commencement (EH: QA23-105-102749; MH: QA2023122; PH: SA/103943/PH-2023).

A total of 1766 people with T1D requiring a cumulative 3512 multiday acute admissions during 2021–2023 was assessed. The total number of people with T1D (and total number of admissions) requiring multiday admissions in each year was 753 (1182), 744 (1141) and 770 (1189) in 2021, 2022 and 2023 respectively (Tables S1,S2). Admitting units are listed in Table S3. As some people with T1D had admissions across multiple years, the sum of people by year exceeds the total number assessed.

Of these, 234 people with T1D with 382 admissions (of these, 48 (13%) required intensive care) had inpatient CGM glucose data evident on hospital-linked CGM software accounts during their hospital stay. The median age was 49.5 years (interquartile range (IQR) 31.2–64.0), 54% ($n = 126$) were male, median Charlson Comorbidity Index was 3 (IQR 1–6), mean HbA1c was 9.0% (SD 2.1%), and median length of stay was 3.1 days (IQR 1.5–6.7). Libre or Libre 2 was used by 68% ($n = 159$) Guardian 3 or 4 by 8% ($n = 19$) and Dexcom G5 or G6 by 24% ($n = 56$). Median inpatient CGM data capture was 83% (IQR 46–99) of total expected CGM measures based on admission duration.

The proportion (and number) of patients in each year who had inpatient CGM glucose data in hospital-linked CGM software accounts increased over time: 3.2%
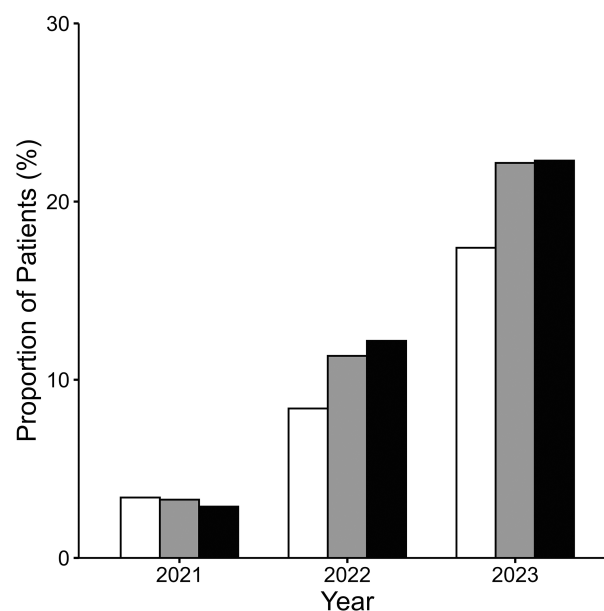
Figure 1 Prevalence of continuous glucose monitoring (CGM) use in hospital among adults with type 1 diabetes (TID). Proportion of hospitalised adults with T1D who had inpatient CGM data recorded in hospital-linked web-based CGM software accounts, by year and health service (white: Eastern Health; grey: Melbourne Health; black: Peninsula Health).

($n = 24$) in 2021; 10.3% ($n = 77$) in 2022; and 20.5% ($n = 158$) in 2023. The proportions of patients with inpatient CGM glucose data in hospital-linked CGM software accounts according to health service and year are represented in Figure 1.

Discussion

In our hospitalised retrospective cohort of people with T1D, the availability of CGM data linked to hospital web-based CGM software accounts during hospital admissions increased over five-fold between 2021 and 2023, from 3.2% to 20.5%. This rise in inpatient CGM use with available glucose data for hospitalised adults with T1D parallels the rapid rise in outpatient CGM use among people with T1D, which has increased from 51.6% in 2021 to 82.4% in 2023 (60% increase), as reported in serial Australian National Diabetes Audit (ANDA)/Australian Diabetes Clinical Quality Registry (ADCQR) national audits performed during the same time period,[8,9,11] noting the expansion of the NDSS CGM subsidy in July 2022 to provide universal coverage for people with T1D.[7] Based on the marked difference between CGM usage reported in ANDA/ADCQR audits and the inpatient CGM data availability reported

in our study (82.4% vs 20.5%), inpatient CGM use is likely to continue to increase rapidly in forthcoming years.

Inpatient CGM data availability lags behind outpatient CGM usage for two reasons. First, CGM account linkage of patient CGM accounts to health service software accounts must be performed by hospital-based healthcare providers of diabetes care upon a clinical encounter if not previously performed. Increased data linkage of patient CGM to health services likely accounts for some of the increase in inpatient CGM data availability seen in our study. Second, some patients may temporarily cease CGM use during hospital admission, either due to their acute illness or limited access to their usual CGM supplies. A limitation of our study was the inability to assess patients who may have been admitted while wearing CGM but did not have their CGM data linked to that hospital's CGM account. Consequently, our results are likely an underestimate.

Despite the increasing availability of inpatient CGM glucose data, regulatory approval for healthcare provider utilisation of inpatient CGM glucose data remains limited due to uncertainty surrounding device accuracy in acutely unwell patients.[12–14] It is unclear whether the available CGM data were utilised by inpatient teams for treatment decisions for patients in our study. While some international guidelines recommend continued use of CGM in hospital for diabetes self-management when clinically appropriate,[13,15,16] CGM is not currently approved by the Therapeutic Goods Administration for use by hospital staff for inpatient glucose management. Among hospitalised patients, altered tissue perfusion, prescription of interfering medications and exposure to electrical diathermy during surgery may all affect CGM accuracy.[17] In addition, there is limited, emerging data comparing CGM interstitial fluid glucose with gold-standard plasma glucose measurements,[18] especially during acute illness, with poor circulation or oedematous conditions such as kidney failure.[19] If found to be comparable to POC glucose in the hospital setting, CGM use has the potential to improve patient safety through automated hypoglycaemia alerts, reduce the number of invasive finger prick tests and reduce the need to wake patients overnight. Additionally, CGM use in hospital has the potential to reduce overall healthcare costs, with one study reporting a daily saving of 12 euros per patient when used in intensive care to replace POC testing.[20]

Overall, our study suggests that in-hospital use of CGM among Australian adults with T1D is increasing, consistent with the increasing use of CGM in the community. This rising prevalence of CGM use by patients admitted to hospital provides clinicians with an opportunity to understand better the course of inpatient glycaemia. Further research is required to understand how to utilise effectively and safely these inpatient CGM glucose data. Additionally, it will become increasingly important to ensure hospital staff are familiar with CGM technology, including the benefits and limitations of its use in the inpatient setting.

Acknowledgements

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Table S1. Patient numbers, by site and year.
Table S2. Admission numbers, by site and year.
Table S3. Admission unit.