Diabetes technologies – what the general physician needs to know

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ABSTRACT

Technology has revolutionised our society. From the creation of the internet to smartphones and applications (apps), technology has changed how we communicate with each other, undertake regular tasks in our lives and access information at our fingertips. Technology has also transformed how we deliver healthcare with electronic patient records, more sensitive imaging modalities and newer treatments that are less invasive yet more cost-effective. The management of diabetes mellitus is an area that has kept pace with this revolution. With the emergence of a range of widely used technological options that can improve quality of life and metabolic outcomes, general physicians need to be aware of their application in diabetes, as well as how to manage acute diabetes presentations in people using these devices. This article aims to improve the knowledge that general physicians may have with diabetes technologies and guide them on the acute management in people using these technologies.

KEYWORDS: Continuous subcutaneous insulin infusion, insulin pump, continuous glucose monitoring, flash glucose monitoring, artificial pancreas

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Introduction

Ever since the first continuous subcutaneous insulin infusion (insulin pump) prototype was designed in 1963, technology has progressively improved the lives and outcomes of people with type 1 diabetes mellitus.[1–3] People are attracted to the use of diabetes technology for many reasons but most importantly because they can improve quality of life and metabolic outcomes.[4] For example, insulin pumps (continuous subcutaneous insulin infusion (CSII)) can reduce the psychological and occupational hurdles of daily multiple dose insulin (MDI) injections as well as deliver improvements in glycaemia.[5] Glucose monitoring has advanced along its own path too; from urine dipstick measurements giving way firstly to bulky self-monitoring kits in 1970, before more sophisticated handheld devices connecting to mobile phones became the standard.[2,6] Now, the design of subcutaneous continuous glucose monitoring (CGM) devices with links to smartphone and cloud-based technologies has helped people overcome the barrier of repeated finger-prick glucose checking. In this article, we discuss the use of diabetes technologies and common acute scenarios to aid the understanding of general physicians managing people with type 1 diabetes.

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Implementation in the NHS

Current implementation of more recent diabetes technologies in the NHS is largely aimed at type 1 diabetes given the intensive management requirements of this condition. The UK has one of the highest rates of type 1 diabetes in the world, with approximately 400,000 people in the UK living with type 1 diabetes and a fifth of hospital admissions involve people with complications from diabetes.[7,8] As detailed later, healthcare professionals endorse the use of diabetes technologies in subgroups of type 1 diabetes as they have proven to improve metabolic and psychological outcomes, thus reducing the risk of long-term complications and disease burden in intensively managed patients.[4]

With increasing use of technology, a fresh concern emerges. In 2011, a survey highlighted the lack of confidence junior doctors had with prescribing insulin and managing diabetes and 75% of foundation year-1 doctors failed an applied knowledge test on the prescribing of insulin.[9,10] The rise of diabetes technology, therefore, adds further complexity to this already high-risk skill. It is clear that the complexity of diabetes management is evolving rapidly. Even within the diabetes specialty, healthcare professional training for the different disciplines involved in diabetes care needs to be improved. Given the current trends and likely further increase in uptake in diabetes technologies, hospital doctors need to understand how to approach the management of people using diabetes technologies in the acute setting.

Continuous subcutaneous insulin infusions (insulin pumps)

What are pumps?

Insulin pumps are comprised of two elements: a cannula, which delivers insulin subcutaneously, and the pump device, which controls the rate of insulin delivery. People are taught to insert subcutaneous cannulas independently, which attach to the skin at sites where they would usually inject insulin, via an adhesive (Fig 1).

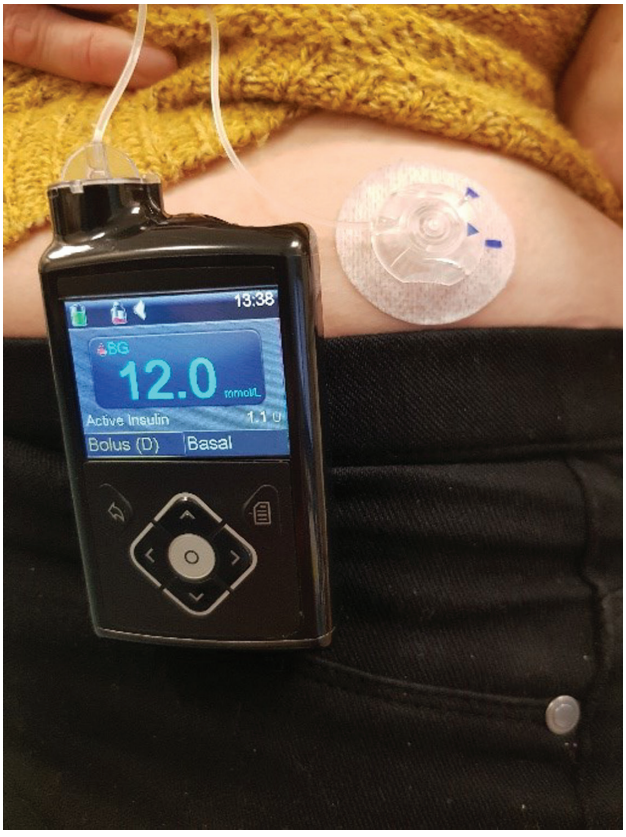

Fig 1. An example of an insulin pump demonstrating the pump device, tubing and cannula. The display and buttons of the pump allow dosing or programming of insulin. In this case the pump links wirelessly to glucose meters and shows the recent glucose value that can be used to calculate and deliver corrective insulin doses.

The cannulas may be made from plastic or, where problems with absorption or adhesion may exist, steel. Insulin pumps are devices the size of a pager, which people often clip to belts for convenience, and have a plastic tube, narrower than a standard fluid infusion tube, which connects onto the cannula. Another variation includes 'patch' pumps that are tubeless. Insulin pumps store between 200–300 units of rapid-acting analogue insulin (usually insulin lispro (Humalog), insulin aspart (NovoRapid or FiAsp)).[11]

To understand their function, it is important to remember the basics of the traditional multiple daily insulin regimen. People with type 1 diabetes will usually inject long-acting insulin, once or twice daily, to provide them with basal insulin – a measure which keeps them safe from ketosis and dangerous hyperglycaemia. At mealtimes, however, a rapid-acting insulin bolus is used to cover the glucose rises secondary to carbohydrate metabolism. This leads to an average of four to five subcutaneous injections a day.

The pump only stores rapid-acting insulin and instead delivers this continuously, hence the term *continuous* subcutaneous insulin infusion. This continuous infusion is termed the basal rate and replaces the basal part of a traditional insulin regimen. The rate at which insulin is delivered is controlled by the pump and each person will have an individualised rate which can be modified to vary several times throughout the day. Such fine-tuning allows someone who tends to experience hypoglycaemia (hypo) overnight, for example, to have lower rates of insulin delivery overnight compared with during the day. It also allows for rises, for example early morning, typically after 3am or 4am, when physiological insulin requirements are likely to be higher owing to higher cortisol and growth hormone levels (dawn phenomenon).

At mealtimes, the person can calculate the amount of insulin required to cover the carbohydrate content (carb-count) and set the pump to deliver this as their bolus through the same cannula before they eat. They can also correct hyperglycaemia as required by additional boluses anytime during the day.

Why are they used?

Pumps offer a number of advantages over conventional injection-based therapy. Their enhanced ability to modify the basal rate leads to fewer hypos, significant improvement in glycated haemoglobin (HbA1c) and a reported better quality of life as compared to conventional injections.[4,12]

However, their use is limited to those meeting criteria for funding. In England and Wales, this is set by the National Institute for Health and Care Excellence (NICE). Since the initial publication of the NICE technology appraisal guidance in 2003, insulin pump usage has steadily increased in England and this trend is also seen across Europe, where some developed western European countries, such as Norway, have nearly five times the number of people on insulin pumps compared with the UK.[4,13,14] While there are still challenges and marked variations in access, it is currently estimated that around 18% of people in England with type 1 diabetes who are managed in specialist centres are using insulin pumps.[13,14] Current criteria are listed below.[4]

Continuous subcutaneous insulin infusion or 'insulin pump' therapy is recommended as a possible treatment for adults and children 12 years and over with type 1 diabetes mellitus if:

- attempts to reach target HbA1c levels with multiple daily injections result in the person having 'disabling hypoglycaemia'
- HbA1c levels have remained above 70 mmol/mol (8.5%) with multiple daily injections (including using long-acting insulin analogues if appropriate) despite a high level of care.

In addition to the above, other selection criteria and characteristics have been proposed.[15] While pumps can offer several advantages including the reduction of frequent insulin injections, they require proficiency and training in set up as well as an ability to perform key daily actions.[11] This includes drawing up the insulin reservoir, priming the tubing and re-inserting the cannula at least every 3 days, while performing regular self-monitoring of glucose levels and adjusting insulin doses based on glucose readings. Efficacy and safety is dependent on these aspects, therefore pump services have to ensure clinical pathways and educational programmes are in place to support individuals on pump therapy.[16]

Managing pumps in the acute setting

General inpatient management

People on insulin pumps who are admitted to hospital should be encouraged to self-manage their pumps as much as possible as long as they have capacity to do so.[17] Any patient who is unconscious and thus unable to self-manage the pump should have the pump removed and started on a variable rate intravenous insulin infusion (VRIII).[17] Fig 2a summarises how to approach these situations.

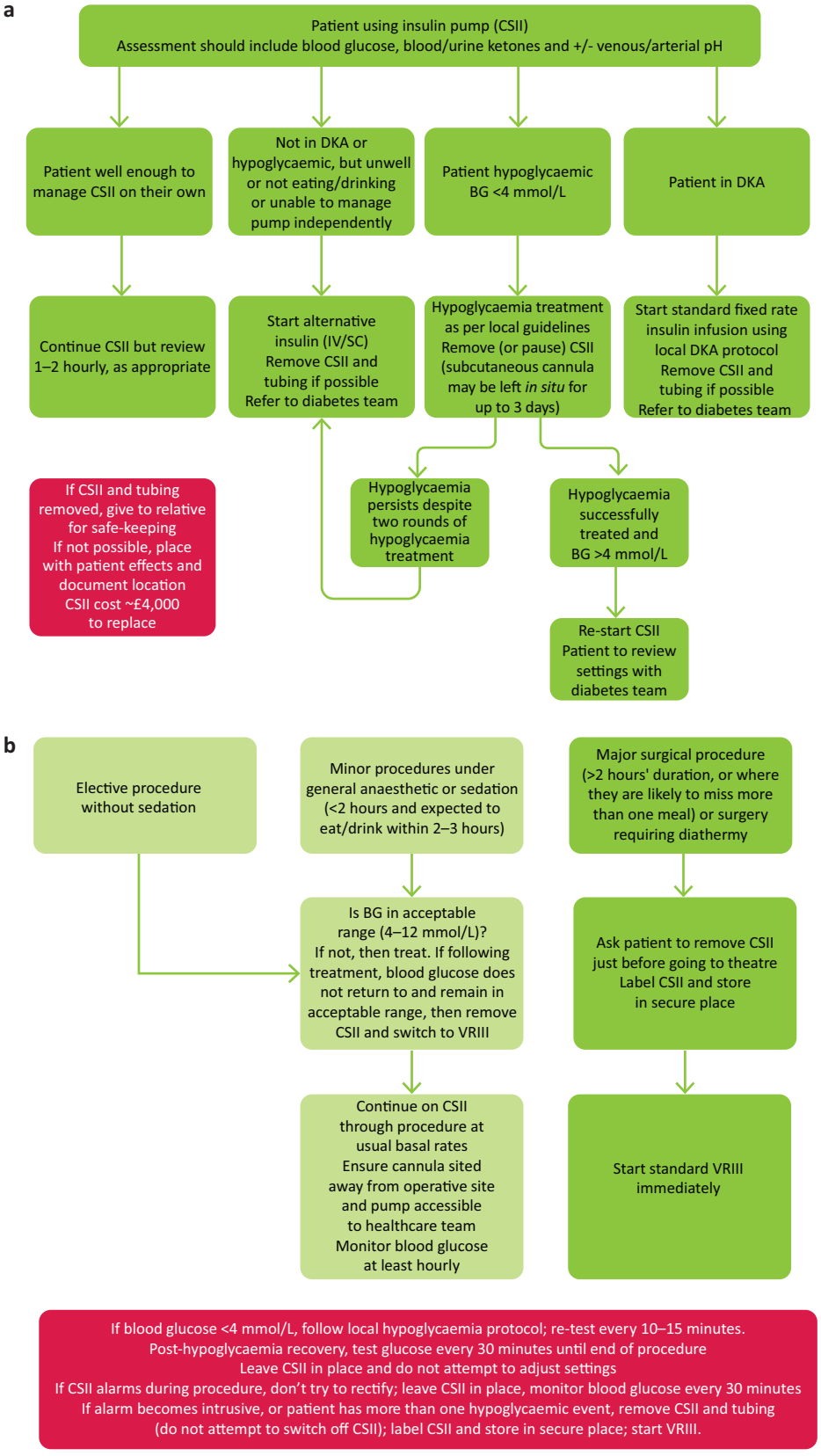

Fig 2. Guidelines for managing CSII therapy in hospitalised patients. Adapted with permission from Diabetes Technology Network UK. *Clinical guideline: Guidelines for managing continuous subcutaneous insulin infusion (CSII, or 'insulin pump') therapy in hospitalised patients*. Association of British Clinical Diabetologists, 2017. a) Emergency admissions and continuous subcutaneous insulin infusion management. An algorithm for insulin pump and diabetes management in patients admitted using insulin pumps. b) Continuous subcutaneous insulin infusion management for elective surgical procedures under sedation or anaesthesia. BG = blood glucose; CSII = continuous subcutaneous insulin infusion; DKA = diabetic ketoacidosis; IV = intravenous; SC = subcutaneous; VRIII = variable rate intravenous insulin infusion.

Main concerns – risk of rapidly evolving ketosis with interruption of insulin delivery

As pumps deliver rapid-acting insulin, if there is any interruption from the pump and no long-acting insulin cover or insulin infusion is administered in replacement, diabetic ketoacidosis (DKA) can ensue very quickly, even within a few hours. Therefore, patients with ketosis on an insulin pump may not necessarily have very high glucose levels typically associated with DKA. As for any patient unwell with type 1 diabetes, ketone measurements while unwell are important. Patients on insulin pumps are educated on self-monitoring blood glucose regularly and to check for ketones if they are unwell or if glucose levels are elevated. They are provided plans for ketone management to treat mild to moderate elevations in ketones (Fig 2b).

Diabetic ketoacidosis management

If a patient on an insulin pump presents with DKA, it is important to consider any cause which may interrupt the insulin infusion alongside standard causes for DKA. These can include cannula dislodgement, cannula kinking, cannula site infections, tube breakage, the reservoir running out of insulin, running out of pump tubing or reservoir supplies, pump battery depletion and, rarely, technical failures on insulin pumps. Therefore, it is important that alongside the standard history, clinicians should confirm when patients last performed a 'set change' (a change of their cannula, tubing and reservoir) and if there have been any recent issues with the pump. Fig 3 shows such an example of a DKA resulting from a subtle kinking or bending of cannula tip.

Patients with pumps presenting with DKA need to be treated as with anyone else in DKA; started on fixed rate intravenous insulin with concurrent intravenous fluids conforming to local trust policy. If there are no concerns with the pump and an obvious cause of DKA is present such as infection, many people can continue their basal rates alongside DKA protocols. This is akin to continuing someone's basal Lantus, for example. If there are concerns regarding pump failure however, then the safest thing to do is to disconnect the pump when treating DKA.

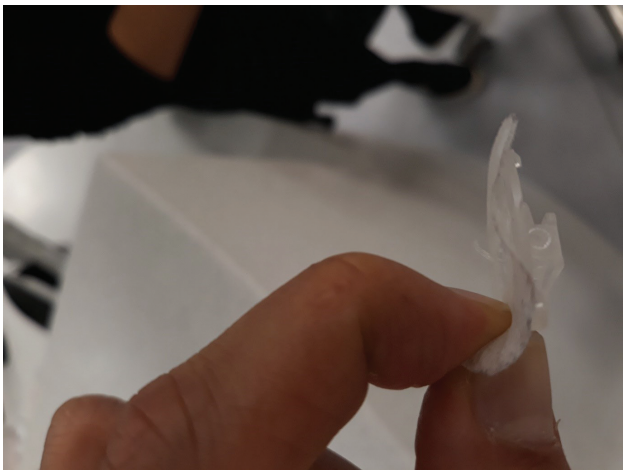

Fig 3. Cannula retrieved from a person with type 1 diabetes presenting in diabetic ketoacidosis (DKA) after performing a 'set change' before bedtime and developing DKA early hours in the morning.

Sick day rules should then be re-iterated following admission with DKA to hospital. An example of sick day rules and ketone treatment plan can be found on page 22 of the Association of British Clinical Diabetologists Diabetes Technology Network UK best practice guide for CSII.[15]

Hypoglycaemia on pump therapy

Hypoglycaemia should be treated exactly the same in a person with an insulin pump and if the patient is unwell, it may be safer to initiate VRIII.[17] Just as long-acting basal insulin should never be omitted, the basal rate should continue to run. If this recurs on VRIII, the basal rate may need to be reduced. This can be done either by the patient themselves or by the inpatient diabetes team.

The basal rate on pumps can be temporarily suspended and pumps can also be disconnected if an interruption in basal insulin delivery is required. This is not recommended standard practice for hypoglycaemia treatment due to concerns of rebound hyperglycaemia or ketosis in the event of basal insulin not recommencing. However, it can be considered in the setting of severe unresponsive hypoglycaemia or if there are any concerns regarding insulin overdose.

Procedures with pump therapy

In certain cases, such as for prolonged procedures requiring sedation or diathermy, patients may need to switch to VRIII and have their pumps disconnected (Fig 2b). As device safety has not been tested when near high frequency electromagnetic currents such as diathermy, current manufacturing advice advocates removal of insulin pumps for interventions requiring diathermy. Some centres may support CSII use in theatre for some forms of diathermy and therefore local policies should be checked.

Switching from pump therapy to subcutaneous MDI

In certain situations, patients need to switch to subcutaneous MDI (eg running out of consumables out of hours or a fault with insulin pump device). Pumps will often display the total daily dose for basal insulin being delivered per day. This can be simply switched to twice daily basal Levemir. However, as the pump only delivers rapid-acting insulin, we recommend disconnecting the pump 1–2 hours after the dose of subcutaneous basal insulin has been given. The mealtime bolus insulin doses should be given at the usual doses via subcutaneous injections.

An example of determining the basal insulin dose:

- Assume a patient has basal rates of 0.4 units per hour from 00:00–04:00, 0.85 units per hour from 04:00–08:00, 0.7 units per hour from 08:00–17:00, 0.8 units per hour from 17:00–22:00 and 0.55 units per hour from 22:00 to 24:00. The total daily dose (TDD) for basal insulin = $(0.4\times4) + (0.85\times4) + (0.7\times9) + (0.8\times5) + (0.55\times2) = 16.4$ units.

If coming off the pump, a reasonable switch would be to give eight units of Levemir twice daily initially. Practically, this would involve giving eight units as close to the next due dose as possible then disconnecting the pump for 1–2 hours after.

In the case that the TDD for basal insulin is not available, a weight-based approach, using 0.5 units/kg could establish a reasonable TDD dose for insulin.[15] This includes the dose for both basal and bolus insulin. Therefore, basal dose would be approximately half of this calculated dose.

An example of determining the basal insulin dose for a 70 kg patient:

- TDD = 0.5×70 = 35 units. TDD for basal insulin = 35 units ÷ 2 = 17.5 units.

A reasonable switch would be to initially give nine units of Levemir twice daily.

Similarly, when patients with insulin pumps need to be switched to VRIII, the pump should be disconnected again 1–2 hours after the infusion has been started to allow for differences in absorption between intravenous and subcutaneous preparations of insulin.

Due to improved absorption of insulin via pumps, the actual required long-acting insulin dose is likely to be 10–20% more than the dose calculated above. However, as the insulin rate cannot be varied, and to avoid risk of hypoglycaemia, the calculations strategy above can be used initially.

Switching from subcutaneous MDI or VRIII to pump therapy

When re-initiation of pump therapy is due from VRIII, the patient should be encouraged to reconnect their pump independently. However, again allow for a 1–2 hour overlap period before stopping the VRIII.

If a patient was on subcutaneous MDI and has been given their basal insulin injection, they can be advised to restart their pump 1–2 hours before their next dose of basal insulin is due to avoid stacking of insulin.

Soft tissue infections

Rarely, patients may develop soft tissue infections at the site of cannula insertion.[11] These need management for soft tissue infections as per local antibiotic policy and removal of the cannula causing the infection. Like any foreign body, the cannula must be removed if it is still *in situ* at the site of infection. An alternative site for cannula insertion must be used until the infection resolves, if it is acceptable for the patient to continue management on pump therapy. Dermatitis to adhesive and Teflon allergy are other concerns which cause skin irritation but do not typically present in emergency sitting.

Radiological investigations

Current manufacturer guidance is based on lack of safety evidence rather than risk of harm and advises that pumps must be suspended and removed prior to any radiological investigations involving radiation (eg magnetic resonance imaging, computed tomography (CT) and X-ray). Steel cannulas are also advised to be removed. However, a number of centres support insulin pump use and steel cannula for non-magnetic imaging such as X-ray and CT. Therefore, local practices should be checked. If removed, they can be removed prior to entering the scanning rooms and must be restarted immediately after the investigation is complete. Given that the anticipated length of suspension is likely to be small (less than 30 minutes) in most cases the impact on blood glucose levels is likely to be minimal and correction doses can be taken if needed.

Continuous glucose monitoring

Advances in technology now allow people with diabetes to monitor their glucose more conveniently using CGM or flash glucose monitoring sensors. Majority of these are inserted subcutaneously for a period of 6 to 14 days and monitor interstitial glucose. An added benefit to CGM is that a directional trend is shown alongside the glucose value (Fig 4) which can alert users to rates of change and allow them to act accordingly. CGM can be subcategorised into flash glucose monitoring and real time monitoring. Both options have recently been approved for use with insulin treated diabetes and driving by the Driver & Vehicle Licensing Agency (DVLA).[18]

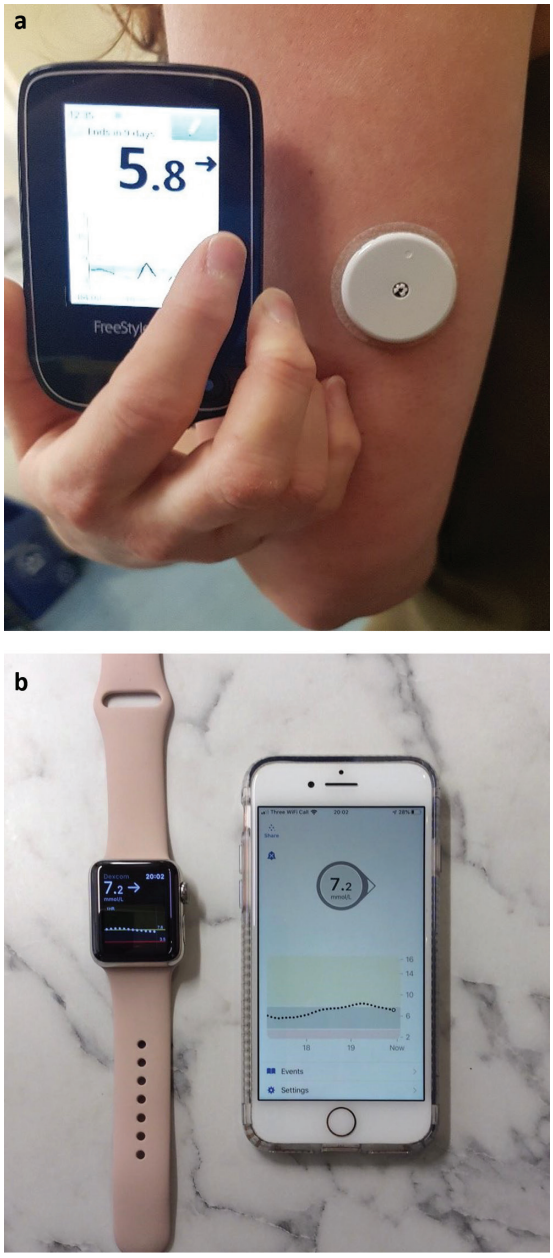

Fig 4. a) A flash glucose monitoring device worn on the arm. This demonstrates a glucose value of 5.8 mmol/L but the arrow suggests the glucose is stable and unlikely to change significantly in the next hour. b) A real-time continuous glucose monitoring output which is displaying glucose data, trend arrow and retrospective graph on a smartphone and linked smartwatch. Data are constantly updated every 5 minutes in real time.

Flash glucose monitoring

What is flash glucose monitoring?

Flash glucose monitoring uses a subcutaneous sensor to measure interstitial fluid glucose levels continuously. Glucose readings are taken only when this sensor is scanned with a reader or phone (Fig 4a). Unlike real-time glucose sensors, they do not offer alarms, alerts or continuous real-time output of the glucose data. Because it measures interstitial fluid glucose instead of capillary blood glucose there is a slight lag between the flash monitor level and standard capillary finger-prick glucose when glucose levels are rapidly changing.[19] Each waterproof sensor can remain inserted and active for up to 2 weeks.

Why is it used?

Flash glucose monitoring offers a more convenient way of self-monitoring glucose levels and therefore improve self-management with additional benefits of trend arrows and retrospective continuous glucose data reviews that help with therapy adjustments (Fig 4a). Recent evidence demonstrates glycaemic benefits alongside improvement in treatment satisfaction.[20]

In 2019, NHS England (NHSE) released its criteria for approving funding for the use of flash glucose monitoring: FreeStyle Libre.[21] Uptake of flash glucose monitoring in adults with type 1 diabetes via prescription in England has steadily increased and is anticipated to reach 20–25% for this cohort of patients.[21] The recent NHSE criteria offers flash glucose monitoring for subgroups that are predicted to cover 20% of those with type 1 diabetes. It also offers this monitoring option to those with cystic fibrosis related diabetes and any form of diabetes on haemodialysis requiring intensive monitoring more than eight times per day. Due to its lower running costs when compared with real-time glucose sensors, patients with both type 1 and type 2 diabetes have been self-funding flash glucose monitoring systems.

Although devices are currently only centrally funded for 20% of people with type 1 diabetes and a small subgroup of intensively managed people with type 2 diabetes on haemodialysis, the metabolic and psychological benefits is prompting calls for this to be reviewed for all people with diabetes requiring intensive insulin therapy.[22]

Managing flash glucose monitoring in the acute setting

Flash glucose monitoring has been shown to provide a reliable means of glucose tracking in critically ill patients.[23] People admitted into hospital who are already using flash glucose monitoring should be encouraged to self-manage their devices. Standard finger-prick checking should still be utilised as per usual inpatient protocols, in particular in case of symptomatic hypoglycaemia, even when flash glucose readings are normal. Unless health professionals are confident about the interpretation and reliability of glucose readings, any titration of insulin or hypo treatment should only be performed against the finger-prick measurements.[19] Local inpatient diabetes teams should be involved for troubleshooting devices or help with interpretation of data.

Real-time continuous glucose monitoring

What is real-time continuous glucose monitoring?

Most real-time continuous glucose monitoring (RT-CGM) use a subcutaneous sensor to measure frequent glucose readings (eg every 5 minutes) and continuously displays this data in real time (Fig 4b), without the need to scan for readings. In addition to this, it also allows customisable high and low thresholds and predictive alarms and alerts.[24] Some can also remotely send alerts to other individuals (eg family or carers) and also share data via smartphone, data and cloud-based technology to carers or health professionals for remote reviews.

Why are they used?

RT-CGM offers several advantages in addition to those for flash glucose monitoring. The alarms and alerts along with improved accuracy, especially at lower glucose levels, make them very useful in settings where hypoglycaemia avoidance is needed (eg patients with reduced awareness of hypoglycaemia or extreme fear of hypoglycaemia).[25] There is strong evidence that RT-CGM can improve glycaemic control, quality of life and diabetes distress.[25,26] Patient narratives also highlight a number of other benefits.[27]

Currently, NICE recommends RT-CGM in people with type 1 diabetes in the following situations despite optimised insulin therapy and conventional blood glucose monitoring:[28]

- more than one episode a year of severe hypoglycaemia with no obviously preventable precipitating cause
- complete loss of awareness of hypoglycaemia
- frequent (more than two episodes a week) asymptomatic hypoglycaemia that is causing problems with daily activities
- extreme fear of hypoglycaemia
- hyperglycaemia (HbA1c level of 75 mmol/mol (9%) or higher) that persists despite testing at least 10 times a day (see NICE guideline NG17 recommendations 1.6.11 and 1.6.12); continue RT-CGM only if HbA1c can be sustained at or below 53 mmol/mol (7%) and/or there has been a fall in HbA1c of 27 mmol/mol (2.5%) or more.

These criteria are mainly relevant in the setting of severe hypoglycaemia or reduced awareness of hypoglycaemia in type 1 diabetes rather than improvements in glycaemic control, quality of life or diabetes distress.[28] A recent consensus statement from Diabetes UK suggests consideration of CGM options for high HbA1c as well.[26] An update for NICE guidance is awaited to re-assess indications for CGM use in type 1 diabetes following the increasing evidence of benefits from these technologies. Although there are no national figures on uptake for RT-CGM, even with the current restricted criteria, there is considerable variation in access in England with the majority of clinical commissioning groups (CCGs) having to use labour-intensive Individual Funding Requests to gain access to RT-CGM.[29]

Managing CGM in the acute setting

Users of CGM admitted to hospital should be encouraged to self-manage their devices. However, healthcare professionals should be aware of the indications for CGM and be vigilant to the risk of hypoglycaemia in this cohort. As with flash glucose monitoring, finger-prick testing should still possess a role in inpatient glucose monitoring. Inpatient diabetes teams should be contacted for troubleshooting issues and if ever there is uncertainty or doubt, a complete return to standard finger-prick monitoring is advised.

Soft tissue infections

As for insulin pumps, patients may rarely develop soft tissue infections at the site of the sensor insertion. The management is

the same as discussed in the insulin pump section earlier. Similarly, dermatitis to adhesives and localised inflammation may occur as well but do not typically present to the acute setting.

Radiological investigations and diathermy treatment

As for insulin pumps, manufacturers advise removal of sensor and transmitter prior to any radiological investigation or diathermy treatment as safety assessments and impact on performance have not been performed. However, a number of centres support the use of sensors for non-magnetic imaging (X-ray and CT) and may allow use with certain types of diathermy depending on proximity to sensor insertion site. Local practices should be checked as removal of sensors in the acute setting can be a very difficult situation for most people with diabetes who may not have a back-up sensor with them.

Implantable sensors

A very small cohort of people are using a certain type of RT-CGM that is implantable and can be worn up to 180 days.[30] Uptake of this form of RT-CGM is relatively low at present and it is used in a very small number of centres. General management and situations are similar to above, except the potential for infection is higher and its removal requires trained healthcare professionals to retrieve the sensor device.[31]

Sensor augmented pump therapy

Advances in continuous glucose monitoring and insulin pumps have allowed integration and connectivity of both devices. In recent years, algorithms for subcutaneous insulin dosing have been developed that can respond to changes in glucose in an automated fashion. Initial versions of systems have offered predicted low glucose suspend features which can suspend basal insulin delivery at or before reaching low glucose levels to reduce the frequency of or time spent in hypoglycaemia.

Closed-loop systems – the future

Future generations of systems are now allowing automated insulin delivery via closed loop hybrid or artificial pancreas systems. These systems can deliver variable automated insulin doses in response to changes in interstitial glucose and depending on other entered or pre-set variables. Dosing is guided by algorithms that are set to maintain glucose values within the desired target. First-generation of such systems are available commercially. Further systems are in clinical trials and it is anticipated that additional systems will be available soon. These systems offer the potential to allow improved glycaemic outcomes with reduced hypoglycaemia.[32] Recently, two artificial pancreas system systems have been licensed (CamDiab, Cambridge, UK) to allow automated insulin dosing in type 1 and type 2 diabetes inpatients. Outcomes have been very impressive and further implementation studies are awaited.[33] However, healthcare professional and patient training for these systems is critical and they are dependent on access to insulin pumps and RT-CGM.

Frustrated by the slow pace of development of artificial pancreas systems, a community of people, including those with diabetes and caregivers, united online using the hashtag '#WeAreNotWaiting' to promote the development of open source diabetes management systems, known as DIY APS (do-it-yourself artificial pancreas systems). Their use has expanded considerably over the last 5 years with largely self-reported outcomes demonstrating impressive glycaemic outcomes and reduced mental burden.[34,35] Consensus from various group statements advocates supporting individuals choosing to use these unlicensed and unregulated DIY APS.[35]

Automated diabetes management systems driven by pumps, continuous glucose sensors and algorithms are also emerging for inpatient diabetes management demonstrating improved glycaemia.[36] The cost, the need for healthcare professional training for setup and the implementation of these in wider hospital settings remain challenges for their widespread use.

Summary

Technology has already had a large impact on the management of diabetes and ongoing developments, such as closed-loop systems and automated inpatient diabetes management systems promise an exciting future. Technology has led to improvements in outcomes such as HbA1c, hypoglycaemia events and quality of life while importantly empowering people to self-manage their diabetes. Further work is needed to improve access and reduce the geographical variation in their use. Technology can be perceived as a more expensive treatment option which has been one of the main barriers to widespread adoption. Nevertheless, funding decisions need to take into account the high costs from complications, which currently account for majority of the £14 billion pounds spent towards diabetes and invest in proven treatment options to reduce this. With diabetes technologies forming a key part of *The NHS Long Term Plan* and increasing use of diabetes devices in children and younger people who are approaching transition to adulthood, we are likely to see an ongoing increase in the implementation and access to diabetes technologies.[37] With increased uptake and common use, awareness of general physicians to their role in diabetes management and approaching common acute situations discussed in this article are important. A key message when managing users of diabetes technology in the acute setting is that close liaison with diabetes inpatient teams is key and users should be encouraged to continue to self-manage unless there are glycaemic concerns, significant uncertainty or where people are unable to self-manage. In this setting, inpatient protocols with attention to aspects discussed in this article should be considered with prompt resumption of patient driven self-management once the situation has improved. ■

Conflicts of interest

Sufyan Hussain has performed non-promotional educational speaker and advisory activities for Medtronic, Roche, Dexcom, Abbott and Novo Nordisk.

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