

Digital Health and Care Institutes Scottish Diabetes Policy and Market Report

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July 2019

Part of

'In Partnership with NHS Lanarkshire'



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Acknowledgements

The DHI would like to thank NHS Lanarkshire staff for their input during the research and development of this report.

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Release Date

First release October 14th, 2018

Published

June 2019



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The Purpose of this report is to lay out the current state of diabetes policy in Scotland and analyse the current and emerging digital health technology market for diabetes care. This report has been produced by the Digital Health and Care Institute. DHI is a collaboration between the Glasgow School of Art and the University of Strathclyde. This report is for informative purposes only and in no way sets out to make recommendations for further development of diabetes care provision in NHS Lanarkshire.

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1. Introduction

In Scotland, the number of people with diabetes has steadily grown over the last 15 years. According to the Scottish Diabetes Survey the number of people with diabetes has risen from 103,835 in 2002 to approximately 298,504 people at the end of 2017, accounting for roughly 5.5% of the national population. Lanarkshire has seen a significant increase in the number of people with diabetes, the figure rising from 16,358 in 2002 to 38,671 in 2017, accounting for around 5.9% of Lanarkshire's overall population. Within this diabetic population 88.2% have type 2 diabetes and 10.5% have type 1 diabetes [1].

It is important to note that these numbers only represent those who are registered as having diabetes, in 2015 it was estimated that a further 45,500 people in Scotland could be living with type 2 diabetes unaware of their condition in Scotland [2]. Simultaneously, approximately 500,000 people have an elevated risk of developing diabetes. This number also increases annually. Projections estimate that by 2035 over 480,000 people will be living with diabetes in Scotland, an increase of 60.8% from 2016.

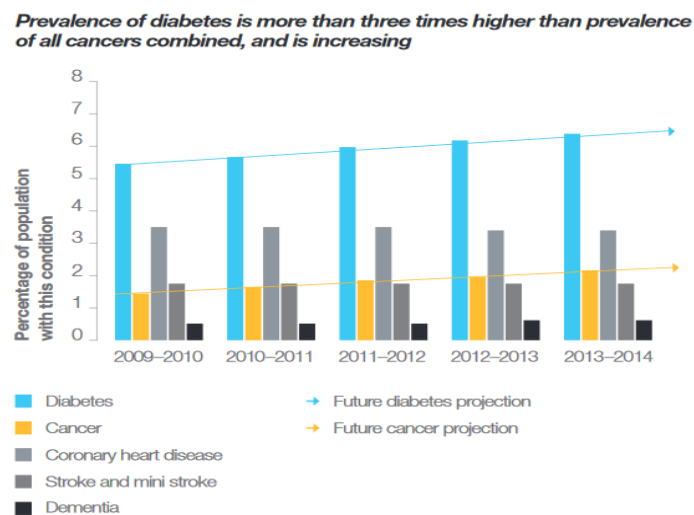


Figure 1. Graph showing the trends of diabetes prevalence. [2]

In 2012, 10% of Scotland's NHS budget was being spent on diabetes, approximately £1 billion - 80% of which was being spent on treating avoidable complications. In 2007 the collective personal costs of diabetes for individual patients in Scotland was estimated to be approximately £50 million a year. This costing was based upon the combination of missed work hours, travel costs, loss of employment and early retirement due to poor health [3,4]. In 2015, diabetes was costing social services £23 million a year, as 1 in 20 diabetics required some form of assistance [5]. As mentioned above, the prevalence of diabetes in Scotland is growing and as of 2012 (see figure 1) the incidence of diabetes in Scotland overtook that of coronary heart disease. If this pattern continues, the costs, both economic and social, may become too great of a burden to bear.

2. Scotland's diabetes policy journey

The following section documents the current state of diabetes policy in Scotland and how it arrived at that point. Additionally, the report analyses the current and emerging digital health and health technology market for diabetes care.

2.1 The Framework

The last 18 years of Scottish diabetes policy can be clearly traced from the 'Scottish Diabetes Framework' published in 2002, through the 2014 'Diabetes Improvement Plan' to the most recent 2018 'A Healthier Future' framework [6,7,8]. The effects of these documents and those that have come in between can be seen in both diabetes specific government publications, and the overall strategies and policies for how healthcare is intended to be delivered in Scotland. The diabetes framework was developed in response to commitments made in 'Our National Health: A plan for action, a plan for change' bringing together the then existing guidance and best practice, with the goal of setting out the first steps for the following 10 years of diabetes care in Scotland. The framework established 22 building blocks, seven of which were identified as first stage priorities and integral to providing the highest quality of diabetes care (these can be seen in figure 2 below). To support and monitor the actual implementation of the framework, the Scottish Diabetes Group was established to act as a national steering group.

The framework specifically identified milestones on the path to developing a patient centred diabetes service and mapped out the key actions to be taken to ensure that these milestones were reached (see Table 1).

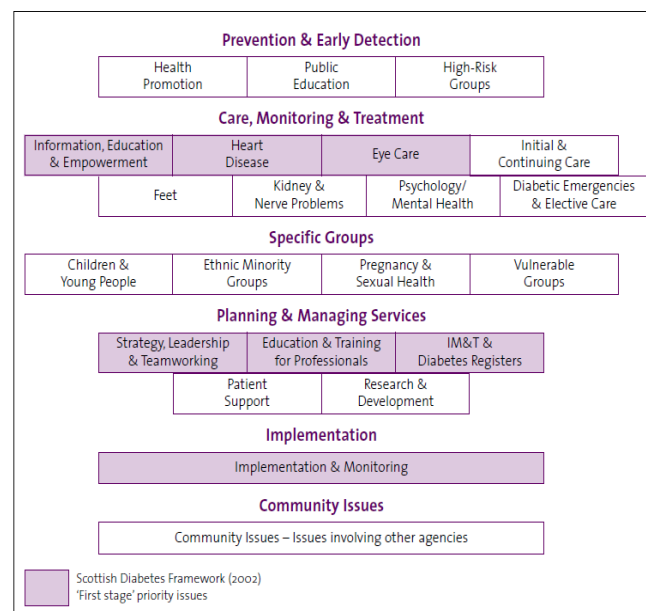


Figure 2: the building blocks of diabetes care in 2002 [6]

Table 1. Milestones and actions adapted from the 2002 Scottish diabetes framework
[6]

Priority area	Milestones and Actions
Public Education	<ul style="list-style-type: none"> - All NHS boards will collaborate with other appropriate agents/agencies to organise a minimum of one event to raise public awareness surrounding diabetes during 2002/3
Patient Information, Education and Empowerment	<ul style="list-style-type: none"> - Partners in change will publish a report of its work with people with diabetes by June 2002 - A report on patient education programmes in diabetes will be produced by December 2002 - The Scottish Diabetes Group will work with NHS24 ensuring relevant and up to date information on diabetes care and services is available via NHS24 - The Scottish diabetes group will create a programme of work to ensure high quality diabetes information is available to patients and carers by September 2002 - A project to encourage and support patient involvement in the work of Managed Clinical Networks (MCNs) and local diabetes service advisory groups (LDSAGs) will be funded in 2002. - A guide to encourage activity in these LDSAGs will be published by June 2002. - A national meeting for lay members and potential lay members of LDSAGs will be held in 2002.
Heart Disease	<ul style="list-style-type: none"> - Good practice models for screening for cardiovascular risk factors in diabetic patients will be defined and disseminated by December 2002
Eye Care	<ul style="list-style-type: none"> - All diabetics will have their eye status recorded in the local diabetes clinical management system by September 2003 - The Scottish Diabetes Group will create plans to take forward the implementation of the report of the Health Technology Board for Scotland on the organisation of services for diabetic retinopathy screening by September 2002. - A national coordinator will be appointed to support the implementation of the recommendations of the Board on the organisation of services for diabetic retinopathy screening by September 2002.
Initial and Continuing Care	<ul style="list-style-type: none"> - Annual measurement of glycated haemoglobin (HbA1c) will be offered to all people with diabetes by September 2002. Results will be recorded by local diabetes clinical management system.
Children and Young People	<ul style="list-style-type: none"> - An educational video for children with diabetes and their families will be funded, produced and made available by autumn 2002, all new families will be offered a video or DVD.
Ethnic Minority Groups	<ul style="list-style-type: none"> - By September 2003, the Scottish diabetes group will publish a report in conjunction with the Ethnic Minority Resource Centre of the Public Health Institute for Scotland, on the epidemiology of diabetes amongst Scotland's ethnic minorities

Strategy, Leadership and Teamworking	<ul style="list-style-type: none"> - Clinical leaders should be identified at locality level to champion local integrated diabetes services in all NHS boards by June 2002. - A dedicated diabetes coordinator to improve communications within the local diabetes community and provide admin support to enhance integrated care across primary and secondary care should be identified in all NHS boards by December 2002. They should be responsible to the LDSAG for strategy and implementation of policy at locality level. - All NHS boards should establish an effective multi-professional LDSAG with service user involvement by June 2002. - All NHS boards should publish an Annual Diabetes Report. A report for 2002/3 should be published by each LDSAG by June 2003. Boards should also publish a local diabetes strategy and implementation plan by April 2003 - A Workforce survey of diabetes services in hospitals and the community will be commissioned by January 2003 - A diabetes collaborative Improvement Programme will be established by March 2002 to support the sharing of experience and best practice throughout Scotland to improve care and outcomes for people with diabetes. - MCNs for diabetes will be established in all NHS boards by September 2004.
Education and Training for professionals	<ul style="list-style-type: none"> - A short-life group will be established by the Scottish Diabetes Group to assess the availability and quality of existing diabetes education and training to ascertain the training needs of staff, especially in primary care, and make recommendations for meeting these needs. A report will be published by December 2002.
IM&T and Diabetes Registers	<ul style="list-style-type: none"> - All hospital-based diabetes clinics will be supported by an effective IT system by December 2002. - A national IT system to support all aspects of diabetes care will be fully implemented throughout Scotland by December 2005. - All NHS boards should submit data for the 2002 Scottish Diabetes Survey in September 2002 - A conference for those involved in developing and maintaining local diabetes registers will be held by Summer 2002 to update progress, and foster collaboration between all Scottish regions in the £1.5 million Scottish Care Information-Diabetes Cloud (SCI-DC) programme.
Implementation & Monitoring Scottish Diabetes Group	<ul style="list-style-type: none"> - The CSBS will publish an assessment of the standards of care provided by diabetes services in 2003 - A website to improve collation and dissemination of information about diabetes in Scotland - www.show.scot.nhs.uk/diabetes – will be established by the Scottish Diabetes Group by September 2002. - A conference to promote best practice in diabetes care (including service delivery and design, clinical IM&T, research and development, LDSAGs/managed clinical networks, and eye screening) will be hosted in Scotland in November 2002. - The Scottish Diabetes Group will review and revise the Scottish Diabetes Framework by Spring 2004.

The implementation of the Diabetes Framework was reviewed in 2004 evidencing the successes of the framework and determining that the key priorities identified should be retained in future. Notably, the review highlighted that while the changes made from the framework were essential for the long-term improvement of diabetes services, they had been invisible to patients, and going forward there needed to be a more concentrated effort to create benefits that directly affected the patients in a manner that they could personally observe and provide feedback.

2.2 Action and Improvement plans

As stated before, the 'Scottish Diabetes Framework' laid the foundations for all diabetes policies, strategies, frameworks and plans that have followed since. The first major publication to follow was the 2006 'Scottish Diabetes Framework Action Plan'^[9]. This document built on the successes of the 'Scottish Diabetes Framework' to address issues surrounding diabetes care where significant developments could be made^[9]. The 2006 action plan began to discuss service redesign for diabetes care, creating a system that would facilitate self-management and deliver services closer to home for the patient. In developing the plan, the Scottish Executive performed a consultation which determined that a greater focus on type 1 Diabetes was required, specifically for children and young people where early life interventions could prevent or reduce complications further down the line. The 2006 action plan focussed on 9 issues that needed to be addressed over the following 3 years, referred to as *9 by 9*, these issues were^[9]:

1. Improve the quality of care and outcomes for all people with diabetes and reduce inequalities.
2. Ensure that all people with diabetes have access to effective retinopathy screening.
3. Enhance patient self-care and self-management by ensuring that all people with diabetes in Scotland have access to appropriate information and education.
4. Strengthen and develop Diabetes Managed Clinical Networks (MCNs) to improve the effectiveness and efficiency of services for people with diabetes.
5. Improvement in the quality of patient data to improve clinical management and service planning.
6. Develop and support staff enhance their knowledge and skills in caring for people with diabetes.
7. Increase diabetes research in Scotland.
8. Support initiatives to promote healthier lifestyles for people with diabetes and for the population.
9. Improve the communication and dissemination of information about diabetes in Scotland.

The 2010 action plan acted as a continuation of the 2006 plan whilst also reflecting on the principles set out in NHS Scotland's 'Quality Strategy'^[10, 11]. The directive of which focussed on ensuring a person-centred, safe, effective, efficient, equitable, and timely approach to diabetes care. The 2010 action plan set out specific actions to be taken to achieve these aims. These being^[11]:

- **Self-management:**
 - The Scottish Diabetes Group (SDG), with the diabetes MCNs, and working with local patient representatives and relevant voluntary sector organisations, will seek to identify and promote appropriate self-management tools for diabetes.
 - SDG, through its Diabetes Care Focus Group, will monitor and review provision of information for people living with diabetes, including local and national annual overviews.
 - SDG, with NHS Health Scotland and other agencies, will improve the information available, for example on cardiovascular disease, on www.mydiabetesmyway.scot.nhs.uk, and increase use of the website by people with diabetes.

- **Maintaining vascular health:**
 - The SDG will support initiatives to improve vascular health, including continuing to monitor cardiovascular risk factors and the prevalence of cardiovascular disease in the annual Scottish Diabetes Survey and sharing this with all stakeholders.
 - The SDG will support implementation of SIGN 116 by supporting SCI-DC initiatives to integrate information on vascular risk.

- **Foot care:**
 - A series of initiatives will be undertaken to promote prevention of foot problems including:
 - Within the previous 15 months, in line with the NHS Quality Improvement Scotland (QIS) clinical standards, 80% of people with diabetes should have an allocated foot risk score which should be electronically communicated to all healthcare professionals involved in the care of the patient. This score should be communicated effectively and clearly to patients.
 - All patients at low risk should have access to education for self-management of foot care. This should be supported by the national foot care leaflets which will be available online for healthcare staff in a variety of languages.
 - The national foot care leaflets should be evaluated through patient feedback.
 - IT links are required to allow transfer of foot related information (and other information) between the national diabetes database and the main four GP systems with reference to the transfer of foot screening information.
 - Through the SDG resources that have been allocated, each NHS Board will designate an existing individual whose responsibility will be to:
 - educate and support podiatrists and other relevant healthcare professionals delivering diabetes care in the community and to organise up-skilling and maintenance of competencies and practical skills;
 - ensure access to the national foot care leaflets, patient education programmes, including electronic learning opportunities, to support people with diabetes in managing their foot care.

- **Eye care:**
 - SDG will continue to support the development of the Diabetic Retinopathy Study (DRS) collaborative and encourage links between DRS and all other stakeholders in the diabetes community.
 - NHS Boards will consider the benefits of adopting the approach taken by the community optometry DRS pilots in NHS Highland and NHS Borders.

- **Renal care:**
 - A series of initiatives will be undertaken to promote optimal kidney function:
 - Identify and provide information on the prevention and progression of diabetes complications for people with diabetes and renal disease/chronic kidney disease.
 - The annual Scottish Diabetes Survey will report on estimated glomerular filtration rate eGFR rates through better data linkage. Target 80% by 2011.
 - There should be clear pathways for referral between diabetes services and the local nephrology service.
 - As part of its patient access programme, SCI-DC will work with the Renal Patient View to promote self-management and ensure people with diabetes understand the significance of results.

- **Diabetes and pregnancy:**
 - NHS Boards, through their Diabetes MCNs, will ensure:
 - awareness raising sessions on diabetic pregnancy are promoted in both primary and secondary care for healthcare professionals to improve pre-pregnancy and ante-natal diabetes care and glycaemic control in women with diabetes
 - collaboration between multidisciplinary pregnancy care teams and the local Diabetic Retinopathy Screening so that systems are in place for appropriate retinal screening during pregnancy
 - programmes are in place to detect and treat gestational diabetes during pregnancy.
 - Following delivery those with gestational diabetes mellitus should have:
 - lifestyle advice with the aim of reducing type 2 diabetes mellitus
 - regular screening with the aim of early detection of type 2 diabetes mellitus.
 - SDG, along with NHS Quality Improvement Scotland and other national organisations, will investigate the feasibility of repeating in 2012 the national pregnancy audit in light of SIGN Guideline 116.

- **Children, young people and families:**
 - Initiatives to improve self-management skills within families and communities include:
 - A new DVD for children with type 1 diabetes will be commissioned;
 - A symposium on diabetes in schools as part of a wider review of existing arrangements for diabetes in schools will be held by September 2010 following which a set of action points will be published.
 - Organisation of paediatric care will be reviewed at national and local levels, and:
 - A paediatrician will be appointed to the SDG.
 - Each NHS Board, through its diabetes MCN, will develop, publish and show evidence of implementation of a transitional care plan with

measurable outcomes identified and reported through SDG by June 2011.

- NHS QIS will commission an audit of glycaemic control in children and adolescents.

- **Insulin therapy:**

- The SDG will prioritise the recommendations from the type 1 diabetes SLWG report as part of developing services for those with type 1 diabetes.
- Local insulin strategies will be reviewed for people with type 1 and 2 diabetes
- People with diabetes who could benefit from intensive insulin therapy should have access to structured education programmes as documented in section 3.10. In particular:
 - Patients will receive carbohydrate counting instruction prior to initiation of intensive insulin regimens.
 - Mydiabetesmyway.scot.nhs.uk will include a section on intensive insulin therapy.
- The availability of insulin pump therapy for those who would benefit from it will be promoted by:
 - Including in the Scottish Diabetes Survey figures on pump usage;
 - Arranging further national pump awareness days;
 - The SDG commissioning waiting times criteria for insulin pump therapy in line with national criteria and make recommendations for a consistent approach across the country.
 - Scottish Government Health Directorates scoping the implications of putting pumps and associated consumables onto the National Drug Tariff.

- **Diabetes managed clinical networks:**

- The Diabetes Voices programme will be reviewed, updated and rolled out further.
- NHS Boards will maintain the effectiveness of the diabetes MCNs, in particular by ensuring proper engagement of the MCNs in Boards' planning of future patient-centred service developments.
- NHS QIS will work with diabetes MCNs on developing a quality improvement programme and on the continuous review of diabetes care.
- The MCN Lead Clinicians' group and MCN Managers' groups will continue to meet regularly to:
 - share expertise and best practice
 - advise SDG in strategy development
 - collaborate with other members of SDG, including Diabetes UK Scotland and the Diabetes Care Focus Group.
- NHS Boards will accredit their diabetes MCN where this has not already been done.

- **Remote care:**

- MCNs will explore telehealth opportunities and consider how Telehealthcare solutions can be embedded into the pathways of people with diabetes.
- MCNs will develop effective links with community pharmacy services. NHS boards through their diabetes MCN and Child Health Partnerships (CHPs), will ensure that people with diabetes and their carers get access to a range support at local level, including voluntary groups, peer support and events.

- **Use of technology:**

- Optimal sharing of clinical information will be promoted through the increased use of NHS Boards' diabetes databases during routine clinical care.
- Ensure that the electronic diabetes systems meet the needs of users and record and store clinical data in 70% of clinical encounters relating to foot ulcer, paediatric diabetes, dietetic and DSN reviews
- To maximise the use of the diabetes care system by patients to enhance self-management and improve patient/professional communication:
 - The Scottish Diabetes Group will support the development of a Patient Held
 - Record Project in partnership with Diabetes UK to start in 2010.
 - There will be an increase in the number of patients directly accessing their own data electronically.
- To ensure current existing diabetes system functionality is maintained within each NHS Board and integrated into existing and future systems:
 - further integration will be encouraged between NHS Boards' diabetes databases, non-diabetes registers and currently operating relevant systems such as primary care and emergency care summary.

Following the release and implementation of the 2010 Diabetes action plan, the Scottish government released the 'Diabetes Improvement Plan' in November 2014 ^[7]. In-between the publication of these two documents, considerable progress was made in improving the provision of care for diabetics in Scotland. In February 2012, the Scottish Government, guided by the National Institute for Health and Care Excellence (NICE) and the Scottish Intercollegiate Network (SIGN), issued a letter asking Health Boards to develop "local plans to increase the provision of insulin pumps so that 25% of people under 18 years with type 1 diabetes would be using pumps by March 2013." Individual Health Boards were also supplied with an adult target of 6.1% of ≥ 18 yrs ^[12].

Insulin pumps are portable devices attached to the body that continuously deliver amounts of rapid or short acting insulin via a catheter placed under the skin. They are seen by some as a better form of insulin delivery for the patient as they reduce the need for multiple injections and allow the user an increased ability to control their blood glucose levels.

As of September 2014, over 2,340 people in Scotland are using an insulin pump – over 5% of the total number of people over 18 with type 1, and more than 1 in 4 children and young people. By April 2015, 26.3% of Lanarkshire type 1 diabetics under the age of 18 and 5.8% of those over 18 were on insulin pumps ^[7, 12].

In the same window the number of patients with foot risk stratification increased from 25% in 2007 to 91% nationally in 2013, with regional variation being reduced significantly, and a national inpatient foot care initiative having been launched ^[7]. These are just two examples of how Scottish diabetes policy has impacted the provision of care to the patient population.

In addition to carrying on the work of previous diabetes policies, the 'Diabetes Improvement Plan' set out how diabetes care would carry out the vision of NHS Scotland's 'Quality Strategy'. This strategy being the "blueprint for improving the

quality of care that patients and carers receive from the NHS across Scotland. It sets out ambitions which acknowledge:

- Putting people at the heart of everything the Health Service does;
- A focus on providing the best possible care; and
- Recognition that real improvement in quality of care involves all staff, both clinical and non-clinical, working at all levels in all roles

While highlighting several key priority areas to improve the experience and clinical outcomes for patients living with diabetes in Scotland. These being ^[7]:

<p>Prevention and Early Detection of Diabetes and its Complications</p> <p>To establish and implement approaches to support the prevention and early detection of type 2 diabetes, the rapid diagnosis of type 1 and the implementation of measures to promptly detect and prevent the complications of diabetes</p>	<p>Type 1 Diabetes</p> <p>To improve the care and outcomes of all people living with type 1 diabetes</p>
<p>Person-Centred Care</p> <p>To ensure people with diabetes are enabled and empowered to safely and effectively self-manage their condition by accessing consistent, high quality education and by creating mutually agreed individualised care plans.</p>	<p>Equality of Access</p> <p>To reduce the impact of deprivation, ethnicity and disadvantage on diabetes care and outcomes.</p>
<p>Supporting & Developing Staff</p> <p>To ensure healthcare professionals caring for people living with diabetes have access to consistent, high quality diabetes education to equip them with the knowledge, skills and confidence to deliver safe and effective diabetes care</p>	<p>Inpatient Diabetes</p> <p>To improve the quality of care for people living with diabetes admitted to hospital by improving glucose management and reducing the risk of complications during admission.</p>
<p>Improving Information</p> <p>To ensure appropriate and accurate information is available in a suitable format and effectively and reliably used by all those involved in diabetes care.</p>	<p>Innovation</p> <p>To accelerate the development and diffusion of innovative solutions to improve treatment, care and quality of life of people living with diabetes.</p>

Figure 3. Image showing the priority areas of the Diabetes Improvement Plan ^[7].

Each of these priority areas was assigned specific actions to meet the goals of the 2014 Improvement plan. These actions are listed below:

- Priority 1: Prevention and Early Detection of Diabetes and its Complications
Around 80% of diabetes complications can be prevented or delayed through early detection, good care, and access to appropriate self-

management tools and resources to combat this the improvement plan suggests the actions:

- Enhance strategies to support people at risk of developing diabetes and early identification of those with diabetes
- Earlier identification of the diagnosis of diabetes and its complications

- Priority 2: Type 1 Diabetes
 - Improve the care of children and young people
 - Improve glycaemic control

- Priority 3: Person-Centred Care
 - Timely and appropriate access to high quality patient education and self-management support
 - Improve care planning
 - Empower and engage people living with diabetes
 - Improve the outcomes in pregnancy

- Priority 4: Equality of Access
 - Minimise the impact of deprivation, ethnicity and geography
 - Improve outcomes for individual requiring additional support

- Priority 5: Supporting and Developing Staff
 - Increase the level of consultation and patient engagement skills
 - Increase the level of educator skills and confidence in delivering diabetes education
 - Increase the level of psychological assessment skills

- Priority 6: Inpatient Diabetes
 - Improve glycaemic control of people admitted to hospital
 - Improve foot care outcomes
 - Improve the experience of people with diabetes admitted to hospital

- Priority 7: Improving Information
 - Improve access to appropriate and accurate information
 - Better reporting and use of data at both national and local levels
 - Improve patient access to their data to support self-management

- Priority 8: Innovation
 - Promote networking and mechanisms to support innovation
 - Increase the pace of adoption of proven innovations

Since 2014 there has been a marked improvement in the accessibility and uptake of structured education for diabetes (type 1 and 2) and a national 'know your numbers' campaign has been launched to help improve glycaemic control.

2.3 A Healthier Future

The most recent addition to the diabetes policy environment came in July 2018, when the Scottish Government released a follow up to their 'Diabetes Improvement plan' in the form of 'A Healthier Future – Framework for the Prevention, Early Detection and Early Intervention of type 2 diabetes' [8]. The framework was developed to address certain priority areas set out in the 2014 improvement plan and will be funded with £42 million over the next 5 years [8].

The priorities areas that the framework seeks to address include the prevention of diabetes (outlined as priority 1 in the 2014 improvement plan) and equality of access (priority 4) as type 2 diabetes prevalence is 40% higher amongst the most deprived areas in Scotland when compared to the least deprived [8]. The framework aims to reduce health inequalities and continue the work of the prevention agenda focusing on those at risk of, at high risk of, or newly diagnosed with type 2 diabetes.

Research has shown that an individual's weight is seen as most adjustable risk factor for type 2 diabetes. Currently 87% of those with type 2 diabetes in the age range of 18-54 are above their ideal weight [8]. Through the introduction of innovative weight management programmes NHS Scotland could potentially improve the overall health and wellbeing of diabetes patients, whilst simultaneously reduce the burden on the systems resources and finances. The 'Healthier Future Framework' sets out a person-centred, value-based care approach to weight management, emphasising the co-production of services and resources to ensure the best value for the end user. The framework is presented in a basic overview below (see figure 4).



Figure 4. Framework at a glance, a brief overview of what the framework aims to achieve [8].

The actions required to achieve these goals will be taken by the Scottish Government, the SDG, NHS Scotland and Integrated Joint Boards. The focus of the framework and the intention of its outlined actions are all intended to provide comprehensive weight management services for the prevention, early detection and early intervention of type 2 diabetes. The framework recommends a tiered approach to these programmes that addresses the individual's risk, these tiers can be seen in figure 5 below.



Figure 5. Proposed tiered approach to weight management programmes [8]

The framework identified structured education as being central to diabetes care and to self-management of long-term conditions in general, because of this each MCN responsible for diabetes care should ensure that patients have timely and appropriate access to high quality education programmes and self-management support.

Five early adopter sites were approached to carry out the first year of implementation. NHS Lothian, Fife, Borders, Ayrshire and Arran, and Tayside all began work to redesign and deliver services in line with the framework. These boards were supported by a Scottish Government appointed professional advisor and set up oversight groups, made up of specialist stakeholders, to oversee the long-term planning and delivery of each boards work. The actions of these groups were [8]:

1. Initial scoping of service delivery – understanding current delivery and identifying gaps.
2. Agreeing the local approach to co-production and redesigning of services and integration of weight management teams and diabetes specialists.
3. Decisions on the delivery of programmes under each level.
4. Use data and wider evidence to identify, local health inequalities and action required to reduce them, and how progress will be measured.
5. Funding decisions based on the central funding allocation.
6. Support in redesign, implementation and training to build capacity for health and social care professionals to support the type 2 diabetes weight management services.
7. Monitoring and evaluation of services with use of SCI diabetes and GP clusters.
8. Report on delivery and share best practice.

GP clusters will support the implementation of the framework, and the oversight group will use existing networks (MCNs, Child Health teams etc.) to ensure information is disseminated to raise awareness of the framework. Training will be made available to health and social care professionals to support them as services change and to properly initiate what can be a highly sensitive behavioural change conversation regarding weight management. The ‘Small Talk Big Difference’ programme is an example of this training and will be made available across the NHS following trials in the Autumn of 2018 ^[8].

Work is on-going to allow for the utilisation of SCI-Diabetes to integrate those in the at risk and high-risk categories. As well as linking those recorded onto SCI-Diabetes with MyDiabetesMyWay, in future SCI-Diabetes will be able to pull information from Acute, Maternity and Community TrakCare software. This will help identify who is being referred to weight management interventions, which type of intervention and the outcomes of said interventions ^[8].

The success of the changes proposed will be evaluated at the end of the first year. This will help inform future changes and improvements to the framework. To help with this evaluation boards will be responsible for recording progress against set indicators. These being ^[8]:

- Progress towards identification of those with undiagnosed diabetes
- Identification and recording of those with pre-diabetes, ‘impaired fasting

- hyperglycaemia' or 'impaired glucose tolerance'
- Identification and recording of those with gestational diabetes
- Referral rates to weight management services for specific groups – at risk, with pre – diabetes, with gestational diabetes and with recently diagnosed type 2 diabetes.
- Uptake rates
- Completion rates
- Dropout rates
- Weight loss monitoring
- Weight gain monitoring
- Sustained weight management
- Remission rates for those attending a level 3 targeted weight management intervention
- Progression rates of those with pre-diabetes states to type 2 diabetes
- Monitoring of complications for those with type 2 diabetes

In future, key outcome indicators will be monitored and assessed, to determine the frameworks achievements. These success criteria will be:

- A comprehensive provision of services across all boards in line with the framework
- Reduction in the estimates of people with undiagnosed type 2 diabetes
- Increased number of people with an up to date BMI record in SCI diabetes
- Increased uptake of weight management interventions from referrals
- Increased completion rates by individuals of interventions
- Reduction in the number of people recorded as obese/overweight in SCI diabetes
- Reduction in the number of people experiencing diabetes related complications at point of diagnosis.
- Reduction in the rate of prescribing type 2 diabetes medications.

2.4 Realistic Medicine

As mentioned above, in 2010 the Scottish government released its 'Healthcare Quality Strategy for NHS Scotland' [11]. The strategy set out the government's desire for every citizen to live longer, healthier lives, receiving care at home or in a homely setting whenever appropriate. It outlined three quality ambitions these being the development of mutually beneficial partnerships between patients, their families, and those delivering healthcare; avoiding all harm and; providing the most appropriate care at the right times [11]. As seen throughout the evolution of diabetes policies and strategies, the values and goals outlined in the 'Healthcare Quality Strategy' began to appear throughout all NHS Scotland strategies, frameworks and action plans. Away from the field of diabetes in January 2016 the Chief Medical Officer (CMO) released the 'Realistic Medicine' report to specifically address clinicians about the changes inferred by the healthcare quality strategy [12]. The report advocated for a move away from the 'doctor knows best' approach to medicine towards a more personalised approach to care, based upon shared decision-making and informed consent [12]. It discussed the 6 key issues surrounding Scotland's changing healthcare, these being [12]:

- Build a personalised approach to care
- Change our style to shared decision-making
- Reduce unnecessary variation in practice and outcomes
- Reduce harm and waste
- Manage risk better
- Become improvers and innovators

This was followed up by the release of the CMO's 'Realising Realistic Medicine' report in January 2017. The report highlighted the desire from medical professionals in Scotland to adopt realistic medicine and outlined the CMO's 2025 vision that all healthcare providers in Scotland would embody the approaches, behaviours and attitudes outlined by realistic medicine [14]. In 2018 the Scottish Government released the 'General Medical Services Contract in Scotland', to propose a refocussing of the GP's role as expert medical generalists [15]. Fundamentally the contract is a move towards the realisation of 'Realistic Medicine' in general practice. With the contract emphasising that GP and GP practice workload will reduce and refocus, with certain tasks currently performed by GPs to be carried out by a wider multi-disciplinary care team. This new system, in which service redesign is embedded throughout, will allow for longer consultations, for patients requiring complex care due to multi-morbidities. This in combination with many other changes will help to improve the overall patient experience in Scotland and create an overall improvement of health and care provision across all levels of NHS Scotland. Predominantly the contract focuses on priority areas agreed upon by the Scottish government, NHS Boards, the British Medical Association and the Scottish GP Committee. These being:

- Vaccination services;
- Pharmacotherapy services;
- Community treatment and care services;
- Urgent care services and;
- Additional professional services.

While no direct mention of diabetes care is referred to, the outlined redesign of services will have a direct impact on the provision of health and care to all diabetes patients.

2.5 What policy means for the patient

The Scottish Diabetes Group are responsible for surveying the provision of diabetes care by NHS Scotland, and SCI-Diabetes have developed 12 measures to determine the improvement of diabetes care [7]. These measures act as indicators of what diabetes policy determines standard diabetes care to be. A patient with diabetes should expect to receive 9 processes of care for diabetes. These vital checks that are required to prevent the onset of complications in diabetic patient, and are:

1. Blood glucose control check – HbA1c test
2. Weight check (BMI)
3. Blood pressure check
4. Smoking status
5. Retinopathy screening
6. Blood lipid check – cholesterol test
7. Urinary albumin test
8. Creatinine
9. Foot examination

In some cases, health boards are providing 90-95% of patients with their required processes of care. Although this is a vast improvement over care provision in the early 2000's there are still a significant number of diabetes patients who are not receiving all of their required processes of care [2]. While some boards are performing relatively well, there are considerable disparities in care provision rates between the Health Boards across Scotland. According to the Scottish Diabetes Survey of 2015 and the State of the Nation: Diabetes Report 2015, NHS Lanarkshire has regularly ranked below other health boards in the delivery of some care processes for diabetes. An example of this being that 76.5% of people with type 2 diabetes in Lanarkshire had their foot risk score assessed in 2017, whereas in Tayside nearly 86% were assessed [1]. These statistics are not a reflection of poor management on the part of NHS Lanarkshire, the root causes of these differences are in fact not fully understood in any Health Board. In most instances differences in statistics are most likely due to patients' absences, or through simple population, geographical and socioeconomic variations. Alternatively, these low statistics could be due to a lack of understanding on the part of patients of what services are available for them, what is expected of them to properly manage their health and wellbeing or in certain cases mismanagement of service delivery.

In addition to the 9 health checks, patients should expect to receive individual care planning from their diabetes healthcare team at various points throughout their patient journey. They should be provided the opportunity to attend educational courses: there are multiple courses for both type 1 and type 2 diabetics, available publicly from the NHS and privately via various other means. Individual Health Boards have either developed bespoke structured education resources or have utilised existing nationally accredited programmes for newly diagnosed diabetes. Children with diabetes should receive specialised paediatric care, and patients should receive specialist care from appropriate diabetes specialists if hospitalised or planning a pregnancy. Those who are eligible will obtain access to insulin pumps, and NHS Scotland will strive to get

patients access to the best technology to help them self-manage and monitor their own conditions.

With the release of the 'Framework for the Prevention, Early Detection and Early Intervention of type 2 diabetes' patients should expect a greater amount of support and access to resources that specifically relate to weight management. The framework aims to address certain priorities outlined in the diabetes improvement plan, providing patients with greater support to prevent the onset or reduce the burden of type 2 diabetes.

2.6 Digital health and care strategy

In April 2018, the Scottish Government released its new digital health and care strategy. Highlighting that digital technology is integral and must underpin the transformational changes in service provision required to improve the health and care outcomes for citizens ^[16]. The focus of the strategy is to empower citizens to better manage their own health and wellbeing, and to put in place the 'underpinning architectural and information governance building blocks' to ensure the safe and secure exchange of patient information across the entire health and care system. The strategy aims to establish a national decision-making board to oversee this digital transformation, so that by 2020 Scotland have an established national approach to information assurance going forward. For diabetes care this digital transformation will allow for better information exchange between citizens and their health and care team. This will allow for more informed self-management and improved remote monitoring to create a more efficient and effective patient experience. This in turn will provide greater value for both the individual patient and the health and care system at large.

3. Digital solutions in diabetes

With the proposed changes from the Digital Health Strategy in mind it is important to explore the existing and emerging digital solutions for both diabetes, and other areas of medicine in which valuable solutions can be adapted to provide a more seamless experience for patients with diabetes.

There is already a wealth of both low tech and high tech analogue and digital solutions for diabetes. Such as:

- Blood glucose meters
- Continuous Glucose Monitors (CGMs)
- Injectors and auto-injectors
- Mobile-enabled solutions for diabetes management
- Food scanners
- Insulin Pumps
- Foot and eye monitoring products, usually in the form of image-capture based applications
- Exercise devices
- Mobile applications

The following section will discuss the various forms of digital solutions for diabetes care and management.

3.1 Blood Glucose Meters and CGMs

Blood glucose meters are a means of supporting people to monitor and manage their diabetes. Patients use monitors in combination with test strips to determine their blood glucose level. Strips are available both privately and publicly via prescription.

There are numerous types of blood glucose meters that are available on the market. All diabetes services recommend a range of blood glucose meters and strips for patients to use in the management of their own condition. If a patient purchases their own glucose meter outside of these recommendations, consumable strips can still be prescribed. The market for blood glucose meters is quite large with the following examples being just a small sample of what is available ^[17]:

- FreeStyle Lite
- Optium Xceed
- Accu-check Aviva Nano
- Ascendia Contour
- OneTouch Vita
- Glucomen LX
- Jazz

Continuous Glucose Monitors are sensors that are inserted into the skin and measure glucose within the interstitial fluid within and surrounding the user's cells. The sensors are connected to a transmitter that sends results to a wireless device where the information can be analysed and shared. CGMs are available for purchase privately, but can be prescribed to a patient if they meet certain criteria, these being ^[18]:

- If having more than one severe hypo a year that's brought on by no obviously preventable cause.
- A complete loss of hypo awareness.
- Frequent episodes of problematic hypos occurring without symptoms.
- If an extreme fear of hypoglycaemia is causing problems or distress.
- If unable to achieve an HbA1c of under 75 mmol/mol (9%) despite testing blood sugar levels at least 10 a day.
- The user is on multiple daily injections or insulin pump therapy.

There are several CGM products currently available, but the market is still expanding with the majority of demand coming from the North American market. The below list showcases NICE approved CGMs ^[18]:

- Freestyle Navigator
- Freestyle Navigator II
- Dexcom G5 Platinum CGM
- Dexcom Seven Plus CGM
- Medtronic Enlite Sensor
- Medtronic Guardian REAL-Time

The Dexcom G6 Mobile CGM system is now available, while more and more innovative CGM solutions are being developed. One such example is Dexcom's work with Verily to produce a miniaturised CGM patch that subcutaneously monitors glucose levels. The output of this collaboration will be the Dexcom G6 which is released in 2018 ^[19]. Verily are also working on a smart lens program that will provide continuous monitoring of glucose levels ^[20].

Both blood glucose meters and CGMs are regularly paired with wireless devices in diabetes management platforms to analyse and share blood glucose information in conjunction with various other physical and lifestyle factors, with the best platforms utilising multiple datasets within the same system.

3.2 Insulin pumps

Insulin pumps are battery powered devices that help regulate insulin delivery throughout the day. Insulin is delivered subcutaneously via a flexible tube, providing diabetics with greater control of their condition and flexibility in their daily schedule. As mentioned before, insulin pumps are available from the NHS if certain criteria are met. There are several pumps available as of the 2018 Scotland Procurement contract. These are ^[21]:

- Medtronic Minimed 640G & 670G Systems
- Medtronic Veo
- Roche – Accu Chek Insight pump
- Roche – Accu-Chek Combo
- Dana Diabecare RS Remote System

- OmniPod
- CellNovo management system
- Medtrum – S6 EasySense™ Disposable CGM System
- Ypsomed pump
- Tandem T-slim

Like CGMs, insulin pumps can be paired with either their own specific diabetes management platforms, or other open access platforms that connect with multiple devices, to utilise patient information to better regulate insulin delivery and allow the patient to have greater control of their own care and treatment.

3.3 Diabetes management platforms

There are many diabetes management mobile applications available for patients to use as management platforms. Table 2 below shows a list of existing diabetes solutions. These applications focus on range of subject areas specific to diabetes, and often provide multiple functions per app. While this list is in no way exhaustive, it does highlight the considerable number of diabetes apps currently on the market.

Table 2: A sample list of diabetes mobile applications [22].

Diet	Physical activity	Blood glucose e-log book
Healthy out	Track 3	Diabetic
Foodily	My Fitness pal	Diabetes in check
Whole food market recipe	Moves	Diabetes companion
CarbControl	Nike + running	My sugar Junior
Lose it	Strava	Go meal
Weight watchers	UP by jawbone	Glooko
Daily burn	Endomondo	Glucose buddy
Calorie counter PRO	GymPact	DiabetesApp lite
iCookbook diabetic	FitnessFast	My net diary
Fooducate	Pacer	Glucose companion
EatLocal	Insulin dose calculators	Relaxation and meditation
Calorie king	Insulin calculator	Calm
HEALTHeDiabetes	iBolus calc	Sleep cycle
Glucose monitoring	Insulin dose calculator pro	Equanimity
iBGStar	Diabetes personal calculator	Medication adherence
Telcare	Rapid calc diabetes manager	MyMedSchedule
Diabetes education	PredictBGL	MyMeds
WebMD	EZ insulin calculator	MedSimple
Diabetes insight	Insulin units	Pillmanager
Up to date		Pill reminder
Managing type 1 Diabetes		RxmindMe Prescription
Diabetes EDC		Pillboxie
Diabetes @point of care		

The most valuable applications in terms of patient benefit are often paired with a digital device and/or are part of a suite of applications that provides a complete diabetes management toolkit. Some examples of these are:

3.3.1 MySugr

MySugr is a platform specialising in all-round care for diabetics. It contains a collection of apps and services that provide diabetes coaching, therapy management, unlimited test-strips, automated data tracking, and the ability to integrate with a growing number of medical devices. It is available in 52 countries, including the UK, and in 13 languages [23].

The MySugr App is a class 1 medical device in the EU: the app acts as a diabetes companion application. The application records your blood glucose, your estimated A1c, acts as a bolus calculator and allows access to coaching for users in the USA. To record blood glucose levels, the app's mySugr Scanner transfers blood sugar values from your blood glucose meter into your iPhone and the mySugr Logbook without cables or Bluetooth - the scanner simply captures the data from your blood glucose meter, see below [23].

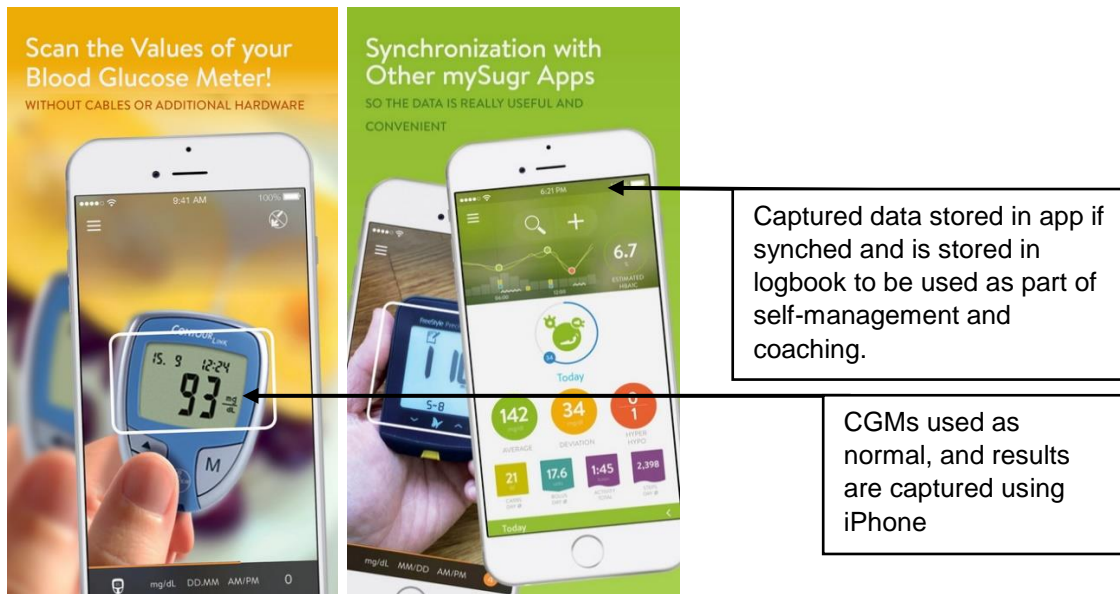


Fig 6. Image showing basics of the MySugr application [23].

MySugr Coach brings world-class personalised advice and diabetes education to users. A diabetes expert in the USA (Gary Scheiner) and their team analyse user's diabetes data and offer insights based on a user's goals and questions [23].

MySugr also offers support for children with diabetes via MySugr Junior, this service is a logbook app especially developed for children with diabetes and their carer. For carers, it provides peace of mind and communication while their child is away. For the children, it gives them more independence in their day-to-day life and supports them in learning to deal with diabetes in a fun and playful way [23].

3.3.2 Tactio

The Tactio health group uses technology powered by Tactio apps, Internet of Things (IoT), forms, surveys and messaging, to create digital patient experiences for specific conditions. Tactio offer mobile-powered remote diabetes management services, which include blood glucose and A1C monitoring, weight loss tracking, physical activity log, nutrition and medication plan, education and engagement. It connects health professionals with their patients to support and monitor their progress. TactioRPM Diabetes implements preventive care standards to incentivise patients to make lifestyle changes, while providing clinicians with patient-generated data and an engagement platform to improve their workflow. Tactio offers services for both type 1 and 2 diabetes patients, such as [24]:

- Automatic blood glucose tracking via connected health devices, or from manual entry;
- Insulin dose adjustment advice before meals;
- Wellness tracking of weight, activity, blood pressure and more;
- Critical state messages for patients with critical glucose levels;
- Nutrition and medication plan;
- Insulin sensitivity;
- Glycosylated haemoglobin monitoring (A1C monitoring);
- Carb counting and carb to insulin ratio;
- Educational resources and science-based health coaching.

Tactio's advantage over other applications, platforms and services, is that it allows for multiple chronic condition management. It allows for remote care of obesity, hypertension, COPD and more [24].

Tactio's clinical interfaces are designed through working with healthcare professionals from across the sector. It provides an overview of a clinician's entire patient population enabling healthcare professionals to provide remote chronic care [24].

3.3.3 Glucose Buddy

Glucose Buddy is a free to use diabetes monitoring tool, which provides users with a clear visual understanding of the daily trends in their glucose levels. The application has a built-in logbook to record diet, medication and exercise habits. It offers the ability to email glucose readings to a patient's healthcare providers. It requires manual entry of the user's data [25].



Figure 7. Image showing the layout of the Glucose Buddy application [25].

3.3.4 Sugar.IQ

Sugar.IQ is a diabetes application powered by IBM Watson, the cognitive computing software, which can inform users about how specific foods will influence their glucose levels, track their diets over extended periods of time and discover patterns in data that would be otherwise unobserved [26].

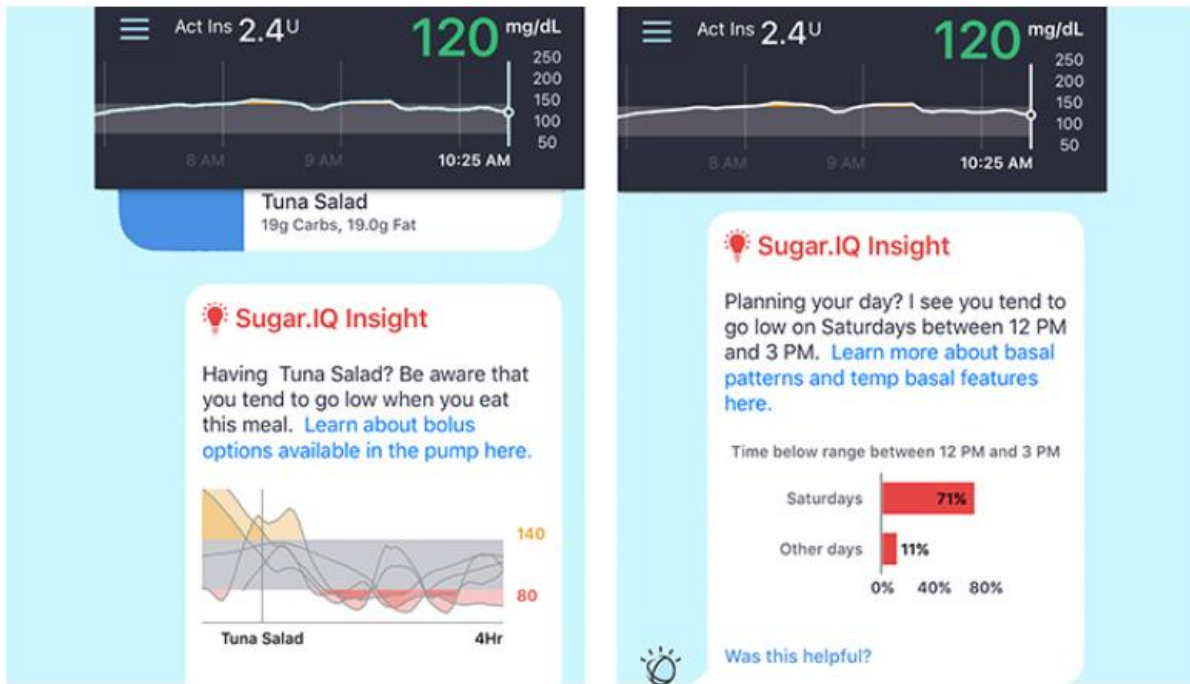


Figure 8. Image shows how Sugar.IQ interacts with users and tracks their conditions [26]

The app was designed by Medtronic and IBM, it uses real-time continuous glucose monitoring and insulin data recorded from Medtronic pumps and sensors. Watson’s cognitive computing power finds hidden patterns in this data, providing real-time personalised insights on a single platform that brings together relevant data, context and insights. The app is designed to help answer key questions that people with diabetes have about their current health status, about where their health is trending towards and what actions they can take to better manage their diabetes in the future. Notably, it can be used to uncover behaviours that influence glucose levels and send appropriate alerts to users. The app’s Glycaemic Assist feature enables users to inquire about how specific foods impact their personal glucose levels, and the software can track food to deliver meal-related insights to help people better control their diabetes. More specifically, Sugar.IQ can be used to uncover behaviours that influence glucose levels and send appropriate alerts to users. [26].

3.3.5 Glooko + Diasend

The Glooko platform works as a combination of a mobile hardware solution and Glooko’s MeterSync device, working in sync with blood glucose meters, insulin pumps and Continuous Glucose Monitors. It supports over 30 types of existing glucose meters, linking said meters to mobile technology via Bluetooth. It contains a full food database to provide the user with the most accurate dietary information that allows them to eat safe and become well educated about their own diets. It reminds the user to take their medication and to test their blood glucose levels, and lets users log their information in the cloud so that their care team can access it and advise them accordingly [27].

The Glooko platform analyses the recorded data and displays these in formats that are easy to digest for the user. Users can more easily self-manage their condition, while simultaneously highlighting critical moments to their healthcare practitioners to ensure rapid intervention when necessary. Figure 9 below shows how information is visualised on the platform [27].

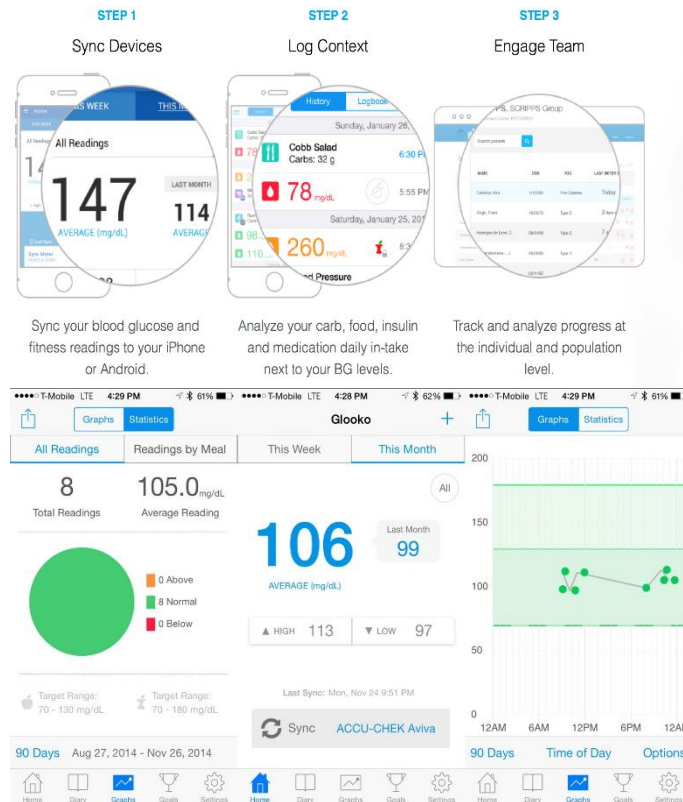


Figure 9. Data displayed when using the Glooko platform [27]

Glooko have recently merged with Diasend to provide a joint platform that will download data from over 160 devices that include glucose meters, insulin pumps, CGM's and activity trackers, covering 95% of the diabetes devices used worldwide. The joint venture will also offer an API for enterprise customers, and will have a product line that will include [27]:

- A diabetes self-management mobile app and web app, including advanced decision support modules;
- A remote diabetes patient monitoring application;
- A clinic workflow and device upload solution – as well as analytics, reports and decision support tools;
- As well as a number of diabetes data products.

3.3.6 My Diabetes My Way

The My Diabetes My Way (MDMW) platform is probably the best-known digital health solution for diabetes in Scotland. Created in 2008, MDMW is a digital self-management platform that allow patients to have a more interactive role in their care. It is an award-winning national electronic personal health record linking multiple national institutional and patient recorded data sources to provide a unique resource

for person-centred care and self-management. It is the flagship product of MyWay digital health. The platform is aligned with the 'Gaun Yerself' strategy and gives information on the key stages of support as outlined in the strategy ^[28]. The resources encompassed in MDMW are:

1. An educational resource website;
2. An e-Personal Health Record for all diabetic patients;
3. Patient-decision support;
4. Goal-setting functions;
5. A linked, remote glucose monitoring system;
6. Social media including peer-to-peer discussion groups.

MDMW gives patients access to diverse educational resources providing information on a range of topics such as diet and healthy lifestyle choices; medication categories; the various definitions of diabetes; information on possible complications and many other topics. MDMW has tackled the issue of interoperability as it has a direct link to the SCI-Diabetes. The SCI-Diabetes launched in 2002, is the statutory data store and shared electronic health record for all diabetes patients in Scotland. Despite the benefits of the MDMW platform, in 2017 approximately 32,000 out of 298,504 diabetes patients were registered to access their diabetes information in Scotland ^[29, 30]. September 2018 saw the launch of the MDMW app in both Scotland and Somerset. The app provides users with access to the MDMW platform while they are on the move ^[29].

In December 2017, MDMW obtained a £1 million Digital Health Catalyst award from Innovate UK to develop a novel Artificial Intelligence system to support healthcare professionals and those living with diabetes ^[30]. The grant will be used to develop MyDiabetesIQ to use data to predict whether a patient is likely to find themselves in a high-risk situation. The solution will enable intervention at an early stage to prevent complications associated with diabetes. It will combine patient recorded data with a patients NHS record helping to improve the overall quality of life for diabetes patients ^[31].

3.4 Diabetes SBRI: Personalised Diabetes Education and Care

In early 2016, NHS Scotland launched an open innovation competition to identify new mobile health solutions, with up to £500,000 as an award. In October 2017, the first phase of the competition ended with two Scottish companies - AxSys Technology in Paisley and UHI Research and Enterprise Ltd in Inverness - being shortlisted alongside three others ^[32]. The shortlisted companies were given further six months to develop a prototype for their solution. Following this a final two teams were shortlisted with AxySys Technology Ltd being one of them ^[32].

3.5 Diabetes SBRI: AxySys Technology Ltd

The AxySys Technology solution is a mobile app to support young adults with type 1 diabetes by providing helpful and timely reminders, educational resources and assessments to help support them to manage their blood glucose levels through the review of and learning from their own data. The app is intended to be tailored and deeply personalised for each user, setting it apart from the well-established diabetes app market ^[32].

3.6 Barriers to Technology

As stated above there is a wealth of diabetes health technology available on the market and the previous selection offers a brief overview of this market. This poses the question, if there is such a large selection of technological solutions what is blocking the employment of said solutions within the NHS?

The issue of barriers to implementation is not unique to digital health solutions, attempts to integrate improvements and innovations into the NHS have faced multiple barriers to their introduction in the past. Research has shown that some barriers to implementation are organisational issues such as culture, leadership and service and IT infrastructures; system-wide issues such as perverse incentives and lack of systems support for information sharing; and issues with individuals such as resistance among professionals across all levels and little time and capacity to learn and develop their skills [33, 34]. However, it is important to note that these barriers do not lie solely within the Health Service as barriers are also evident in the design and delivery stages of implementation [33].

4. Conclusion

Over the last 18 years, diabetes policy and care have travelled towards a more personalised model of care. A major contributing factor in this change has been the policy emphasis on preventative care and patient-centredness, and the increasing reliability of available self-management tools for monitoring long-term conditions. While the vast array of digital solutions for diabetes can be daunting, NHS Boards need to be aware of the resources available to them right now, how these can be adopted at scale and implemented as part of routine care and be prepared for further innovations in the near future. Preventative and patient-centred digital health solutions can help NHS Scotland meet its goals for both diabetes care and the quality of health and social care overall.

When integrating digital solutions into the health and care process NHS Boards need ensure they map the right solutions to the right services. In this new digitally enabled system they have the further responsibility of ensuring useful, reliable, safe and secure information exchange between the patient and their clinical team. Using prescribed, NHS assured, digital diabetes care solutions.

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