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Abstract

This document outlines guidelines for the selection of diabetes patients who are most likely to benefit from U4H services, including those patients who appear unlikely to benefit. The report draws on information from the nine deployment sites who implemented the long-term monitoring of diabetes service and the outcome of the analysis at site level.

Key Word List

Diabetes, telehealth, guidelines, patient characteristics, patient profile, future health service provision, technology

Executive Summary

Background

United4Health has implemented a long-term management telehealth service for patients suffering from Diabetes Mellitus (Type I and II) in nine regions across Europe. The telehealth service is the same at an overall level as per the United4Health service model and all sites have carried out the deployment and study according to the United4Health protocol for Diabetes. However, local customisation in delivery, processes, technology, etc. have done according to local or national context and requirements.

Consequently, the report addresses the selection of future patients for the Diabetes telehealth service based on the deployment regions individual qualitative experiences with the service and the quantitative and qualitative findings:

- Selection of patients from a **clinical perspective**
- Selection of patients from a **patient characteristics/profile perspective**
- Selection of patients from a **telehealth solution and IT infrastructure / technical perspective**

Findings

The selection of patients in the future from the three perspectives varies in each site due to local experiences, but also the differences between the deployment sites in the implementation and processes of their respective diabetes services.

Scotland:

- Continue to include Type 1 and Type 2.
- Will scale up the use of Diasend across the secondary and acute sector clinics + include community care and GP practices.
- Data from Diasend was perceived to be accurate and allowed for more meaningful and in-depth consultations - even if the consultations were slightly longer due to the time take to access data.
- Clinicians select patients based partly on motivation, capacity for self-management, managed by insulin therapies, as well as appropriateness for care management.
- Patients with confidence in the use of technology devices responded quickly to the Diasend system. Deployment experiences from the clinical sites suggest that younger cohorts of patients (16-25 years) adopted the technology quickly.
- Those patients who potentially benefitted the least were typically patients whose management of diabetes was considered problematic and required direct clinical support for staff.
- Pregnant patients with Type 1 Diabetes and newly diagnosed patients were highly motivated to use Diasend to manage their diabetes and improve HBA1C levels.
- Access to, and familiarity with, PC / laptop and internet (adequate internet and broadband) + competence in using blood glucose monitors is required.

Wales:

- Advantages of telehealth within U4H have not been restricted by key demographic factors including age, gender, social background or ethnicity etc., thus the potential health improvements provided by telehealth may be greater than previously thought.
- It is possible to provide the service to patients who have never used a mobile phone before, providing there is formal training and support from the Clinical Lead for telehealth and the patient's family and/or carers.
- Patients who received oral, as well as written, instructions prior to commencement were more likely to start monitoring than those who were relied upon solely to follow written instructions.
- A number of infrastructure issues and the breakdown of communication due to poor GPRS signal had an impact upon the continuity of telehealth over the trial periods.

Northwest Moravia:

- Patients with Type 2 Diabetes that are registered by the internal clinic of University Hospital Olomouc will continue to receive the service. Negotiations to include enrolment of patients from other regional hospitals and outpatient departments are ongoing.
- There is benefit in providing telehealth services for patients with severe and badly compensated Type 1 Diabetes, and also for patients with pregnancy diabetes.
- There is no restriction on selection based on infrastructure as the system is able to support 100s of further patients.

ARSAN, Campania:

- The target population should be extended to patients with Type 1 Diabetes, and more generally to all patients with poorly control diabetes.
- The eligibility criteria required the patients to have available a DSL broadband connection and an accessible modem router. In the further development of the adopted technical solution, the options for Internet connection should be revised.

ASP Cosenza, Calabria:

- A widespread availability and stabilisation of telehealth should be promoted for those patients who, whilst at high risk of complications, are not fully aware of the importance of self-monitoring.
- Patients suffering from Type 2 Diabetes with a good knowledge of computers and software, even with non-higher education, are those who have benefited most. Patients such as women in their fifties and people with computer literate, caring children living at home have also embraced telehealth well.
- Despite being young, well-educated and computer literate, some Type 1 Diabetes patients have accepted telehealth reluctantly or even not at all.
- Compulsory requirements are a good knowledge of computers and software, or the possibility of having a young, computer literate caregiver living at home.

South Karelia:

- Chronic disease patients will benefit from their information being available to healthcare professionals, and they can make contact via secure messaging.
- Citizens of working age gave feedback that eHealth services help them when they need to take contact with healthcare professionals outside traditional hours.
- The system can be used by mobile phone, but it is only a website; in the future, there has to be an app that users can use to send their measurements directly to the PHR.

Thessaly, Central Greece:

- The impact of telehealth services varies among different T2DM patient populations and settings, and seems to provide an effective tool for better quality of life and tighter glycemic control in patients under 60 years old.
- Low-end mobile phones are easier to handle for older patients, and better promote patient's acceptance of the telehealth service.

Berlin:

- Patients who live alone and are completely autonomous in solitary living arrangements are the most interested in medical interventions, innovations and developments.
- Patients who live alone (but whose homes are networked) are also committed to maintaining their health (sports, intelligence gathering, and joint activities).
- Patients who live on their own but in a shared building, and have their own rooms, some also their own sanitary facilities; this type of accommodation is complemented by common areas for all roommates. These patients demand telehealth for medical or nursing support if needed, and find telehealth an important complement to traditional care (telehealth as an add-on function).
- Regarding the younger participants, they are much more interested in the data management and the technical possibilities of telehealth. This group strongly believes that with telehealth they can develop a higher expertise regarding their own health.

Slovenia:

- Telehealth support encourages clinical specialists to call patients with high variation of blood sugar earlier for physical examination and talk.
- The group of diabetes patients which benefits the most are patients who do not stick to the clinical recommendation regarding food intake and physical activity. For these patients, changes in lowering HbA1c are greatest. Changes are not age or sex related.
- Due to geographically rough terrain and consequently poor coverage by 3/4G signal, some patients cannot be recruited. Occasional poor signal coverage is overcome with the technical solution embedded into the mobile phone app, that sends the locally collected data (measuring device to mobile phone) when an adequate network signal is available.

Conclusions

Significant differences in the factors influencing the selection of future patients for diabetes telehealth service were highlighted. Some sites have found age to be an indicator of adoption and compliance to using the technology, whereas in other sites this was not the case. Also, one site found that the patients who potentially benefitted the least amount were typically patients whose management of diabetes was considered problematic and required direct clinical support from staff (Scotland), while other sites see benefits in providing telehealth to severe and badly compensated (Northwest Moravia) and poorly controlled (ARSAN) patients.

On the other hand, several deployment sites report that there is benefit in expanding to Type 1 Diabetes (only Scotland included Type 1 during the project) and to pregnant diabetics. It was also generally found that PC skills or in-house access to these skills had a positive effect on patients.

Change History

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Version Changes

0.0	Table of Contents
0.1	Consolidation of regional responses
0.2	Preparation of first draft (missing 3.1 and 5) for QA
0.3	Final draft for QA
0.4	Updates following internal review.
0.5	Final minor revisions
1.0	Final version for issue

Outstanding Issues

None.

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1. Introduction

1.1 Purpose of this document

This document sets out the diabetes patients who appear most likely to benefit from U4H services, and those who appear not to benefit, based on the experiences of each of the sites which deployed the diabetes telehealth service.

1.2 Glossary

BG	Blood Glucose
BGM	Blood Glucose Monitor
CHF	Chronic Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
DM	Diabetes Mellitus
DMT1	Diabetes Mellitus Type 1
DMT2	Diabetes Mellitus Type 2
HbA1c	Glycated haemoglobin
HCP	Healthcare Professional
Health Board	Local / regional health authority in Wales and Scotland
GP	General Practitioner
MAST	Model for Assessment of Telemedicine
MD	Medical Doctor
MDMW	My Diabetes My Way
PHR	Personal Healthcare Record
RCT	Randomised Controlled Trial
SCI-Diabetes	Diabetes database in Scotland
TM	Telemonitoring
U4H	United4Health

2. Background and methodology

2.1 Background

Deployment sites are seeing increases in the number of people living longer with chronic conditions, and are looking at ways to shift the balance of care towards the home and out-of-hospital environments by investing in 'upstream' interventions which focus on self-management at the patient level.

In addition, the current context of economic pressures is requiring care systems to achieve better value from their resources, while improving the quality and reducing the use of health services, particularly for those living with long-term conditions, through the use of technology; telehealth is seen as one of the key enablers for the transformation of healthcare delivery.

For the life-long management of diabetes, telehealth services aim to promote self-care and self-management by encouraging the implementation of self-monitoring of blood glucose and lifestyle risk factors associated with the development of diabetes-related complications or additional chronic conditions, and by providing ongoing health coaching.

2.2 Methodology

United4Health has had a strong emphasis on organisational assessment, including the views and experiences of healthcare professionals, patients and carers.

For U4H, a common template based on open-ended questions was provided to all deployment sites along with detailed background information and guidance. Data collection was carried out in each deployment site, and subsequently reported back to the central evaluation team.

Section 3 draws on particular themes that have an impact on the selection of future patients for life-long monitoring of diabetes from the organisational assessment and patient perception information gathered from the deployment sites. This information has been derived from a range of activities undertaken in the sites, including focus groups with patients and workforce members, individual interviews conducted by an external university researcher either face-to-face, or by telephone or video conference, and semi-structured interviews carried out by a project team or telehealth service delivery team member, again either face-to-face or by phone or video conference.

3. Guidance on selection of patients for future deployment of telehealth

Based on the evaluation results and local experiences, this chapter outlines, for each of the sites deploying the telehealth service for long-term management of diabetes patients (Type 1 and 2), which patients achieved improvements in their health and wellbeing, through either improved physiological measurements, quality of life, or healthcare resource utilisation.

3.1 Selection of patients from a clinical perspective

3.1.1 Scotland

In Scotland, deployment plans are in place to continue to scale up the use of Diasend as per U4H criteria across the secondary and acute sector clinic settings in all deployment sites. Across these sites, there are plans to embed the use of telehealth monitoring for all newly diagnosed patients where it is deemed clinically appropriate to their care management. In addition, the telehealth solution will be extended into community and GP practices. Please refer to deliverable D3.9 for details of the deployment plans.

In U4H, no additional regular monitoring by the clinician took place unless previously agreed. However, when contact was initiated at the patient's request or during a routine appointment, staff reported significantly more accurate data being available, allowing meaningful dialogue with the patient to take place. This was reported by staff as a positive outcome, despite potentially longer appointments for all patients. Irrespective of age, gender, or type of diabetes, clinicians expressed improved levels of satisfaction with the data available through the solution. In addition, patients reported feeling "empowered" and "motivated" by the information available, and allowed clinicians and patients to discuss issues which were potentially not evident during previous consultations.

Clinicians tended to select patients that they considered would benefit from the monitoring solution based on factors such as motivation, capacity for self-management, and those managed by insulin therapies. This was also identified in the focus group discussions with diabetes staff.

Patients who were more confident in the use of technology devices responded quickly to the Diasend system. Patients who were already using or familiar with the Diasend software were also targeted due to high levels of familiarity with this type of monitoring solution.

Those patients who potentially benefitted the least amount were typically patients whose management of diabetes was considered problematic and required direct clinical support for staff.

3.1.2 Wales

Within Hywel Dda University Health Board, it has been interesting to note that the advantages of telehealth within U4H have not been restricted by key demographic factors including age, gender, social background or ethnicity, etc. This is positive, in that preconceived groups did not have more or less benefit from telehealth than any other group; therefore, the potential health improvements provided by telehealth

may be greater than previously thought. Having assessed (without statistical analysis) the quantitative and qualitative data, the Board has not identified any particular subgroup that benefits differently to others in a significant way.

Future plans for telehealth deployment will depend upon the U4H data analysis, but, as a direct result of the type 2 diabetes telehealth research, Hywel Dda University Health Board have commenced a monitoring and eCoaching service for two other groups of patients: anticoagulation monitoring and weight reduction monitoring; they are currently exploring osteoporosis and pre lung cancer surgery telehealth as well.

3.1.3 Northwest Moravia

Future patients to enrol in the service will be patients with type 2 diabetes that are registered at the internal clinic of University Hospital Olomouc. Negotiations are ongoing to include enrolment of patients from other regional hospitals and outpatient departments.

The moderate experience with the effects of diabetes service in comparison to necessary efforts suggests supporting this intervention to reduce visits by the diabetic patients. The diabetes service will have a central role in patient empowerment scenarios. Based on the experience that the University Hospital Olomouc has gained with patients with co-morbidities (cardiac), moderate results and advantages for patients with type 2 diabetes were shown, though it must be noted that the majority of the patients were cardiac patients. Evident benefits of using future telehealth services for patients with severe and badly compensated type 1 diabetes, and also for patients with pregnancy diabetes were seen.

3.1.4 ARSAN, Campania

The study targeted patients living with type 2 diabetes with complications, who actively monitor their blood glucose levels. In the further development of the telehealth service, the target population should be extended also to patients with Type 1 Diabetes, and in general to all patients with diabetes in poor control.

In the medium-term, patients with type 2 diabetes with no complications, or with complications but good control, remain excluded from the telehealth service as another programme of disease management, managed by GPs, is currently being carried out in the Campania region.

3.1.5 ASP Cosenza, Calabria

Patients who were already attending specialist's appointments on a regular basis before using telemonitoring have had further improvements in terms of health and life quality. The experience of telemonitoring has been too short (one-year maximum) for patients who were not sending glucose data regularly. A widespread availability and stabilisation of telemonitoring should be promoted for those patients who, whilst at high risk of complications, are not fully aware of the importance of self-monitoring.

3.1.6 South Karelia

The “Own Care” portal is effective for citizens who need to collect different measurements. In particular, chronic disease patients will benefit from their information being available to healthcare professionals, and they can make contact via secure messaging.

In all of Eksote’s services, PHR and Own Care are accessible in patients’ care processes. Also in Own Care, there is the possibility to keep different diaries (urination, food, sleep, pain etc).

The impact of the availability of this data depends a good deal on how professionals make use of eHealth services, e.g. when a patient is going in to surgery, he/she can fill in the Initial Information Sheet before pre-operative visits.

3.1.7 Thessaly, Central Greece

Since 2008, the Telehealth Centre located in the Municipality of Trikala¹ has already been running local telehealth services, partly funded by the third Community Support Framework (CSF). The Municipal Enterprise e-trikala SA runs the telehealth service in cooperation with the local hospital and affiliated private practice physicians. The telehealth service will continue run in the Municipality of Trikala based on this model.

During the Renewing Health and U4H projects, the telehealth service was expanded at regional level, in cooperation with the Municipalities of Central Greece and the 5th Regional Health Authority of Central Greece, which ensures proper monitoring of patients by specialists based in the Regional University Hospital in Larisa.

During 2016, a proposal for a large scale regional telehealth service for the Region of Thessaly is expected to be submitted for funding of its infrastructure via the EU Cohesion Policy 2014-2020 for Greece (EU structural funds).

The conclusion of the telehealth service evaluation for T2DM patients, via the Renewing Health RCT study, is that the impact of telemedicine services varies among different T2DM patient populations and settings, and seems to provide an effective tool for better quality of life and tighter glycemic control in patients under 60 years old².

According to those findings, telehealth for those profiles of T2DM patients was also proven to be a cost-effective choice for the Greek national health system³.

¹ www.trikalacity.gr

² Dafoulas G.E., Bargiota A. Long-Term Telemonitoring of Patients with DMT2: Results of the RENEWING HEALTH Cluster 2 Multicenter Randomized Pragmatic Trial, Association's 75th Scientific Sessions Abstract Book, the June 2015 supplement to the journal Diabetes G.E. Dafoulas et al. "Long term telemonitoring of patients with DMT2: Preliminary Results of the Greek pilot of the Renewing Health multicenter randomized trial" 7th International Conference on Advanced Technologies & Treatments for Diabetes-2014 Diabetes Technology and Therapeutics, vol.16, Supplement 1, pp. A26.

³ Af Mavrodi, G.E. Dafoulas et al. Cost-utility analysis of long-term telemonitoring of DMT2 patients among different EU health systems: the Renewing Health multicenter trial. Paris, ATTD 2015

3.1.8 Berlin

The indications for patient selection were not obvious, since for both COPD and diabetes diagnostic groups, results indicated comparable benefits. However, based on our experience in U4H, the project has shown that different fields of intervention need to be addressed. This means that from a clinical point of view and in terms of medical interventions, we can distinguish three patient groups and identify the significant effects:

- Patients who live alone and are completely autonomous in solitary living arrangements.
- Patients who live alone but whose homes are networked. This can be e.g. the apartments that are age appropriate in a large apartment building, or there is close regional networking within the framework of a project.
- Patients who live on their own but in a shared building, and have their own rooms, some also their own sanitary facilities; this type of accommodation is complemented by common areas for all roommates.

The types of interventions vary depending on the type of housing:

- Self-monitoring and strongly independent, autonomous control of external interventions, which are usually virtual.
- Self-monitoring or partially common measurements in close cooperation with healthcare providers, but also in close cooperation with neighbours and acquaintances.
- Most support in the measurements and frequent visits by the healthcare provider.

Based on validation with clinical data, the effects of telemonitoring (TM) for the various forms of intervention on the basis of different forms of housing can be selected. It may be possible to select the effects between the both COPD and diabetes clinical groups.

The first group is more interested than the other participants in medical interventions, innovations and developments. The second group is more intense than the other two groups in the exchange about health and wellness issues, and is committed to maintain health (sports, intelligence gathering, and joint activities). The third group demands TM for medical or nursing support if needed, and sees TM as an important complement to traditional care (TM as an add-on function).

For all three intervention groups, it is very important that health crises are detected as early as possible by TM, and a targeted intervention with a high probability of hospital avoidance is implemented. A requirement is that TM support is included in the contracts for external care providers or new care programmes covered by health insurance.

In summary, it can be said that within the framework of different programmes, different forms of intervention and different target groups can be identified. These are:

- insured in a special health insurance project;
- patients for discharge management;
- support of a community in the context of optimisation of hospital planning with a view to increasing outpatient care structures; and
- patients with TM or nursing care.

3.1.9 Slovenia

Telemonitoring of diabetes patients using U4H telemonitoring service model proved to have a statistically significant improvement in the patients' health indicator "average HbA1c". In the cohort of 128 supported patients using the service for a minimum of nine months, the average HbA1c dropped from 8,02% to 7,7% (4% improvement). Relating this to leg amputation due to diabetes, this means a 16% reduction in the number of amputations each year.

Positive clinical outcomes of telemonitoring support encourage clinical specialists to call patients with high variations of blood sugar earlier for face-to-face examination and talk. This imposes additional work on the clinical staff at the SB-SG hospital, but has secondary positive effects in prevention of further complications and consequences resulting from long-term too high blood pressure.

3.2 Selection of patients from a patient characteristics / profile perspective

3.2.1 Scotland

U4H in Scotland focused on two deployment objectives: 1) integrated use of Diasend with BGM, and 2) expansion of the number of patients registered on the diabetes based self-management web portal called MyDiabetesMyWay (MDMW). The eligibility criteria for the project required that the patient had a clinical diagnosis of type 1 or type 2 diabetes, was actively monitoring their BG, and was receiving insulin treatment as part of their diabetes management plan. These criteria were sufficiently broad to enable the telehealth intervention to be available to the population who are at high risk of early diabetes related complications. Equally, supported self-management is the key to successful day-to-day diabetes management; therefore supporting patients' access to the MDMW self-management website services is providing vital education to the population.

Profile of patients using Diasend

Although no formal statistical analysis has been completed, the data system in place in Scotland allows an overview of the profile of patients who use Diasend through U4H:

- Gender: 54% Male & 46% Female.
- Type of Diabetes:

Type of Diabetes	% of Registrations
Type 1	70%
Type 2	28%
Other	2%

- Age Range:

Age	% of registrations
16-24	20%
25-44	34%
45-54	16%
55-64	16%
65-74	10%
75-84	3%
85 and over	1%

Factors influencing patient selection

- Experience from the deployment sites suggests that patient motivation levels and an interest in self-management of their diabetes was a key factor in terms of patient selection. However, the deciding factor for all patients was whether or not the patient had access to a laptop or PC. Many patients deemed clinically appropriate were not able to use the solution, as the current technology was not yet compatible with their tablets and smartphone devices.
- Deployment experiences from the clinical sites suggest that younger cohorts of patients (16-25 years) adopted the technology quickly with the least amount of support from clinicians.
- Pregnant patients with type 1 diabetes and newly diagnosed patients were highly motivated to use Diasend to manage their diabetes and improve their HBA1C levels.

Early feedback from a Scottish developed patient questionnaire confirms high levels of satisfaction with the technology, with 65% of patients reporting that they found it very helpful to view their results, and 77% reporting that they required no or only a little help to connect their BGM to computer. Further results are still being collated.

3.2.2 Wales

Hywel Dda University Health Board has noted that the uptake and acceptance of telehealth has not been restricted by key demographics. This is positive, in that different groups did not take on or continue telehealth more than other groups; this reinforces our findings that the potential reach of telehealth may be greater than previously thought.

Some patients, who had never used a mobile phone before, were agreeable to monitoring using this type of device, after some formal training, and with support from both the Clinical Lead for telehealth and the patient's family and/or carers. These patients continued monitoring using a mobile device for a minimum of three months. Also, those patients who received oral as well as written instructions prior to commencement were more likely to start monitoring than those who were relied upon to follow solely written instructions. Therefore communication is potentially critical to support the deployment of telehealth to patients who may not have experience of using technologies.

3.2.3 Northwest Moravia

Patients need to be capable of using the technology, including mobile devices, Android application and glucose measurements. Based on the current situation, type 2 diabetics are well controlled by standard treatment, and they do not significantly benefit from telehealth service if the current model of care is maintained. However, greater benefit of telehealth services has been recognised by the hospital team for patients with type 1 diabetes with poor compensation of diabetes, and for women with pregnancy diabetes. It is necessary to consider device related issues, e.g. existing glucometer, reimbursement, consumables, accuracy / differences in measurements by different devices.

3.2.4 ARSAN Campania

In Campania the study targeted patients living with type 2 diabetes with poor compensation who actively monitor their blood glucose levels. Except for the availability of an Internet connection, no other specific profiles emerged as particularly relevant for the telehealth service.

Coaching and medical assistance was provided by phone, SMS or email according to the patient's capabilities. Since the sending data from the glucometer via the hardware gateway through the Internet was fully automated (a kind of "plug and forward"), and technical assistance was provided by phone, and in special cases also on site, no specific computer literacy was needed for the patients enrolled.

3.2.5 ASP Cosenza, Calabria

Patients suffering from type 2 diabetes with a good knowledge of computers and software, even without high education, are those who have benefited most. Patients such as women in their 50's, and people with computer savvy caring children living at home, have also embraced telehealth well. On the other hand, despite being young, well-educated and computer savvy, some type 1 diabetes patients have accepted telehealth only reluctantly, or even not at all. However, this may be because they knew they would be checked on the regular use of self-monitoring.

3.2.6 South Karelia

Citizens of working age gave feedback that eHealth services help them when they need to make contact with healthcare professionals. They can use PHR, even at night time, and they can send messages to the nurse; they do not need to wait on the phone - it is difficult to phone at the right time. (Almost all professionals have a "calling time", only one hour, and lots of patients who need to call).

3.2.7 Thessaly, Central Greece

Only the profile of patients with T2DM related with age was identified as the profile of patients that had the best benefit with the introduction of telehealth into their care management.

3.2.8 Berlin

There is a significant distinction regarding the different age groups. The younger participants are much more interested in the data management and the technical possibilities of telehealth. The identification and interpretation of their own

measurement data are at the forefront of interest. In this group, there is a strong opinion that they can develop a greater expertise regarding to their own health using telehealth.

Regarding the older group, the largest group in Berlin, the safety aspect plays a much more important role than in the other groups. The feeling is significant that the addition of telehealth to the usual medical system can create a higher level of security.

3.2.9 Slovenia

The group of diabetes patients which benefits the most are patients who do not stick to the clinical recommendations regarding food intake and the necessary physical activity. In these patients, changes in lowering HbA1c are the largest. Changes are not age or sex related.

The site has not yet analysed data in relation to having a carer or not, smokers vs. non-smokers, or patient's geographic location, etc.

A preliminary analysis demonstrated that, through the collected data for the group of patients visiting only one clinical specialist, we are able to analyse the quality of work of that specialist and compare it to outcomes of another clinician.

A detailed statistical analysis will be done by the end of 2015.

3.3 Selection of patients from a telehealth solution and IT infrastructure / technical perspective

3.3.1 Scotland

Based on the U4H experience, the following technological aspects were identified as prerequisites for any patient cohort to be able to benefit from the service:

- Access to laptop or PC.
- BGM needs to be compatible with the Diasend software (80% of BGMs in Scotland are compatible).
- USB cable needs to be available to support the uploading of BG readings into Diasend. Alternatively, the BGM provided to the patient needs to be Bluetooth enabled.
- Patients need to be familiar with reading and interpreting their own BG readings.
- Competency in using PC / laptop and internet.
- Competency in using blood glucose monitors.
- For professionals, access to clinic transmitter for registration or via SCI Diabetes linkages in Diabetes Centres / GP practices.
- Access to MDMW website (free in Scotland).
- Adequate Internet or broadband access.

3.3.2 Wales

Hywel Dda University Health Board should see patients as a heterogeneous group rather a subgroup with homogenous characteristics.

Irrespective of patient characteristics, the Health Board discovered that there was an impact on the continuity of telehealth due to a number of infrastructure issues and the breakdown of communication due to poor GPRS signal. These need to be addressed, as they potentially form a critical barrier to the future success of telehealth intervention and support.

As a finding of this study, a prerequisite for any Hywel Dda type 2 diabetes telehealth service in future is to have an unrestricted multi channel communication portal (GPRS, wifi or landline option) with technology that is easy to use for any patient with reduced dexterity or vision. The Board's experience showed that some patients were excluded from entering the telehealth system due to interface issues between the mobile phone and the patient, e.g. a patient with visual impairment and no family / carer was unable to type in a blood glucose reading to a mobile phone device. In moving forward, Hywel Dda University Health Board needs to explore alternative technology to overcome these issues that will extend the accessibility of the telehealth service to otherwise excluded groups who may benefit.

Future deployment of a primary care directed telehealth programme such as in the U4H study will require extended engagement from primary care practitioners to have the capability to manage any technical issues that may arise; though for the level of technology used in this study, this is likely to be minimal. Some work will therefore need to be undertaken to engage primary care. A key component of this will be analysis of local level data. If this does indeed show a reduced reliance on primary care services, it is likely that more widespread uptake of the programme will occur.

3.3.3 Northwest Moravia

The infrastructure built for the U4H project is able to support 100s of further patients. The diabetes service does not require high speed data transmission. Invasive measurements can be considered a barrier for better acceptance of the service by patients.

3.3.4 ARSAN Campania

The eligibility criteria require the availability of a DSL broadband connection for patients and an accessible modem router to plug in the hardware gateway. In the further development of the adopted technical solution, the options for Internet connection should be revised. Even if dedicated and automated gateways were favourably welcomed, wireless communication (e.g. via 3G) should be supported in the future. The costs for data connections remain with the patients.

A mandatory condition for the enrolled patients was to adopt the glucometers distributed by the technological partner, because they were the only ones able to communicate with the gateway and the centralised server. In order to further develop the telehealth service and to scale it up, a region-wide interoperable solution for data gathering and management should be adopted.

3.3.5 ASP Cosenza, Calabria

The vital compulsory requirements are:

- a good knowledge of computers and software; or
- the possibility of having a computer literate caregiver living at home.

3.3.6 South Karelia

Because of eHealth service security issues, users have to use Bank Identifiers when logging in to the Hyvis.fi-portal. This quickly uses up citizens' bank codes. When using the PHR, it is better if users collect data on paper first and, for example, transfer that information once a week to the PHR Own Care portal. Own Care can be used by mobile phone, but it is only a website; in the future, there has to be an app that users can use to send their measurements directly to the PHR Own Care.

3.3.7 Thessaly, Central Greece

During the trial phase of the telehealth service, it was identified that low-end mobile phones are easier for elderly patients to handle, and better promote patient's acceptance of the telehealth service.

3.3.8 Berlin

Here, two target subgroups were identified:

- Firstly, the group that has an interest in the technology itself, and which is also interested in the flexibility. The equipment has to be designed in such a way that a high possibility exists for multiple applications. The group prefers access to the documented data. This will be made possible by a remote access which has a well-structured abstract of recognised vital data of the patients.
- The other group is interested in the use of data. This should be realised through home visits by nursing staff or physicians. There it is a rather limited interest in the technical application.

3.3.9 Slovenia

All patients in the diabetes intervention group were able to measure blood sugar even before their recruitment, using glucometers not much different to those used in the U4H project. From this point of view, almost no patients have had any difficulties.

A support system has been in place for the telehealth service users:

- Carers are also trained to use the system.
- A "primary help desk" is available by phone at the telemedicine centre staffed in the morning shift, serving as the first level technical support.
- A "secondary help desk" is available for the centre staff, and if needed also as a direct contact for those patients having technical difficulties.
- A field nurse is available to visit patients having difficulties in using the system, or experiencing technical difficulties at home.

Some patients (5%) have difficulties in keeping their mobile phone (used as a gateway) charged. They have forgotten to charge the battery.

In the study, two different types and models of mobile phones were used (HTC Desire 500, Samsung Galaxy Core II). Both models are inadequately designed for use by older people. An action with side buttons pressed at the same time as turning off the screen resulted in entering the phone set-up; patients experiencing this type of difficulty resolved the problem with help from the telemedicine centre operator. Around 2% of patients experienced this difficulty.

Due to geographically rough terrain and consequently poor 3G/4G coverage in the region where the service is provided, some 3% of patients could not be recruited into U4H. Occasional poor signal coverage is overcome with the technical solution embedded into the mobile phone app that sends the locally collected data (measuring device to mobile phone) when an adequate network signal is available.

4. Conclusions

The selection of patients in the future from a clinical, patient characteristics / profile, and telehealth solution and IT infrastructure / technical perspective varies in each site due to local experiences, but also the differences in the implementation and processes (including patient recruitment) of the diabetes service between the deployment sites.

Below is a summary of the key indicators for selection of future patients for each deployment site:

Scotland

- Continue to include type 1 and 2.
- Will scale up the use of Diasend across the secondary and acute sector clinics + include community care and GP practices.
- Data from Diasend was perceived to be accurate and allowed for more meaningful and in-depth consultations - even if the consultations were slightly longer due to access to data.
- Clinicians select patients based partly on their motivation, capacity for self-management, and those that are managed by insulin therapies, as well as appropriateness for care management.
- Patients with confidence in the use of technology devices responded quickly to the Diasend system. Deployment experiences from the clinical sites suggest that younger cohorts of patients (16-25 years) adopted the technology quickly.
- Those patients who potentially benefitted the least amount were typically patients whose management of diabetes was considered problematic and required direct clinical support for staff.
- Pregnant patients with type 1 diabetes and newly diagnosed patients were highly motivated to use Diasend to manage their diabetes and improve HBA1C levels.
- Access to and familiarity with PC / laptop and internet (adequate internet and broadband) + competence in using blood glucose monitors is required.

Wales

- Advantages of telehealth within U4H have not been restricted by key demographic factors including age, gender, social background or ethnicity etc., thus the potential health improvements provided by telehealth may be greater than previously thought.
- It is possible to provide the service to patients who have never used a mobile phone before, providing there is formal training and support from the Clinical Lead for telehealth and the patient's family and/or carers.
- Patients who received oral as well as written instructions prior to commencement were more likely to start monitoring than those who were relied upon solely to follow written instructions.
- A number of infrastructure issues and the breakdown of communication due to poor GPRS signal had an impact upon the continuity of telehealth over the trial periods.

Northwest Moravia

- Patients with Type 2 Diabetes that are registered by the internal clinic of University Hospital Olomouc will continue to receive the service. Negotiations to include enrolment of patients from other regional hospitals and outpatient departments are ongoing.
- There is benefit in providing telehealth services for patients with severe and badly compensated Type 1 Diabetes, and also for patients with pregnancy diabetes.
- There is no restriction on selection based on infrastructure as it is able to support 100s of further patients.

ARSAN, Campania

- The target population should be extended to patients with type 1 diabetes, and more generally to all patients with poorly control diabetes.
- The eligibility criteria required the patients to have available a DSL broadband connection and an accessible modem router. In the further development of the adopted technical solution, the options for Internet connection should be revised.

ASP Cosenza, Calabria

- A widespread availability and stabilisation of telehealth should be promoted for those patients who, whilst at high risk of complications, are not fully aware of the importance of self-monitoring.
- Patients suffering from type 2 diabetes with a good knowledge of computers and software, even with non-higher education, are those who have benefited most. Patients such as women in their fifties and people with computer literate caring children living at home have also embraced telehealth well.
- Despite being young, well-educated and computer literate, some Type 1 Diabetes patients have accepted telehealth reluctantly or even not at all.
- Compulsory requirements are a good knowledge of computers and software, or the possibility of having a young, computer literate caregiver living at home.

South Karelia

- Chronic disease patients will benefit from their information being available to healthcare professionals, and they can make contact via secure messaging.
- Citizens of working age gave feedback that eHealth services help them when they need to take contact with healthcare professionals outside traditional hours.
- The system can be used by mobile phone, but it is only a website; in the future, there has to be an app that users can use to send their measurements directly to the PHR.

Thessaly, Central Greece

- The impact of telehealth services varies among different T2DM patient populations and settings, and seems to provide an effective tool for better quality of life and tighter glycemic control in patients under 60 years old.
- Low-end mobile phones are easier to handle for older patients, and better promote patient's acceptance of the telehealth service.

Berlin

- Patients who live alone and are completely autonomous in solitary living arrangements are the most interested in medical interventions, innovations and developments.
- Patients who live alone (but whose homes are networked) are also committed to maintaining their health (sports, intelligence gathering, and joint activities).
- Patients who live on their own but in a shared building, and have their own rooms, some also their own sanitary facilities; this type of accommodation is complemented by common areas for all roommates. These patients demand telehealth for medical or nursing support if needed, and find telehealth an important complement to traditional care (telehealth as an add-on function).
- For all three intervention groups, it is very important that health crises are detected as early as possible by telehealth, and a targeted intervention with a high probability of hospital avoidance is implemented.
- Regarding the younger participants, they are much more interested in the data management and the technical possibilities of telehealth. This group strongly believes that with telehealth they can develop a higher expertise regarding their own health.
- Regarding the group of older patients (the largest group in Berlin), the safety aspect plays a much more important role. The feeling is significant that the addition of telehealth to the usual medical system can create a higher level of security.

Slovenia

- Telehealth support encourages clinical specialists to call patients with high variation of blood sugar earlier for physical examination and talk.
- The group of diabetes patients which benefits the most are patients who do not stick to the clinical recommendation regarding food intake and physical activity. For these patients, changes in lowering HbA1c is greatest. Changes are not age or sex related.
- Due to geographically rough terrain and consequently poor coverage by 3/4G signal, some patients cannot be recruited. Occasional poor signal coverage is overcome with the technical solution embedded into the mobile phone app, that sends the locally collected data (measuring device to mobile phone) when an adequate network signal is available.

In conclusion, large differences are seen in the factors influencing the selection of future patients for diabetes telehealth service. Some sites have found age to be an indicator of adoption and compliance with using the technology, whereas in other sites this was not the case. Also, one site found that the patients who potentially benefitted the least amount were typically patients whose management of diabetes was considered problematic and required direct clinical support from staff (Scotland), while other sites see benefits in providing telehealth to severe and badly compensated (Northwest Moravia) and poorly controlled (ARSAN) patients.

On the other hand, several deployment sites report that there is benefit in expanding to type I diabetes (only Scotland included type 1 during the project) and to pregnant diabetics. It was also generally found that PC skills or in-house access to these skills had a positive effect.