Implementing Transnational Telemedicine Solutions

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***Abstract*—The Implementing Transnational Telemedicine Solutions (ITTS) project aimed to implement transnational telemedicine solutions at scale across Europe's Northern Periphery Program area, introducing new telemedicine applications to remote and rural areas in order to improve healthcare delivery for rural communities. ITTS incorporated ten demonstrator projects, which shared knowledge and experience between six project partners and clinical teams in order to simplify the process of subsequent implementation. Across 9 of the 10 demonstrator projects, a total of 25 new services in more than 40 sites across the program area have now been implemented successfully, and are in use with patients. A mixed methods assessment will determine whether the projects become effective and sustainable. This paper documents the process of knowledge exchange and implementation and describes the services now in place. Evaluation results will subsequently be reported and published as a policy-informing guide. ITTS has shown, to date, that transnational knowledge sharing can facilitate the implementation of telemedicine solutions.**

Keywords- telemedicine; eHealth; transnational; implementation

I. INTRODUCTION

Telemedicine and eHealth have been identified as important tools in the delivery of health care in the 21st century. EU eHealth strategy aims to improve citizens' health by making life-saving information available using eHealth tools, to increase healthcare quality and access by making eHealth part of health policy and coordinating EU countries' political, financial and technical strategies, and to make eHealth tools more effective, user-friendly and widely accepted [1]. Each of the countries involved has developed strategy accordingly. The Scottish Government released a National Delivery Plan that sets out the vital contributions of telehealth and telecare to health and care strategies in Scotland until 2015, including enabling services for 300,000 more people and normalising use of the technology into relevant services [2]. In Northern Ireland, the Telemonitoring NI service a scalable, mainstream, end-to-end service which provides a clinical triage service, was launched in 2011, aiming to benefit around 20,000 people over the following six years [3]. The Norwegian Centre for Integrated Care and Telemedicine [4] is the world's largest centre for research and development in telemedicine and e-health and is based in Tromsø. It has provided advisory services, plus research and development of telemedicine solutions since 1993.

Delivering healthcare to remote and rural populations is a significant challenge, requiring innovative strategies to overcome infrastructure deficits, travel difficulties and staffing problems. There is an urgent need to reduce transport costs and carbon footprint, plus a growing acknowledgement that models of long-term care will have to evolve to cope with demographic changes and the economic downturn. Telemedicine may help to provide equity of health service regardless of distance from major centres of care. Yet telemedicine is not in common use; while there have been numerous pilot studies, on completion technology is often withdrawn and the services have not been sustained. The disconnected nature of developments has meant similar problems are often encountered during each new implementation and knowledge is not shared between sites. Implementing Transnational Telemedicine Solutions (ITTS) proposed transnational knowledge exchange about services already proven to work in one country [5], using this knowledge to implement services in new settings.

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transnational telemedicine solutions in an effective and sustainable manner, normalising them into everyday practice. The plans for the project have been documented [6]. ITTS began in September 2011 and finished in March 2014, and built on previous work which mapped telemedicine services available in remote and rural areas of Northern Europe [7]. Six NPP area countries were actively involved and ten demonstrator telemedicine projects were implemented. The project teams were: Scotland (Lead Partner): Centre for Rural Health, University of Aberdeen; Finland: Oulu Arc Subregion; Ireland: National University of Ireland, Galway; Northern Ireland: Centre for Connected Health & Social Care; Norway: Norwegian Centre for Integrated Care and Telemedicine (NST); and Sweden: County Council of Västerbotten.

The objectives of ITTS were to create sustainable, long-term projects, enabling the uptake of transnational best practice and normalising the use of technology into everyday practice, at scale. ITTS aimed to improve accessibility by situating services in local communities, or in patients' homes, and reducing unnecessary hospital visits and travel for patients and staff. It also aimed to demonstrate cost-effective service delivery and evaluate the return on investment, encouraging the development of eHealth as a key business sector in the region. It was hoped this would encourage further development of telemedicine in remote and rural areas.

The ten demonstrator projects were classified into three themes: videoconferencing consultations; smartphone and internet based mobile self-management; and home-based health services. While most of the technology used in the demonstrator projects is in existence, the implementation occurred in new sites, and in a co-ordinated fashion to promote sustainability.

The major benefit of videoconferencing (VC) is to save travel time and costs, either for the patient who can contact their doctor at a site nearer their home, or for the healthcare staff, who need not travel large distances to visit patients. It also allows the introduction of services to areas that have been previously deemed too remote to allow cost-effective access. Because VC can use readily available, relatively inexpensive technology with which many people and institutions now have experience, it is a simple and economic introduction to telemedicine for clinics [8].

Smartphones are becoming increasingly popular and can provide reminders, symptom or activity tracking facilities, and of course, communication with health services, among many other features, allowing an inexpensive method of interaction with large numbers of patients. Similarly to websites, they can support self-management programs, providing an exchange of information for various health areas and the potential for patients to participate in their health care more pro-actively, thereby reducing the burden on existing services [9][10].

Finally, home-based care is of particular interest to people living in remote and rural areas, especially those who suffer from multiple or complex health and social care needs, and those who are restricted in their ability to travel by illness or mobility issues. Telemedicine can reduce hospital visits and help keep patients in their own communities, bringing care into their homes that they would otherwise not be able to, or have the opportunity to access [11]. The ten demonstrator projects are listed in Figure 1.

Previous work encouraged the idea that countries with experience of specific telemedicine implementations could 'export' their currently existing project to 'importing' countries which had little or no experience of the application [7]. This knowledge allows technology to embed more rapidly, anticipating and overcoming obstacles before they arise. ITTS had access to a wide range of experts within the different partner countries, with a similarly wide range of experience. However, the different countries have varying health systems and infrastructure capabilities, plus different legal situations, and so some 'translation' between countries is needed. An International Telemedicine Advisory Service (ITAS) was created to advise on all elements of the project planning, implementation and analysis. ITAS comprised telemedicine experts from all of the participating countries.

Project 1: VC links for speech therapy services *(Ire, NI, Scot, Swed)*
Project 2: VC links for renal services *(NI, Nor, Scot, Swed)*
Project 3: VC links for emergency psychiatry services *(Nor, Scot)*
Project 4: VC links for remote diabetes services *(NI, Scot)*

Project 5: Smartphones for tracking physical activity *(Ire, Nor, Scot)*
Project 6: Smartphones and internet support for diabetes
Project 7: Smartphones for inflammatory bowel disease *(Ire)*

Project 8: Remote support in medical and social care emergencies *(Fin)*
Project 9: Remote exercise classes for rehabilitation *(Fin, Ire, Scot, Swed)*
Project 10: Home-based service delivery for multimorbidity patients *(Fin, Ire, Swed)*

Figure 1: The ten demonstrator projects with the participating countries

Previous work [6] described the plan and proposed methods of the ITTS project (summarised briefly in section II). Section III presents new results of two years work in the implementation of this plan. Conclusions are drawn in Section IV. Future assessment will demonstrate whether there are travel savings, and whether the services are effective, sustainable and improve access to healthcare in remote and rural communities.

II. METHODS

The ITTS project began in September 2011 with projects identified from previous work [7]. Each participating country identified whether there was any telemedicine activity for the subject areas in their region and scoped the potential for its introduction. Potential sites were assessed for appropriateness and readiness. Each country identified which demonstrator projects they felt able to proceed with. Business cases were created to provide details of the clinical teams, aims, risks and expected impact of the projects, and the financial investments required. The project funding allowed for some purchase of telemedicine equipment for the demonstrator projects in each country. The business cases were reviewed by ITAS, who provided comments on the design and implementation strategies. Their feedback was addressed before any implementation began. Project development workers liaised with the clinical teams, organising all aspects of the implementation from assessing

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requirements to purchasing and installation. Once the technology was installed and staff trained in its use, the services were offered to patients, followed by the start of data collection for the evaluation.

The evaluation aimed to ascertain whether the demonstrator projects worked in each country, the factors associated with successful and unsuccessful implementation and the cost implications. Assessment examined patients' access to services, changes in hospital visits and travel for patients and staff, patient and staff views on their experiences of the services, social and cultural factors affecting implementation and sustainability and cost savings and return on investment from the projects. The methodology for this 'mixed methods' evaluation of the ten demonstrator projects was selected based upon the Model for Assessment of Telemedicine (MAST) [11]. It included the e-Health Implementation Toolkit (e-HIT) [12], to assess readiness and potential barriers to implementation; questionnaires and interviews with clinical staff and patients using the new services; details of health service and travel activity before and after implementation; and a health economics analysis including socio-economic scenarios modelling the impact of expansion of the new services.

III. RESULTS

The majority of the demonstrator projects have now been successfully implemented: ITTS has supported the development of 25 new services at more than 40 sites in the six participating countries. Table 1 provides details of these services.

Project 1: VC links for speech therapy services (Ire, NI, Scot, Swed)

Scotland and Sweden had both previously delivered speech and language therapy (SLT) services using VC systems to link hospitals [5]. VC has the potential to reduce travel costs for patients or therapists; for example, in Scotland therapists can travel for up to a 6-hour return journey to see a patient for an hour-long appointment. Reducing travel time releases time for therapists to see other patients. VC also facilitates the provision of intensive therapy courses requiring shorter but more frequent sessions. Various patients benefit from SLT, and ITTS implemented services with stroke patients in Northern Ireland, head and neck cancer patients in Sweden, and children with speech difficulties in Ireland. VC systems were located in patients' homes in Sweden, or within local community hospitals in remote or island regions such as the Aran Islands in Ireland and the Scottish Highlands.

Project 2: VC links for renal services (NI, Nor, Scot, Swed)

Existing renal VC services were expanded in Norway and Scotland and were exported to Northern Ireland and Sweden. Norway supported patients who are undergoing haemodialysis in their homes in addition to linking central and remote clinics. Scotland expanded their service to offer outpatient review appointments between the main hospital in Inverness and local renal units in Fort William and the Western Isles. Sweden set up links between Umeå hospital and local hospitals in Skellefteå and Lycksele to improve staff support and access to specialist care. Northern Ireland introduced home-based haemodialysis.

Project 3: VC links for emergency psychiatry services (Nor, Scot)

Emergency services cover out of hours assessments of patients in need of acute psychiatric help. VC connections with specialists can help prevent the automatic transfer and admission of patients by providing an assessment of the patient at the initial hospital, wherever that might be located. Norwegian studies have demonstrated that both patients and professionals reported no differences in quality and satisfaction between face to face consultations and VC assessments [14]. Reducing patient travel can help prevent additional distress and allows patients to remain near to the stability of home and carers. Norway had previously implemented 24-hour consultant VC cover from Tromsø and in ITTS expanded their service to include care for adolescent patients in Narvik, Lødingen and Tysfjord, as well as exporting it to Lorn and Islands Hospital, Oban, in Scotland. VC was also being used in multi-disciplinary team reviews to include community teams in ward rounds to help prepare for patient discharge and transfer.

Project 4: VC links for remote diabetes services (NI, Scot)

VC for diabetes services allows local access to specialists without the patients having to travel as far, or as often for several different appointments. Readings from blood glucose meters can be included in the VC link. VC was used in Scotland for patients with diabetes for annual or biannual review appointments, connecting the Inverness-based consultant with patients accompanied by diabetes specialist nurses based at community hospitals in Thurso. ITTS expanded the service to include Fort William and Portree on the Isle of Skye. Existing services in Orkney were extended to include smaller islands, where the VC is also used to connect three sites across the islands with the main centre at Balfour Hospital, with the option of a 3-way link to specialists in Aberdeen. The service was exported to Northern Ireland, connecting Ulster Hospital with Bangor Hospital.

Project 5: Smartphones for tracking physical activity (Ire, Nor, Scot)

The combination of the growing problem of obesity and the increasing popularity of smartphones motivated this project in which the accelerometer sensors in phones were used to monitor physical activity. A survey of pedometer applications (apps) was made and a suitable program chosen: Accupedo by Corusen LLC (Texas, USA). This app runs in the background as users go about their daily tasks and provides graphs detailing daily step count and progress

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TABLE I. SERVICES IMPLEMENTED BY COUNTRY

Project	Finland	Ireland	N. Ireland	Norway	Scotland	Sweden
VC links for speech therapy services	-	VC between the National University of Ireland Galway and the Aran Islands for paediatric patients. Start: August 2013	VC connection to stroke patients' homes in Newry and Mourne, plus a local health centre. Start: November/ December 2013	-	VC network in the northern Highlands is expanding and connecting to specialist services in Aberdeen and London.	Expanding use to head and neck cancer patients, connecting to patients' homes around Västerbotten.
VC links for renal services	-	-	Home haemodialysis support and care reviews. Start: November/ December 2013	Home peritoneal dialysis support via VC. Start: May 2012	VC consultations between Inverness, Fort William and the Western Isles. Start May 2013	VC network between hospitals in Skellefteå, Lycksele and Umeå. Start: November 2012
VC links for emergency psychiatry services	-	-	-	Connects Tromsø to Narvik, Lødingen and Tysfjord for assessment of paediatric/adolescent patients. Start: October 2013	Mobile VC connections between Lorn and Islands Hospital, Oban and on-call psychiatrists. Start: July 2013	Withdrawn
VC links for remote diabetes services	-	-	VC consultation between Ulster Hospital and Bangor Hospital. Start: February 2013	-	Expanding VC network between Inverness, Portree, Fort William and Thurso, plus links between Orkney island hospitals and Aberdeen.	-
Smartphones for tracking physical activity	-	Following a pilot trial, four GP clinics are 'prescribing' the app. Start: April 2013	-	App available at a Healthy Living Centre in Tromso, a public activity service for unemployed people and a Weight Loss Club. Start: May 2013	One Highland GP clinic offering the app. Start: May 2013	
Smartphones for inflamatory bowel disease	-	Consultant at National University of Ireland, Galway offers the app to patients. Start: September 2013	-	-	-	-
Remote support in medical and social care emergencies	Telehealth technology installed in Oulu Arc area nursing home. Start: May 2013	-	-	-	-	-
Remote exercise classes for rehabilitation	Classes delivered to elderly patients' homes in Oulu Arc area. Start: January 2013	Classes delivered in person and to COPD patients' homes in County Clare. Start: January 2013	Withdrawn	-	Classes delivered in person to COPD patients at Wick and Fort William, plus link to remote centres at Golspie and Broadford. Start: August – October 2013	Classes delivered to long-term pain patients' homes in Västerbotten. Start: May 2013

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TABLE I. SERVICES IMPLEMENTED BY COUNTRY (CONTINUED)

Home-based service delivery for patients with multimorbidity	VC support for Oulu Arc area patients with multimorbidity living at home, plus a health website providing test results and a method of communicating with health staff. Start: Oct 2012	Health room within a County Clare GP surgery offers monitoring equipment: BP, pulse oximeter, respiratory/ peak flow, BMI; plus exercise quipment:, health promotion DVD. Start: June 2013	-	-	-	Self-measurement of blood pressure at centres in Malå, Sorsele and Storuman. 'Check-up Bag equipment for nurses visiting patients to measure BP and calculate INR. Start: Nov2012 – May 2013

toward daily goals. The partners in Ireland ran a randomised controlled trial with the app [15] to determine its effectiveness and a suitable protocol for export to the other countries. The app was 'prescribed' by GPs in Ireland and Scotland and used by weight loss groups in Norway.

Project 6: Smartphones and internet support for diabetes

Diabetes is a condition that has massively increased in the past decade and is expected to further grow in the next few years [16]. There are already a large number of websites and smartphone apps to help users with the disease and partly because of this profusion, little is known about which are worthwhile recommending to patients. No new services were implemented within ITTS in this project; instead an international knowledge exchange was organised to tackle this complex subject area. Various stakeholders, including primary and secondary care clinicians, patients, technology developers and other interested parties, contributed to a discussion about diabetes telemedicine. Topics of particular interest included supporting self-management, providing access to integrated information, encouraging lifestyle changes, maintaining patient engagement, remote monitoring and improving access to care. Information and evidence about useful technology, smartphone and internet applications and other resources relevant to diabetes care was collated, and a network of expertise and resources created. A position paper is being written and future projects planned.

Project 7: Smartphones for inflammatory bowel disease (Ire)

A smartphone app was developed and trialled in Scotland in a collaboration between a surgeon at Raigmore Hospital, Inverness, and a technology developer company (Open Brolly, Forres, Scotland) to help monitor inflammatory bowel disease, and through ITTS this was exported to Galway, Ireland. The app allows patients to record and transmit their symptoms to a specialist nurse, with details of their medication use. The nurse views data on a central 'dashboard' which highlights any changes in patients' conditions, allowing the nurse to contact the patient and advise on any management adjustments required. This prompt response should help reassure patients, prevent unnecessary outpatient appointments and reduce admissions.
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Project 8: Remote support in medical and social care emergencies (Fin)

Northern Ireland in particular has considerable experience with telecare systems to support people with health or social care needs and help them to remain independent at home. Finland imported this service for frail elderly people in nursing homes who are given alarms which link to a centre from which help can be sent promptly.

Project 9: Remote exercise classes for rehabilitation (Fin, Ire, Scot, Swed)

VC rehabilitation classes for people with chronic obstructive pulmonary disease (COPD) or other conditions where guided exercise can be useful are particularly advantageous because such patients often experience difficulty travelling and the ability to take the classes at home or at a local hospital is beneficial. Remote patients perform the exercises and benefit from the same social, educational and clinical interactions as those physically present at the clinic. Scotland exported this project to Finland, where it is used with the elderly in their homes; in Ireland, where COPD patients participate in classes from home; and Sweden with patients suffering from long-term pain conditions. In Scotland, the service has been implemented in new sites using a 'hub and spoke' model, with physiotherapists in larger COPD clinics in Wick and Fort William leading classes for those present while also linking to remote community clinics in Golspie and Broadford. It is hoped that more clinics can join the links.

Project 10: Home-based service delivery for patients with multimorbidity (Fin, Ire, Swed)

Based on previous experience of home-based services for patients with complex care requirements, this project took different forms in different countries. In County Clare, Ireland, a self-monitoring station based within a GP clinic where patients can check their blood pressure and weight and use exercise equipment was implemented. In Sweden, clinic-based blood pressure self-monitoring services were implemented in Malå, Sorsele and Storuman, in addition to a second service: a "check-up bag" that nurses used on home visits to evaluate blood pressure and calculate the INR blood clotting measure. In Finland's Oulu Arc Subregion, patients used a web portal to access laboratory results, monitor their health and contact healthcare staff with any questions, plus

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housebound patients with social and health care needs were offered a VC care option.

At the time of writing, only three projects were not yet fully implemented and it was expected that continued effort would result in their implementation at a later date. The implementation of projects at two sites was cancelled due to service and department restructuring or closures. Many challenges were overcome, providing significant learning points, such as working with hospital IT departments to ensure that equipment is correctly installed and determined to be safe and secure, especially in projects where systems were located in patient homes. Other issues included information flow from management to front-line staff, and the effects of staff turnover.

Initial feedback from patients suggested they appreciated the time and travel saving that VC allowed. Those using home-based services said they enjoyed the social interaction the video links offered, as well as the access to services they would otherwise not have been able to use. Complaints mainly referred to connection quality: intermittent problems with the sound or picture on VC, for example.

ITTS collected and analysed data from the demonstrator projects. Results from the evaluation will be reported, and recommendations made aiming to help others interested in starting their own telemedicine services. Planned dissemination of the project results includes presenting the results from the demonstrator projects and cost analysis in peer-reviewed journal articles; attendance at various conference and policy-informing events; a report collecting together all the business cases ("A Case for Telemedicine"); and a guide containing an interactive checklist ("Telemedicine into Everyday Practice") aimed at policymakers and service planners, all of which will be available on the project website [17].

IV. CONCLUSION AND FUTURE WORK

Historically, telemedicine has rarely moved beyond pilot projects. The reasons include infrastructure issues, organisational barriers – both clinical and cultural – economic considerations and governance and security concerns. ITTS implemented telemedicine services across northern Europe, using transnational knowledge exchange to facilitate implementation, and encouraging success and sustainability. Patients are now using these services as a direct result of the project. ITTS has implemented 25 new telemedicine services across the six countries, offering benefits to patients and staff and showcasing what the available technology can achieve. Assessment will provide evidence about effectiveness and sustainability, but the achievement of implementing this number of telemedicine applications, from the initial planning stage [6], to the stage where they are operational should not be underestimated. This is the stage where many pilots fail, without attention to organisational issues.

The challenges of implementing solutions that are sustainable, transnational, and that bring telemedicine into everyday practice are considerable, but this project has demonstrated the impact of strategic investment. The goal of the project was to implement transnational telemedicine solutions, in an effective and sustainable manner. Effectiveness and sustainability are as yet to be measured, but ITTS has created expert networks which will hopefully continue beyond the project timeline. This contribution will form a foundation for further work as those services which are successful mature and expand, and new applications are developed. ITTS has provided a demonstration of what can be achieved with transnational collaboration and efforts to ensure knowledge and experience is shared in practical ways.

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