Connected Health in Ireland
An All Island Review
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Report Commissioning

This report has been commissioned by Enterprise Ireland and has been prepared by BioBusiness.

Acknowledgements

BioBusiness would like to acknowledge the support Enterprise Ireland provided in undertaking this project and it is hoped that the data collated can be utilised in the development of strategic decision making in ensuring Ireland (North and South) can position itself as a global centre of excellence in Connected Health.

BioBusiness would also like to offer a special thanks to all the survey participants in contributing and providing the data and enabling a better understanding of the connected health sector on the Island. A full list of participants is given in Appendix C.

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1. EXECUTIVE SUMMARY

Ireland (North and South) already has an international reputation for the quality of software development and medical device companies and research. While Connected Health is very much a convergent field with many technologies and services, the predominant capabilities lie in ICT and medical devices, hence underpinning the opportunity Ireland can leverage in terms of international recognition and capability. Coupled to this is the advantage of the Public Health Authority in Northern Ireland which provides a predominantly single payer health system, integrated health and social care and a population where many of the chronic conditions are prevalent. There is also a drive within the agencies north and south to embrace the potential that connected health can bring in terms of research opportunities, product and service innovation, company emergence and evolution as well as targeting foreign direct investment.

Connected health is a term that has come into use in the last number of years to describe the use of all aspects of information and communication technologies in the field of healthcare to improve the quality of care and outcomes. The term encompasses the topics included under the term of eHealth -as used within the EU-, digital health, health informatics, telemedicine, mHealth, ambient assisted living and the use of supportive technologies in ageing. However, Connected Health implies the use of operational and integrated systems to deliver patient centred healthcare and to provide remote connectivity with healthcare professionals to improve outcomes while also reducing risk and achieving greater efficiencies. It has additional benefits in patient empowerment in their own healthcare plan as well as in helping in compliance. While connected health makes use of software and hardware, medical devices, telecommunications and other technologies, the patient is at the centre of the model and linked to doctors, nurses, pharmacists and other healthcare professionals as appropriate.

Connected health by its nature lends to a collaborative network structure. It requires many stakeholders to provide input from patients, clinical end users, businesses and academics. This report covers the activities in connected health in Ireland circa March 2010. It encompasses many of the academic, business and clinical activities planned, currently being undertaken or undertaken in the recent past and now completed. It encompasses some of the activities in the wider international community to illustrate our global opportunity. In addition some of the collaborative programs, cross-border and international organisations, with activities ongoing in Ireland have been included.

The economics of healthcare are a complex issue and who ultimately pays for the connected health solution is always contentious. Due to the diversity of connected health solutions each should be dealt on a case by case basis. This report will not investigate the health economics of connected health.

Within academia, the report illustrates a diverse set of skills and capabilities with some larger research groups focused on connected health along with diverse pockets of individuals working within their own institutions. There is varying degrees of activities cross each of the Universities, FE Institutes and Institutes of Technology on the island with some more active than others. Specific Connected Health thematic areas are well developed in University of Ulster, Jordanstown and Dundalk IT. Healthcare applications for proving out technologies are one of the methods within academic research. A number of industry and clinical collaborations with academics are also yielding new product developments and advancements. There are many projects with connected health applications within the various Science Research Clusters (SRCs), Centres for Science Engineering and Technology (CSETs) and Applied Research Enhancement (ARE) Programme facilities. There have been very little commercial activities through spin-out or licensing from the academic sector with a handful that could be mentioned. There is however a number of academic-business link ups with major interests in connected health thematic area e.g. TRIL. One major area of interest is in Ambient Assisted Living with two groups in DKIT, UUJ, and NUIG, UL, GeorgiaTech pursuing active areas of research. The larger research centres to date have not had specific focus on connected health but much of
the work is at the periphery and many applications have been developed that are relevant to the sector including sensor development, communications middleware systems, data mining, telemedicine, and assistive and remote technologies. There is a lot of activity in the ambient assisted living area across the country but this is only one of the thematic areas organisations are investigating.

It has long been recognised that ICT is a major enabler to help in delivery of healthcare. It is also accepted that there has been insufficient ongoing investment in healthcare ICT locally. The report details a number of connected health initiatives that have been implemented or are currently being implemented across Ireland with some cross-border initiatives. It includes both social care and healthcare projects implemented by healthcare organisations and charitable non-governmental organisations. There are local, regional and national connected health initiatives each with their challenges. Feedback has been very positive from clinical and patient perspectives in the majority of connected health projects. The difficulty for many has been in the continuation of the projects and securing funding unless they were part of national initiatives and had secured that transformation from pilot study to roll-out. In general, connected health initiatives require a change in clinical work practices and established protocols. It also requires different interactions with patients and their buy in to the change. The implementation of connected health solutions must be seen as part of a transformation process. A number of issues of selling to the HSE and NHS are included as examples of dealing with the national public healthcare providers and a number of clinicians involved in connected health projects have been included. Details of the major NI initiative in connected health are included, which is Europe’s current largest project in delivery of Telehealth.

We have included over 48 companies in the connected health database (see Appendix A) involved in service delivery and product development in the connected health space in Ireland. There is a large cohort of multinationals both ICT and Medical Device active in Ireland in manufacturing and R&D that have connected health interests and activities. There are many that are not here in Ireland at all. There are opportunities to attract these to these shores through providing an infrastructure of collaboration across the different agencies- EI, INI, HSE, ITI, IDA etc. making Ireland a best place “to do” Connected Health. The HSE and PHA systems on either side of the border look to many of these larger organisations to provide the infrastructure on which to build their ICT solutions as well as the enterprise systems they implement. The local companies struggle to penetrate these public healthcare providers through cumbersome and protracted procurement processes. The private healthcare providers in ROI are also subject to HSE rules of procurement and can be just as difficult to penetrate for small companies. The public healthcare providers are generally followers, risk adverse and not leaders in the development and procurement of novel technologies and services especially in connected health. How, these companies engage with the public healthcare providers needs to be revised to support the growth of indigenous organisations.

As a developing sector, there are many opportunities for local companies to develop new products and to evolve new services. Many of them are detailed within the report. The difficulty locally is getting new products and service innovations trialled and implemented within the local healthcare system to provide evidence when selling globally. Many of the products evolving within the connected health space are by their nature aimed at an international market and links between indigenous SMEs and multi-nationals is paramount in developing sales channels and market acceptance. There are huge requirements for local service innovation within this space as connected health technology solutions are irrelevant without the links through service providers to clinical care teams ensuring a continuum of care.

Within the indigenous business sector there are again a diverse set of skills and capabilities covering eHealth, mHealth, Telecare providers, system integrators, sensor development etc. There is a necessity to keep these companies here, to support their growth through local sales opportunities and R&D support. There is a need to create a new thematic area of converging technologies and move away from the linear systems of medical technologies or ICT as these sectors collaborate closely and overlap. There is an opportunity for Ireland to position itself in the area of translational research working on the premise of “from bench to bedside” and successfully evolve new products, devices and services locally for the international commercialisation.
Ireland can attract the inward investment needed to drive the “knowledge economy”. This can and should be an all island initiative and drive. We must also learn from other countries activities through benchmarking and also seize the opportunities and provide leadership in the international marketplace.

Notwithstanding there are many examples of connected health solutions within the clinical space and ambient assisted living and telecare that have evolved and are being successfully used, and are evolving, on both sides of the border. There are multiple opportunities to learn from each jurisdiction’s experiences. Although there are significant differences in the funding of Healthcare provision in the two jurisdictions of Ireland at present the concepts of connected health allow a truly patient centred perspective regardless of the institutional structures or funding mechanisms. However, concerning opportunities for innovation in connected health in Ireland the greater decentralisation of healthcare in the ROI and diversity of funding mechanisms is likely to result in a greater diversity of initiatives in ROI than in NI where there is more centralised administration of health and social services.

This report is a review of a considerable number of connected health activities on the Island. The report is as inclusive as possible within time and resource constraints of the project, and there is a flavour of the diverse activities across Ireland. A number of recommendations are provided to support the development of this thematic area and help develop and grow the commercial sector within Ireland.
2. REPORT PREPARATION

2.1 Report Focus

BioBusiness have been involved in various connected health initiatives across Ireland (see note) since 2006. A working knowledge of the sector has been formulated and this has shaped the basis of the project engagement. This report delves deeper into the activities currently underway in Ireland but does not claim to be completely exhaustive. The report will illustrate activities within academia highlighting key contacts, research centres, collaborative projects and initiatives. Business activities and key focus areas are also detailed. The aim is to highlight some of the early clinical adopter active in this space as well as primary, and secondary care centres including hospitals. In addition charitable organisations were also engaged as appropriate.

The intention was also to cover various government initiatives in the connected health area across Ireland. From an international perspective a number of countries are spearheading the implementation of connected health services and some best in class example projects are included.

Note: The nomenclatures used to differentiate the different jurisdictions are as follows:

- ROI – Republic of Ireland
- NI – Northern Ireland
- Ireland – Republic of Ireland and Northern Ireland combined – all island

2.2 Our Approach

A database of contacts and information was already available through BioBusiness and was used to form the initial starting point for the report. Additional contacts and project details were obtained through a series of telephone conversations, website reviews, report reviews, one to one meetings, emails and network events. As additional contacts were made these were also engaged and as appropriate are detailed in the acknowledgements section. The companies and academics engaged were requested to confirm/supply information on their activities.

All those engaged were very forthcoming in supporting the initiative to develop a landscape of connected health activities in Ireland and to help promote Ireland as a place “to do” Connected Health.

Connected Health activities in Ireland are categorised as follows:

- Personal health records and informatics in support of acute care and in-hospital systems
- Medical devices / advanced diagnostics and point of care devices
- Telehealth monitoring of chronic conditions / home based monitoring systems
- Telemedicine and the use of telecommunication systems in clinical care
- Social alarms, Telecare, ambient assisted living (ageing well) systems and services
- Personal health, wellness and lifestyle support systems.
- mHealth (the use of mobile and smart phones in relation to any or all of above)

Companies that have been identified as presently or previously engaged in the healthcare / connected health space are included. There are many other companies in Ireland with potential capability to
participate in connected health and may have been omitted. The aim is to cover the above areas within the report. The list as above will not be exhaustive. Where new companies emerge or additional contacts made, these can be channelled through to the relevant support bodies. One of our recommendations is to maintain an active database of connected health activates and players.

Medical devices / advanced diagnostics and point of care devices or Personal health, wellness and lifestyle support systems are not specifically included within the scope of this report due to time constraints.

### 2.3 Report Layout

The report is broken down into specific thematic areas:

- Clinical
- Business
- Academic
- Government and Non-Governmental groups activities
- International perspective

As with the nature of connected health, there are many crossovers within each of these areas with business to clinical links, academic initiatives across campuses with company involvement. Connected health doesn’t work without collaborative networks. It was easier to section the report under the above banners. However, where available we have included the links between different organisations and individuals.

Much of the information is taken from press release, meeting notes, websites, reports and individuals directly.

### 2.4 Networking Benefits

Throughout this exercise it has been BioBusiness’ goal to maximise the opportunity for networking. As appropriate links have been made between individuals and organisations where potential synergies have been identified. These have typically come out of the one to one conversations. Many links have been made through the course of this work.

BioBusiness through the process of preparing this report have made a substantial number of introductions to individuals and organisations that previously had not engaged or were not aware of each other.

### 2.5 Abbreviations and Acronyms

- ABC: Academia, Business, Clinical
- ABHI: Association Of British Healthcare Industries
- AMNCH: Adelaide Meath National Children’s Hospital
- ARE: Applied Research Enhancement
- BCH: Belfast City Hospital
- BCI: Brain Computer Interface
- BCI: British Computer Industry
- **BHTA** | British Healthcare Trades Association
- **BMI** | Body Mass Index
- **BMW** | Border Midlands West
- **BRIC** | Brazil, Russia, India, China
- **BSO** | Business Services Organisation
- **BT** | British Telecom
- **CAALYX** | Complete Ambient Assisted Living Experiment
- **CARDI** | Centre For Research For Independent Living
- **CASALA** | Centre For Affective Software For Ambient Living Awareness
- **CAVE** | Cave Automatic Virtual Environment
- **CAWT** | Cooperation And Working Together
- **CEO / CE** | Chief Executive Officer
- **CFC** | Chlorofluorocarbon
- **CH** | Connected Health
- **CHF** | Congestive Heart Failure
- **CIC** | Community Interest Company
- **CITO** | Centre For Innovation, Technology And Organisation
- **COPD** | Chronic Obstructive Pulmonary Disease
- **CSA** | Co-Coordinating Support Action
- **CT** | Computerised Tomography
- **C-TRIC** | Clinical Translational Research And Innovation Centre
- **CUH** | Cork University Hospital
- **DATHs** | Dublin Academic Teaching Hospital
- **DCU** | Dublin City University
- **DEL** | Department Employment And Learning
- **DHSSPSNI** | Department Of Health, Social Services And Public Safety
- **DKIT** | Dundalk Institute Of Technology
- **DNA** | Deoxyribonucleic Acid
- **DTC** | Dundalk Town Council
- **EC** | European Commission
- **ECCH** | European Centre For Connected Health
- **ECG** | Electrocardiogram
- **ECHC** | European Connected Health Campus
- **EEG** | Electroencephalogram
- **EHR** | Electronic Health Record
- **EI** | Enterprise Ireland
- **EMC** | Emergency Medical Centre
- **ENT** | Ear Nose Throat
- **EOG** | Electrococulogram
- **ePCR** | Electronic Patient Care Reporting
- **EPR** | Electronic Patient Record
- **FDA** | Food & Drugs Administration
- **Fold** | Fold Housing Association Ltd
- **GE** | General Electrics
- **GP** | General Practitioner
- **GPIT** | General Practice Information Technology
- **GPS** | Global Positioning System
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<td>Middleware Group Communication Resource Embedded Systems</td>
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<td>Plug And Play Electronic Patient Record</td>
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<td>SPE</td>
<td>Structural Patient Education</td>
</tr>
<tr>
<td>SToRC</td>
<td>Software Technology Research Centre</td>
</tr>
<tr>
<td>SVUH</td>
<td>St Vincent’s University Hospital</td>
</tr>
<tr>
<td>TCD</td>
<td>University Of Dublin, Trinity College</td>
</tr>
<tr>
<td>TCP</td>
<td>Temperature Controlled Pharmaceuticals</td>
</tr>
<tr>
<td>TED</td>
<td>Tenders Electronic Daily</td>
</tr>
<tr>
<td>TILDA</td>
<td>The Irish Longitudinal Study On Aging</td>
</tr>
<tr>
<td>TRAIL</td>
<td>Technologies For Rurality Aging And Independent Living</td>
</tr>
<tr>
<td>TRIL</td>
<td>Technology Research For Independent Living</td>
</tr>
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<td>Telecommunications Software And Systems Group</td>
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<td>Television</td>
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<td>UCC</td>
<td>University College Cork</td>
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<td>UCHG</td>
<td>University College Hospital Galway</td>
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<td>United Kingdom</td>
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<tr>
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<td>UK Council For Health Informatics Professionals</td>
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<td>University of Limerick</td>
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<td>UUJ</td>
<td>University of Ulster, Jordanstown</td>
</tr>
<tr>
<td>UUMagee</td>
<td>University of Ulster, Magee</td>
</tr>
<tr>
<td>VA</td>
<td>Department of Veterans Affairs</td>
</tr>
<tr>
<td>WALT</td>
<td>Wireless Assisted Living Testbed</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wireless Computer Network</td>
</tr>
<tr>
<td>WISAR</td>
<td>Wireless Sensor Applied Research Laboratory</td>
</tr>
<tr>
<td>WIT</td>
<td>Waterford Institute of Technology</td>
</tr>
<tr>
<td>WRC</td>
<td>Work Research Centre</td>
</tr>
<tr>
<td>WSNs</td>
<td>Wireless Sensor Networks</td>
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</table>
### 3. INTRODUCTION

#### 3.1 Connected Health Definition

Connected Health is a term proliferated in recent years to encompass terminology such as eHealth (as used by the EU), digital health, telehealth and home based care. The incentive behind connected health is to develop and deliver healthcare solutions that can increase quality of life and reduce the risk to patients while lowering the overall cost of care. Systems of connected telecare and telemedicine solutions, foster independence and empower people and organisations to better manage their own life, health and wellness.

Joe Kvedar (Founder and Director of the Centre for Connected Health, Boston Mass. 2007) defined the following - “Connected Health is the use of messaging and monitoring technologies to bring care to where the patient is, when the patient needs it.” The term is used to describe a model for healthcare delivery that uses technology to provide healthcare remotely. It aims to maximise healthcare resources and provide increased, flexible opportunities for consumers to engage with clinicians and better self-manage their care. It uses technology – often leveraging readily available consumer technologies – to deliver patient care outside of the hospital or doctor’s office. Connected health includes programs in telehealth, remote care (such as home care) and disease and lifestyle management, and is associated with efforts to improve chronic care. Essentially “Connected Health” is the utilisation of “connecting” technologies (communication systems – broadband, wireless, mobile phone, fixed phone lines) and medical devices for healthcare applications with the relevant healthcare professionals.

The provision of interoperable devices and services fall into three major categories: chronic disease management, independent ageing, and health & physical fitness. By enabling systems readily in connected health and medical devices, people with chronic diseases can share vital sign information with clinicians, general practitioners, nurses, carers or family as appropriate. Key elements include the optimal use of modern telecommunications and the internet in operating these networks and will be based on proven international standards of connectivity and interoperability/ harmonisation.

Other terms are also used in reference to particular of Connected Health:

- **Telemedicine** is the application of clinical medicine where medical information is transferred via telephone, the Internet or other networks for the purpose of consulting, and sometimes remote medical procedures or examinations. Sub sets of telemedicine include telecardiology where ECG readings are transmitted for clinical analysis, and teleradiology and teleneurology etc
- **Telehealth** refers to the remote delivery of both clinical and non-clinical services such as medical education, administration, and research.
- **eHealth** is an umbrella term most commonly used in Europe that includes telehealth, electronic medical records, and other components of health IT.
- **Telecare** refers to the use of networks in providing social care services and monitoring for the vulnerable and elderly and in many instances can provide a basic network of communication on which more sophisticated monitoring can be built.
- **Home-based Care** refers to the remote exchange of physiological & physical data between a patient at home and a response centre (hospital, a GP practice, family or 3rd party provider) to assist in diagnosis, condition monitoring and prevention.
- **mHealth** is the most recent term that has emerged with the almost global ubiquity of mobile phone communications and refers to applications of mobile phone technology in healthcare.
Connected health encompasses all these aspects of networking. The concept has implications for all aspects of healthcare and will have a profound impact on future healthcare delivery throughout the world.

It is critical to understand that connected health is an enabler to patient care. It requires many insights and inputs ensuring the continuum of care. One of the central tenets of connected health is putting the patient at the centre of their care and getting their active involvement, minimising or eliminating wasteful processes and achieving effective treatments and support. Technology is only the enabler, but it requires clinical engagement with changes in practices at all levels and a new mechanism for reimbursement.

3.2 The Emerging and Growing Global Market

A number of key global trends will shape the global marketplace in this sector:

- Changes in disease patterns are putting more pressure on healthcare costs.
- Chronic diseases management account for the dominant part of health costs, this derives from an ageing population, rise of obesity and previously terminal diseases becoming chronic through therapy development;
- Emergence of new diseases due to increased global travel and climate changes; growing antibiotic resistance in some existing diseases.
- In a bid to control spiralling costs, a growing number of governments, in both developed and developing countries, are trying to shift the focus from the treatment of disease to its prevention. At the same time, industry will be expected to provide value for money.
- Increasing role of Information Technology (IT). This is anticipated to become a key enabler to more effective storage and retrieval of patient records, improved tracking of medical research and therapy outcomes, and better remote care.
- The Globalised market place. Collaborative product development across boundaries and companies is anticipated to become more pervasive. India and China are fast becoming preferred centres of product development and manufacturing activity.
- The development of globalised “interoperability” and standards to allow the development of integrated uses with different hardware and software.
- The growing interest in “ageing well” and health living as a driver for new product and service innovation
- The drive of local and multinational organisations to influence and drive changes in healthcare provision
- New enabling technologies enabling novel convergence opportunities

Connected health is an emerging field of innovation and in many countries, markets have not yet emerged and they face institutional and other barriers (Hietala, Maksimainen, Brunnen and Saranummi 2009). Thus, present estimates of regional and global markets are rather speculative and are based on many assumptions and extrapolations of the know incidence of different conditions. Indeed market analysis and estimation is more appropriate at a national level where institutional, cultural and financial barriers can be evaluated and projections based on the openness of healthcare practice in that country to innovation.

Recent estimates of the market values in aspects of connected health include the following;
- Tele-health: $591m 2005 to $5.96bn 2010 and $8bn by 2012 (CAPSIL)
- Tele-Care: $220m 2005 to $337m 2010 (Frost & Sullivan, 2006)
3.3 Ireland

Across the Island of Ireland there is a wide range of developing activities and initiatives both north and south. These range from Telehealth services to ambient assisted living research programs, deployments of systems, EPR, R&D in new product developments and the use of new IT solutions in diverse aspects of acute and clinical care. The aim of this review is to identify and record the range of current activities in this area, to provide a basis for further implementation of Connected health and opportunities for collaborative efforts among research community, business innovators and clinicians and health professionals; leading to expanding market opportunities at home and abroad.

Figure 1: The Connected Health Continuum

The Economic development agencies on the Island, namely Enterprise Ireland, the Industrial Development Agency, Invest Northern Ireland, InterTradeIreland and various other funding bodies have targeted connected health as a growing sector where Ireland has an opportunity to become a global centre of activity and excellence.

As an example the Matrix Report\(^2\) gave the Northern Ireland vision of homecare based systems and how they could develop local industry. It showed a continuum from interactions the development of novel medical devices including sensors, assistive devices, alert systems, and vital signs monitoring devices. These are then integrated into telecommunications systems including fixed, wireless, and broadband requirements. Communicated data from the devices requires analysis with the opportunity to develop sophisticated algorithms and data management solutions. To close the loop the system needs an appropriate response mechanism through care givers, telemonitoring (technical and clinical triage) or primary/secondary care givers. Figure 1 illustrates this continuum of care that connected health can bring.
Connected health (technological convergence) fits into the ROI agenda for Building Ireland’s Smart Economy.

“Ireland should not depend excessively on external investors for its economic future. We already have some notable indigenous enterprises that have become worldwide companies. Ireland must build on this success so that we develop a thriving indigenous enterprise sector. Building the stock of knowledge and know-how in the economy is critical to Ireland’s future economic development. Innovation is the key building block in developing a thriving indigenous industry as a complement to Ireland’s concentration of multinationals.

The presence of multinationals and the evidence of technological convergence - the tendency for different technological systems to evolve towards performing similar tasks - create a demand for innovation and partnering with start-up companies which gives Ireland a competitive advantage in innovation”. [Source: Building Ireland’s Smart Economy, Department of the Taoiseach, December 2008.]
4. CLINICAL CAPABILITY AND ACTIVITIES

4.1 Republic of Ireland

4.1.1 ROI National Development Plan 2007-2013

Under the National Development Plan\(^3\), Health Information and Communications Technology Sub-programme of the National Development Plan 2007-2013 Transforming Ireland, it is set out clearly that Telecare and Telemedicine are areas of development in Ireland.

“Developments in the areas of Telemedicine and Telecare will utilise ICT to facilitate the greater delivery of healthcare services over considerable distances. These developments will employ advanced communication technology between doctors, other carers and hospitals and will be increasingly focused on enabling care delivery in the community and in the home, thus offering significant opportunities for improving the way in which healthcare is delivered.”

Back as far as 2001 in the Quality and Fairness: A Health System for You. Health Strategy report\(^4\) connected health solutions had been mooted.

“Mobile communication technologies are evolving rapidly and could enable the development of new eHealth service delivery models, especially for staff working in the field such as public health nursing, and out-of-hours and emergency services, by providing access to medical and administrative records. Telemedicine and telecare systems can bring images and other clinical data (rather than the patient) to the care provider, thus providing remote consultation. By limiting the need to travel, this technology has the potential to increase the accessibility of some services. Telecare and telemedicine has the potential to bring specialised diagnostic and clinical expertise closer to people, especially those in remote locations, making the health service more accessible and responsive.”

Thus, setting the governmental position, ROI have aspirations to enable ICT and technology to enhance care to the patients.

4.1.2 Overview of Services

The expectation of the Irish health system is very clear – the best possible standard of care available to all. The personalised vision expressed in the 2001 health strategy document “Quality and fairness for all” still applies:

- A health system that supports and empowers you, your family and community to achieve your full health potential.
- A health system that is there when you need it, that is fair, and that you can trust
- A health system that encourages you to have your say, listens to you, and ensures that your views are taken into account.

Achieving this vision takes a combination of resources, planning and reform which includes more effective adoption and use of information and communications technology (ICT) for clinical and administrative purposes. These goals are being addressed in the multi-year health service transformation programme that is intended to bring about real improvements in services for patients. ICT has a major role to play in the transformation programme. Already, due to cost overruns, contract and scheduling issues there is the
potential for significant learning from several major ICT enabled change programmes within the Irish health services. Many of these have been well publicised and it is critical that the learning from these projects is successfully applied to deliver real value within the health services.

Drawing on international best-practice and a series of detailed reports, the Irish Government decided in 2001 to introduce a unified health system by fundamentally reorganising the way in which the national health system is structured and managed. Since then two new organisations have been established and are operational: the Health Service Executive (HSE), and the Health Information Quality Authority (HIQA).

General practitioners (GPs) are self-employed. The majority treat public and private patients, and enter into contract agreements to provide services for patients with full medical cards in return for capitation payments. GPs have a complex gate-keeping role: individuals who are not entitled to free primary health care may go to secondary care facilities.

The public hospital sector incorporates voluntary, private and HSE hospitals. HSE hospitals are funded directly by the state and administered by the HSE. Public voluntary hospitals are financed primarily by the state but may be owned and operated by religious or lay boards of governors. In addition there are a small number of purely private hospitals. Hospital consultants are paid on a salaried basis for the treatment of public patients. Contracts permit extensive private practice reimbursed on a fee-for-service basis.

Currently there are 52 acute hospitals, and Accident & Emergency services are provided in over half of these hospitals. 25% of the population has a chronic disease and 60% of deaths are caused by chronic diseases. Today 11% of the population is over 65 years old, and in thirty years time 40% will be over 50 years old. Changing age profiles and increased expectations relative to improvements in health technologies and pharmaceuticals are driving up health care costs.

The health services policy document ‘Quality and Fairness: A Health System for You. Health Strategy’ contains five references to telehealth/telemedicine which recognised - ‘telecare and telemedicine has the potential to bring specialised diagnostic and clinical expertise closer to people, especially those in remote locations, making the health service more accessible and responsive’.

“What people don’t understand is that the HSE is the largest ICT company in the State. We are only spending .75 per cent, around €100 million, of our health budget on ICT, which is extraordinarily low by any comparisons – Scotland, which is roughly comparable to us, spends £225 million sterling. Our spend covers everything, including staff, support and development so by any stretch it’s very low.” [Source: Gerry Hurl – Director of ICT, HSE]

4.1.3 National ICT Strategy

It is expected the HSE’s National ICT Strategy will be published by the end of June 2010, subject to the identification of the required resources and clarification of the capital ICT allocation, the HSE Board has been informed.

In an update to the Board in January, HSE National ICT Director Mr Gerard Hurl reported that during 2009 a series of meetings took place with the Departments of Health and Finance at which support and commitment was received for the underlying objectives, concepts and deliverables of the ICT Strategy.

“All approval has also been obtained to proceed with the development of a framework for applications in information, communication and technical architecture for future ICT developments in the HSE” Mr Hurl
said. “A White Paper on information governance will be published by the end of March and a business case is being finalised for submission to the Departments of Health and Finance on a new ICT organisational structure for the ICT Directorate”, he also told the Board. “In total, 106 existing ICT projects were progressed during 2009 and three new projects were approved by the Department of Finance”, Mr Hurl reported.

4.1.4 Cost-Savings through Telehealth

The potential for cost-savings through Telehealth within the HSE is perhaps best illustrated by some of the HSE’s own statistics.

From Acute Hospital Bed Capacity Review 2006- A preferred Health System in Ireland 2020. Patients over 65 accounted for 48.7% of bed days used, despite only accounting for 26.7% of discharges. This is because the average stay of an over 65 in hospital is 11.5 days compared with 4.6 days for the 0-64 bracket. This review also revealed that a shocking 39% of in-patient services could be treated in alternative settings.

More specifically there will be a need for Telehealth Services as the incidence of COPD, heart failure and diabetes, the three conditions which the Bosch Telehealth Health Buddy system primarily caters for, are high, especially in the BMW regions and rural Ireland. These conditions accounted for more than 1.4 million bed days in between Aug 2006 – Aug 2007. The cost for a patient spending one night in an Irish public hospital is estimated as follows:

<table>
<thead>
<tr>
<th>Area</th>
<th>Cost Per Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSE Regional Hospitals</td>
<td>€758.00</td>
</tr>
<tr>
<td>HSE County Hospitals</td>
<td>€506.00</td>
</tr>
<tr>
<td>HSE District Hospitals</td>
<td>€217.00</td>
</tr>
</tbody>
</table>

Table 1: Hospital Cost per Patient per Night

Taking the average of these three as €494 per hospital bed, the average cost of a stay in hospital for a person over 65 (given the above HSE figure of 11.5 days for average stay) is €5,681 per stay to the taxpayer. This figure does not include any costs occurred during the patients actual treatment i.e. Consultations, tests etc. and this would add substantially to the cost figure, depending on the treatment required. This would bring the average cost of one stay to approximately €7,000.

However, a possibly more significant distinction is the added value like:

- Higher quality of patient health information and reliable evidence that the Telehealth system provides. This is designed to monitor a patient’s condition at regular intervals and avoid the gradual deterioration which will ultimately result in costly unplanned check-ups. The system has successfully achieved this in other markets where the system has been installed.
- Encouraging patient to self–manage and empowering them to feel more in control of their own condition
- Reducing the number of unnecessary trips and waiting times whilst proactively providing early intervention

The actual practitioners and beneficiaries of telehealth are increasingly breaking free of the circle of doubt. One of the largest health plans and integrated health services provider in the US reported results last year for an internal study on a home telehealth program for congestive heart failure. From a recent US study of a Community Based Care System [Source: Continua Alliance], based on a population of approximately 250 CHF patients, the key metrics measured before and during the trial are shown in Table 2.
### Patient Activity

<table>
<thead>
<tr>
<th>Patient Activity</th>
<th>Before</th>
<th>During</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor Office Visits</td>
<td>3466</td>
<td>2099</td>
</tr>
<tr>
<td>Other Office Visits</td>
<td>5329</td>
<td>2835</td>
</tr>
<tr>
<td>ER Visits</td>
<td>908</td>
<td>413</td>
</tr>
<tr>
<td>Inpatient Admissions</td>
<td>783</td>
<td>286</td>
</tr>
<tr>
<td>Inpatient Days</td>
<td>2459</td>
<td>899</td>
</tr>
</tbody>
</table>

**Table 2: Patient Trial Metrics**

The provider concluded that this was sufficient evidence to move beyond the research and investigation on the existential questions and to fully implement the telehealth program. This exemplifies the growing refrain heard from within many large provider organisations which have built their own corpus of hard evidence outside public view—“we are convinced”. [Source: Catherine McGuigan – McElwaine Smart].

### 4.2 Northern Ireland

#### 4.2.1 Overview

The Department of Health, Social Services and Public Safety[^6] is one of 11 Northern Ireland Departments created in 1999 as part of the Northern Ireland Executive by the Northern Ireland Act 1998 and the Departments (Northern Ireland) Order 1999. In April 2007, the 19 providers of health and social care were reconstituted to form five Trusts, and in April 2009 four wholly new HSC organisations were brought into being by the Health & Social Care (Reform) Act (NI) 2009:

- The Health and Social Care Board (HSCB) [http://www.hscboard.hscni.net/](http://www.hscboard.hscni.net/), with responsibility for commissioning, resource management and performance management and improvement;
- The Public Health Agency (PHA) [http://www.publichealth.hscni.net/](http://www.publichealth.hscni.net/), with responsibility for improving the health and wellbeing of everyone in Northern Ireland;
- The Business Services Organisation (BSO) [http://www.hscbusiness.hscni.net/](http://www.hscbusiness.hscni.net/), with responsibility for providing a broad range of regional business support functions and specialist professional services to the whole of the Health & Social Care sector; and
- The Patient and Client Council (PCC) [http://www.patientclientcouncil.hscni.net/](http://www.patientclientcouncil.hscni.net/), with responsibility for providing a strong voice for patients, clients and carers.

The Health & Social Care Services (HSC) in Northern Ireland, manage the Acute and Community Services provided by the 5 Health Trusts, General Practitioner Surgeries and Clinics, Health Boards and Agencies and central government healthcare services. Key figures for the Northern Ireland Healthcare System are

- 77,000 people [10% of the workforce]
- 1100 GPs + 300 sessional GPs in 360 practices
- 1250 Consultants
- 21,000 Nurses & Midwives [1600 in the community]
- 9 main acute hospitals
- 7800 hospital beds, 83% bed occupancy
- 1.5 million hospital attendances
- 720,000 A&E attendances
The European Centre for Connected Health (ECCH) is a separate body under the DHSSPS was set up to formulate and implement Northern Ireland’s Connected Health strategy. They prepared a strategy paper “Developing a Connected Health and Care Strategy for Northern Ireland Health and Social Care Services” which set out a vision for the development of connected health and social care services, to identify the priorities for development and to detail the issues which will need to be addressed to bring the strategy to realisation.

### 4.2.2 European Centre for Connected Health (ECCH)

The primary purpose of the Centre is to improve the patient and client experience, providing for better quality and more effective care. By supporting the more efficient delivery of health and care services, it will also enable the care system to better respond to the future needs of the population. The ECCH is the predominating connected health project in NI and it was set up to:

- Design and facilitate a remote telemonitoring program for 5000 patients with long term conditions by 2011
- Develop a 5-7 strategy for Connected Health for NI
- Establish and develop links with Academia and Industry locally
- Establish links with European and other bodies involved in Connected Health

ECCH has focused on the first aim. The Draft Strategy Document was completed in March 2009 and currently is being considered by the DHSSPSNI.

Four chronic disorders, diabetes mellitus, chronic heart failure, chronic obstructive pulmonary disease (COPD) and stroke have been targeted under the ECCH delivery. The aim is to have telehealth capability supplied to 5000 patients. This is a cumulative total over 1 year. In other words, if a patient only requires monitoring for a 13 week period, the equipment could in theory be recycled 4 times in the year.

Remote telemonitoring is one element of telemedicine. It involves the remote recording of data about a patient without the presence of a healthcare professional, often in the patient’s own home. Typically a remote telemonitoring service will record the vital signs of the patient such as blood pressure, pO2, weight and heart rate etc. However the same technology can also be used for recording other data items such as a patient’s response to preset questions of clinical interest. The remotely captured data is then transmitted using telecommunication systems to the remote monitoring service provider.

The ECCH put the delivery of telemonitoring out to tender in 2008. 47 expressions of interest were finally whittled down to 4. ECCH announced that the following Bidders and their associated subcontractors/partners/consortium members have been invited to proceed to the next stage of the procurement process for the Remote Telemonitoring Northern Ireland (RTNI) Managed Service.

- Robert Bosch GmbH with McElwaine Smart
- British Telecommunications plc (BT) with Home Telehealth Limited
- Hewlett Packard Limited with Honeywell HomMed, Intel and Home Telehealth Limited
- TF3 consortium comprising Tunstall Healthcare (UK) Limited (Tunstall), Fold Housing Association Limited (Fold) and Silicon and Software Systems Limited (S3)

ECCH are working with, and on behalf of, the five Health & Social Care Trusts will now be engaging in an intensive period of dialogue with the 4 shortlisted bidders with the aim of concluding that process and
commencing service implementation in early 2010. Announcement is due in June 2010. The Health & Social Care Trusts will deliver the service to the local community.

**Background**

15 pilots are in operation delivering various aspects of care. Of these 8 most relevant to the substantive program were evaluated by BDO Stoy Hayward. The other 7 were the subject of internal Trust evaluation. Lessons learned from these pilots have helped shape the main program parameters. Both the Paediatric Pilot and the ICD Pilot are likely to be mainstreamed by the host Belfast Trust but are outside the current scope of the ECCH Program.

- 15 pilots on Telecare (vulnerable patients), COPD, Diabetes, Vascular Disease, Dementia, ICD monitoring, Ambulatory ECG monitoring, Stroke support, Bruxism, Paediatric Congenital Heart Disease, e.g.
- Prof Frank Casey (Belfast rust) – paediatric/children congenital heart failure telemonitoring link to homes. This project is still ongoing and providing great support and comfort to patients and families alike.
- Implantable Cardiac Devices (ICDs) daily monitoring. 600 devices are monitored daily. Data is transferred to remote cardiac monitoring centre within the Trusts. Where there are irregularities these can be acted upon. This does not include pacemakers.

The ECCH are restricted to working with the shortlisted bidders. Opportunities for local product and innovation have been limited. There has been more service innovation with changes in processes and practices at the core of the initiative. It is critical that the ECCH delivers an acceptable technical, clinical and cost effective solution. This project is being reviewed with great interest in the EU and beyond as a test case for large scale procurement of connected health.

Some of the feedback is recorded in the BDO Stoy Hayward Report.

- Patients love it
- Clinicians grow to like it
- It appears to reduce anxiety and offer reassurance (mainly to patients!)
- It appears to facilitate appropriate staff deployment
- It may increase workload initially
- Parameter setting (or not) is absolutely crucial

**4.3 Connected Health Product and Service Development**

**4.3.1 Regulatory Implications**

The regulatory position in Ireland is that any connected health product must be CE marked for use in the EU. For trials the following regulatory position was supplied by the Irish Medicine’s board for clarification of the position:

**IMB Ref: Q0893**

Before medical devices may be used in human subjects they commonly undergo various types of pre-clinical testing such as simulated use, bench testing, computer modelling etc. in order to demonstrate safety and performance. However, it is often required to perform clinical investigations of new devices on human subject in order to fully demonstrate the
device safety performance. It is at this point the study may be considered a clinical investigation; prior to commencing a clinical investigation it is critical that every effort has been made during the pre-clinical testing phase to identify major device-related safety issues and that every effort is taken to ensure that unnecessary risks are avoided and unavoidable risks are minimised.

A clinical investigation of a medical device is defined, as per ISO 14155, as “any designed and planned systematic study in human subjects undertaken to verify the safety and/or performance of a specific device”. The majority of clinical investigations that require review by the IMB involve non-CE marked medical devices and are submitted by medical device manufacturers/sponsors; this would also include prototype devices used on human subjects to generate device performance data.

Regards,

Scientific Officer, Clinical Assessment
Human Products Authorisation & Registration
Irish Medicines Board | Bord Leigheasra na hÉireann
Kevin O’Malley House, Earlsfort Centre, Earlsfort Terrace, Dublin 2.
www.imb.ie

The requirements for the FDA or other international bodies are not included herein. It is recommended that the notified bodies and competent authorities are engaged early in any product and service development.

4.3.2 Connected Health – A Transformation Project

Stage I - Conducting pilot studies

When designing a connected health project one must consider the beginning, the middle and the end of the process. The connected health clinical trial pilot study that many projects tumble at has to be seen as stage I of a transformation project (Pilot Phase). Connected health clinical trials, typically, do not fit into the standard randomised clinical trials model and new assessment methodologies are needed. In addition new ethical issues arise\(^8\) and these need new thought processes and innovative approaches to address the new challenges posed. Currently Molecular Medicine Ireland\(^9\) (MMI) is developing a standard ethics submission protocol for use in all the hospitals in Ireland.

It is critical to understand the end-to-end transformation process to ensure a roll-out phase past the pilot phase occurs and projects successfully transfer into procurement. The graph in Figure 2 [Ref: Rodd Bond, Netwell Centre, DKIT] illustrates the all too common death of pilots. From initial engagement through to full implementation requires an holistic approach to ensure acceptance, deployment and sales.
4.4 Working with Public Procurement in the HSE and the NHS

4.4.1 Health Service Executive (HSE)

The HSE ICT Directorate is responsible for all projects involving connected health initiatives in ROI. Individual sites may conduct pilots and trials. Typically these will also pass across the directorate’s tables. Where these impact with active HSE systems and processes, this is where the greatest challenges lie. At a meeting with the HSE ICT Directorate a number of ongoing challenges to developing, engaging, implementing and procurement new connected health type solutions were discussed. There is a massive barrier to adoption in an Irish site where the HSE organisation provides a service on a day to day basis and any new innovation whether it is in the service or technology space must undergo rigorous review prior to any implementation with full risk analysis. A number of points were raised and these are detailed below. It includes a number of recommendations.

- The HSE is not a test bed. It is a service organisation. Preference is for proven technologies and providers.
- They have 160 ongoing projects including 90 capital projects at various stages of development. These are national, regional and local projects and cover all aspects of ICT including potential connected health initiatives.
- >€10K has to go to etenders.gov.ie and a subset of >€260K approx. has to go to EU tenders.
- ICT projects are approved by Department of Finance.
- There is no dedicated unique health identifier for the citizens in ROI. The health information bill is due for publication in 2010 and will help address this issue.
- Companies must take care to understand the requirements of procurement.
- Companies must have an holistic view of engaging an organisation like the HSE and understand who they interact with and their capability to drive pilots and roll out.
• Difficulty for small companies navigating the HSE procurement process. Key is to understand how projects progress from pilot to roll-out and engaging all stakeholders especially the HSE early in the process especially where the project impacts on current processes within the system.
• Understanding the decommissioning process where new system may fail or be rejected.
• Understand the timelines in a project within the HSE.

The two major points that came out of the meeting that the agencies in Ireland need to work on in a truly holistic approach.

• New mechanism for engaging in connected health projects is necessary where it is possible to meeting the company’s needs and the HSE systems.
• Current weaknesses within the healthcare system in Ireland are the lack of domain knowledge and a lack of technical and business resources.

[Source: personal discussions – Fran Thompson, HSE ICT Directorate]

4.4.2 Adelaide and Meath Hospital, Tallaght

The Adelaide and Meath Hospital, Tallaght has expressed their interest in driving an ICT/eHealth agenda as they pursue their strategic initiatives. This is being driven from their senior management teams. They are engaging various outside organisations to help develop this strategy and want connected health to be an integral part of their hospital e.g. Robodoc (see below). They are positively welcoming to trial new products. As with all other larger roll out initiatives they are at the behest of the HSE for larger project implementations.

There are several consultants also working within the hospital interested in technology solutions including a number of gastrointestinal and vascular surgeons. The hospital is linked to the Trinity Academic Medical Centre

Two recent introductions through BioBusiness, Feb 2010, have opened up more opportunities in developing links to local SMEs developing products in the cardiac care in the community and sleep apnoea through enabling clinical input and aiding in running cost effective clinical trials locally.

4.4.3 The National Health Service - NHS

Gary Welch, UKTI, recently presented a paper of on Selling into the NHS - Understanding the NHS Market and Procurement Landscape – as part of the Life Sciences Roadshows by UK Trade and Investment, Belfast, 25 February 2010. From the discussions with the HSE above there are similar parallels with selling to a complex organisation such as the NHS or HSE. The presentation was summated into the following 21 points. They speak volumes to any company or organisation engaging with a health authority anywhere in the world.

• Understand the health economy and how it works
• Be clear about how your product or service helps address national priorities or efficiencies – align your product
• Understand the care pathway and touch points for your product
• Identify key influencers – patients & HCWs – and engage. But remember they may not be the buyers or budget holders. (Lots of support but no sales!!)
• Build evidence – package into a good business case and develop your sales stories around the benefits (sharper, quicker, safer, easier, cheaper)
• Identify who buys (cost) and where the benefits go – may not be the same place
• Secure any necessary approvals
• Identify key centres for your product (e.g. Orthopaedics – SWLEOC)
• Decide the most effective level of entry (local, regional, national) for your product – identify procurement calendars and forward plans
• Consider carefully the complexity and cost of pursuing larger national opportunities
• Be aware of the human factors on the NHS/buying side and any likely departmental user interest and conflicts
• Understand the legal and governance requirements for procurement and use to your advantage – e.g. monitor OJEU (TED – Tenders Electronic Daily)
• If national then check category responsibilities with websites of NHS PaSA (pharmacy), NHS Supply Chain and Buying Solutions - and make contact
• Register with sid4health (www.sid4health.nhs.uk)
• For CPHs contact details research NPA website
• For Trust contact details research DH PICD website, Google or Connecting for Health or Trust websites - seek out contact details for Head of Procurement. Could also use Binleys (www.binleys.com)
• For securing local commitment approach CPHs, CSUs or Trusts – even for national frameworks (uptake)
• To find a partner (agent/distributor) contact the relevant trade associations such as ABHI, BHTA
• For introducing innovative products to the NHS approach innovation organisations – instead of or as well as procurement organisations
• Get expert advice for your product development and sales and marketing teams
• Hard work, tenacity and persistence

[Source: Gary Welch, personal correspondence]

4.5 Clinicians Involved in Connected Health

There are a number of key clinicians involved in developing and trialling connected health solutions. The following are some of the key individuals engaged. They represent a number of clinical areas.

4.5.1 Dr. Seamas Donnelly, St. Vincents / UCD - Respiratory

Dr Seamas Donnelly is the Medical Director of the Clinical Research Centre, and respiratory consultant at St Vincent’s Hospital Dublin. He is also a senior PI at the Conway Institute, UCD. Dr. Donnelly is an advocate for connected health solutions and currently has 6 projects ongoing covering a diversity of applications. Dr Donnelly is working with Shimmer Research, Biancamed, Clarity (an SFI Cluster between UCD, DCU and Tyndall), Bell labs, a project using current standard accelerometer to compare it to newer generation accelerometers and Analog Devices on a number of different initiatives. He also has close ties to Queens University and Belfast City hospital. He is trying to develop an all island Respiratory network. [Source: Personal correspondence with – Seamas Donnelly]
4.5.2 Dr. Ken McDonald / Dr. Mark Ledwidge - St. Vincents / UCD - Cardiology

Prof. Ken McDonald is a consultant cardiologist and Dr. Mark Ledwidge is the Director of Research at the Heart Failure (HF) Unit in St. Vincent's hospital Dublin. They are also linked to the Conway institute in UCD where they undertake some fundamental research including biomarker discovery. In St Vincent’s, over 3500 patients with or at risk for heart failure are managed in the unit which is also one of the best established HF research programmes in the EU. The unit has been involved in remote disease monitoring in the management of heart failure since the unit was established. They use weight gain as an indicator of decline in health and impending cardiac incident and have developed a series of algorithms that are used to monitor patients. The aim is to reduce hospitalisation through continuous monitoring and where alerts occur acting promptly prior to deterioration. This has proved highly effective and successful to date. The latest development of this remote monitoring strategy has been the HeartPhone project. Crofton Cardiac Centre – together with Biancamed, the National Digital Research Centre Ltd (NDRC), and UCD – are commercialising the technology which has been piloted on almost 40 patients to date and will increase to 200 patients during 2010. The potential purchasers/licensees of the technology include insurers, health management organisations, healthcare organisations and technology providers. The HeartPhone project is supported by NDRC through the provision of space, commercial expertise and investment. [Source: Personal correspondence with – Mark Ledwidge]

4.5.3 Dr. Richard Costello – Beaumont Hospital / RCSI - Respiratory

Prof Richard Costello is the Associate Professor, Medicine, RCSI, at the Education & Research Centre, Beaumont Hospital. Prof. Costello is aiming to reduce the costs of health delivery through the use of connected health type solutions. They have analysed the various processes for treating respiratory care patients and identified where technology solutions e.g. connected health, would be applicable and at that stage identified solutions. They have interests in the use of accelerometers for COPD patients and monitoring their movement, in compliance monitoring in inhalers, in patient passports, Smartphone exercise reminder systems. Richard also has interests in Fitfone and Audatum and is a clinical advisor to the Biomedical Diagnostics Institute in DCU and has been working with Sword medical on development of commercially available accelerometers (www.swordmedical.ie). He is also part of a larger network of respiratory consultants organised through Molecular Medicine Ireland (MMI). [Source: Personal correspondence with – Richard Costello]

4.5.4 Dr. Roy Harper – Ulster Hospital, Dundonald - Endocrinologist

Roy Harper is a Consultant Physician and Endocrinologist at The Ulster Hospital, Belfast. He is an experienced clinician and has a particular interest and considerable expertise in harnessing information and communication technologies to successfully enhance clinical care services for patients with diabetes and other chronic diseases. He has developed strong collaborative and productive links with the University of Ulster and was awarded a Visiting Professorship within the Faculty of Engineering (School of Mathematics and Computing) in 2006. He is a clinical advisor to the newly established European Centre for Connected Health and a champion for ICT developments within healthcare. Dr. Harper has been implementing eHealth solutions within his department for the last 10 years including EPR systems and connected health solutions and has been paperless for years. Dr. Harper believes that home (self) monitoring technologies can transform episode driven health services into a relationship based continuum of care.
Dr. Harper is keen to see the evolution of the use of mobile phone based healthcare technologies and is a strong advocate for it. An example of one project Dr. Harper is involved in is Di@log – details can be seen at http://www.youtube.com/watch?v=rvsb5GCs6FU. [Source: Personal correspondence with – Roy Harper]

4.5.5 Others

While there are quite a number of clinicians interested in and some involved in Connected Health, including geriatricians, paediatricians, oncologists, cardiologists, respiratory and ENT specialists, an exhaustive list was difficult to achieve for this report and they are omitted in this instance.

4.6 Connected Health Projects

4.6.1 National Telecare Initiative, HomeSolution, ROI

Launched in March 2009, the Department of the Environment, Heritage and Local Government, Department of Health & Children, Department of Social and Family Affairs, the HSE and the local authorities have commissioned a project for a National Telecare Initiative called HomeSolution. Emergency Response won the tender to deliver a multitude of telecare devices being monitored. The aim is to achieve 120 and review the after 12 months.

The aim of the project is to

1. Evaluate the impact of the use of supportive technologies on older people and their families
2. Assess how supportive technologies integrate with other care services and arrangements
3. Assess how older people relate to both passive and active devices and systems and how effectively they interface with older people
4. Examine whether the financial capital cost of making the provision of supportive technologies is effective
5. Assess the costs of removing, relocating and recycling equipment after it is no longer required by the individual older person
6. Assess the costs of alternatives to home such as the costs of residential care or the increased risks of cross infection
7. Explore the benefits of a central monitoring centre and establish the costs of a mobile carer’s service to visit older people in their homes, when needed, under the scheme.

[Source: Personal correspondence with HSE, Naas]

“It is a national project which covers seven rural and urban areas in total. All the clients have been referred to us by the Public Health Nurse or O/T in the respective area and a specific evaluation of their requirements has taken place and been signed off via a bespoke needs assessment form. We have now deployed in excess of 80 packages and the feedback to date has been extremely positive from patients, carers and family members with increased levels of re-assurance and independence being reported in a large number of cases.” [Source: Personal correspondence with – James Doyle, MD Emergency Response, Mar 2010]

4.6.2 Telehealth Initiative– Carlow / Kilkenny

Home Instead (see section 5) are an organisation that provides elder care in the community. They are currently engaged with developing a mechanism to provide telehealth in the Carlow-Kilkenny area. They are working with St. Luke’s in Kilkenny and the local community practices and aim to provide support for up to 100-200 patients with chronic disorders. The first disorder that will be targeted is COPD. Daily
monitoring with clinical and technical triage will be supported using Intel Health Guide capability. The challenge of this research pilot study is to reduce hospital admissions through an enhancement of the services to the patients. This project is currently under review and plans to go live in the coming months. The intention is to engage with the local Car-Doc team and provide continuous monitoring.

[Source: Personal correspondence with Ed Murphy, MD Home Instead]

4.6.3 Telehealth Initiative – Bosch, McElwaine SMART & Netwell Centre

Bosch Telehealth Trial (10 Mar, 2010) - Netwell Centre in Ireland to conduct Telehealth trial using Bosch Telehealth Plus System. This is a pilot project to assess how patients with chronic conditions may benefit from using Bosch Telehealth Plus System. Robert Bosch Healthcare, a leader in telehealth, has announced that its remote patient monitoring system will be used in a new telehealth trial for chronic disease management in Ireland. The trial is being conducted by the Netwell Centre at the Dundalk Institute of Technology in County Louth, Ireland, which serves as centre of excellence for the applied research, development and exploitation of technologies that enhance quality of life and well-being of older people and support their ability to live independently. The project marks the first involvement of Robert Bosch Healthcare’s telehealth system in Ireland.

The Netwell project will demonstrate how a telehealth system may help patients better understand their chronic illness and motivate them to change their behaviour to improve self-management of their condition. Forty older patients who have either congestive heart failure (CHF) or diabetes are participating in the trial, and a quarter of them will serve as a control group. The main group will use the Bosch patient interface in their home for a period of 90 days. The project has been enabled by the close cooperation of specialist clinical teams in the Health Services Executive within Louth County.

The patient interface is a compact device with a display and simple four-buttons that allows patients to answer a series of questions about their health and symptoms each day. Through these “dialogues” they learn about ways to better manage their conditions, and they receive health tips and reminders to take their medication. In the Netwell Centre trial, the participants will also report their blood pressure and weight or blood glucose levels, depending on their condition, through the session.

The data from the sessions is sent over a telephone line to a secure data centre where it is accessed by care coordinators who are alerted to early warning signs if a patient’s health is deteriorating. The coordinators alert specialist clinical staff within the Health Services if a patient appears to need urgent attention.

In the Netwell project, McElwaine SMART, a project partner of Robert Bosch Healthcare that offers 24/7 monitoring services to a range of people who are trying to manage risks whilst living independently, will provide triage staff to monitor the data received from the patients. By quickly risk-stratifying patients based on the daily interactive sessions, the Bosch Telehealth System enables healthcare providers to intervene before medical issues escalate. The goal is to improve quality of life, enable older people to remain independent longer, and lower costs of care by reducing visits to the emergency department and hospital. [Source: Netwell Press Release]
4.6.4 Projects at St. James Hospital, Dublin

Haemophilia System Release

During 2007, Clintechn installed and implemented the complete EPR system for haemophilia at the National Haemophilia Centre, St. James’s Hospital, Dublin, Ireland. Working in partnership with the hospital over the previous two and a half years, the system had been successfully tested and is now operating on a live basis. The system is networked to Crumlin hospital to include paediatric haemophilia patients. St James is the one stop shop in Ireland for haemophilia care. The system uses Citrix over the HSE virtual private network (VPN). ePrescribing is included within the package. The EPR system is not web enabled and as such cannot currently be used across all hospitals and regions of the country. There are shared care links with Cork University Hospital (CUH).

Studies to measure the effectiveness of the initiatives have been undertaken. These were chosen to evaluate the impact of the implemented services.

EPR

Implementing the EPR has had a very positive impact on patient and clinic management and has overall improved patient safety. It has stimulated the move towards a “paper light” service and has significantly reduced the time searching for patient charts. This allows staff, (clerical, nursing and clinical) to concentrate more fully in direct patient care and patient management activities.

Cold chain delivery service

Central to haemophilia patient care is ensuring that patients receive their medication in a timely manner and that the medication transport and storage complies with international standards. In addition, a major deliverable of the project was to be able to initiate a rapid comprehensive medication recall. A pre and post service audit was undertaken to assess the impact of the implementation of the validated cold chain delivery service on medication usage. Cold chain services are provided by Temperature Controlled Pharmaceuticals.

Medication wastage, due to failure of either cold chain conditions or delivery issues, reduced dramatically. Using barcode technology to track and trace the medication as it moves through the supply chain gives real-time data on storage, movement and usage. A mock product recall can now identify the location of all vials of the selected batch of medication within 10 minutes. There is 100% satisfaction in the new service.

The goal of this connected health initiative is to empower patients to self manage their care and help them improve their quality of life. One of the best ways we’ve been able to do that is by leveraging technology. However, technology is only an enabler – and it is only effective when it helps improve processes, speeds up workflow, and improves patient care.

The implementation of an EPR has allowed for the standardised “once only” capture of key clinical information, in addition the electronic method is more accessible, accurate, and useful in the overall management of haemophilia.

Validated cold chain distribution reduces the risk of product wastage. Electronic tracing of CFC using unique (GS1 – see note) bar codes reduces documentation error and facilitates optimal product recall, identification of recipients of “at risk” products and improves quality of patient consumption data. The validation of software provides documentary evidence of best practice in all aspects of software lifecycle. It also ensures that requirements specified by stakeholders are delivered by the supplier.
The Enterprise EPR system in use at St. James is supplied by Cerner. This is used for general medicine. The system can communicate with this but it is used as a standalone system. There are plans for further disease specific EPRs including urino-genital and HIV.

**Smart Phones – February 2010**

The team at St James are further enhancing this project through working with the pharmaceutical suppliers on uniquely identifying each pack of medication. In the connected health arena they are trialling smart phones for patient medication management. Barcode readers in the phone will be used for reading medication information. A body image will also be included on the phone and then patient will be able to indicate where injury may have occurred. All this information is then fed back to the EPR for the patient. The information can be used for medication management, alerts as well as recording and trending patient medical issues. It is estimated this will be required for up to 170-180 patients.

**Warfarin Drug Management System – March 2010**

As an adjunct project, St James has employed Valentia Technologies to implement a drug monitoring system using texting from mobile phones. Persons on Warfarin, an anti-coagulation drug, perform self-tests and the data is transmitted to St. James where it is reviewed automatically by the system. Patients can be monitored remotely reducing their need to attend for routine testing. The plan is to have the Warfarin management system for up to 350 patients. This system went live in March 2010.

St. James clinic already uses the mobile phone system for reminders to prevent “did not attend” (DNAs).

Note: GS1 (www.gs1.ie) is a leading global organisation dedicated to the design and implementation of global standards and solutions to improve efficiency and visibility in supply and demand chains globally and across sectors. They manage the issuing of barcodes and RFID standards globally.  
*[Source – personal correspondence with Feargal McGroarty, St. James]*

### 4.6.5 Alzheimer’s Society of Ireland Telecare Project

The Alzheimer Society of Ireland has recently completed a study using telecare in dementia care. Emergency Response provided the monitoring capability. The aim was to give people with dementia more independence. An interim evaluation found that the carers primarily benefited from the telecare through reassurance – “Peace of Mind”, better sleep, safety and reducing social fears. The person with dementia benefits through accident prevention, however, there were no reported changes in their independence. The introduction of telecare is a balancing act between the needs and rights of carer and the person with dementia. The final evaluation will examine in further detail the benefits of telecare technology to the person with dementia, their carer and their relationship.

The system provided the following technologies in the home.

**Core Package**
- Lifeline 4000+ and Pendant Alarm
- Bogus Caller/Panic Button
- Property Exit Sensor
- Smoke Detector
- Temperature Extremes Sensor
- Bed Occupancy Sensor Or Pressure Mat
- Flood Detector
Optional Extras

- Additional Smoke Detector
- CO (Carbon Monoxide) Detector
- Fall Detector
- Gas Detector
- Additional Property Exit Sensor

100 packages were deployed in the Dublin, Kildare, Wicklow regions. This work was done in conjunction with Emergency Response and the Working Research Centre. As a follow on to the project a second pan European project “Independent” is commencing shortly. The Work Research Centre is a research and consultancy company providing a multidisciplinary perspective and service in four main areas:

- Socio-economic aspects of telecommunications and telematics
- Health and wellbeing in the workplace
- ICT solutions for disabled and older people
- Human resource aspects of organisational change
- Health and social service innovation

They have conducted a number of pan European studies including the one detailed above. See International perspective below on the WRC activities. [Source: personal correspondence with Alzheimer’s Society of Ireland]

4.6.6 Caring for Carers - Telecare Services

Caring for Carers Ireland is a national organisation supporting family carers and those for whom they care. As a non-governmental organisation, Caring for Carers Ireland works in partnership with the Department of Health & Children, Department of Social & Family Affairs, Department of Community, Rural & Gaeltacht Affairs, HSE, Irish Red Cross Society and many other statutory and voluntary bodies. The range of services we provide are afforded within a framework of ninety Carers’ Groups nationwide.

The Telecare Service is an innovative service for those between the ages of eighteen and sixty five with a physical or sensory disability. Working through remote monitoring at Emergency Response, it affords both the Carer and those cared for, peace of mind and security, and are proving very popular with users. Up to 1000 persons are included within the service provision.

Unobtrusive and flexible, the system can transform the lives of those who wish to remain living in their own homes. It offers immediate help 24 hours a day, 365 days a year, at the touch of a button while increasing levels of safety and independence and enables users to retain privacy and control over their own individual lifestyles.

Known as the ‘Moving Forward Assistive Technology Project’ it is funded by the Department of Community, Rural and Gaeltacht Affairs under the Dormant Accounts Fund.

To qualify for the scheme you must be between the ages of eighteen and sixty five. Assessments are carried out by a Community Occupational Therapist or a Public Health Nurse.

In January 2008, an assessment was carried out to evaluate the progress of the scheme after one year in operation. A questionnaire was designed by Caring for Carers Ireland and it was administered to a total of 59 households. Over 80% reported increased peace of mind and over 75% expressed the desire to try out
new technologies. As one user reported "no amount of money can give me the peace of mind that I have with this system".

Another study into isolation of carers and elders is underway as an extension to this project. This is currently enrolling up to March 2010. [Source: personal correspondence with Caring for Carers Ireland]

4.6.7 Clinical Translational Research and Innovation Centre - CTRIC

The Clinical Translational Research and Innovation Centre (C-TRIC), based at Altnagelvin Hospital campus, Derry, is a unique facility promoting and facilitating translational and clinical research, the primary objective of which is to reduce both the time to market and the costs associated with research and development of innovative health technologies, medical devices and therapeutics. C-TRIC’s unique infrastructure and key support staff facilitate clinical research and innovation, enabling the streamlining of developments from the laboratory to the market place through a focused ‘bench to point of care’ approach. C-TRIC are collaborating on a number of connected health initiatives described below -

Dr Kevin Curran (Intelligent Systems Research Centre at University of Ulster) is collaborating with C-TRIC and the Western Health and Social Care Trust on a range of Telemonitoring projects including:

- Telemonitoring in patients with chronic hypercapnic respiratory failure on non-invasive ventilation;
- A prototype measurement tool for medical clinicians using a wearable data glove for the human hand;
- Diabetes mobile phone application
- A cross border pilot to monitor diabetes during pregnancy

Dr Liam McDaid (Intelligent Systems Research Centre at University of Ulster) is collaborating with C-TRIC and the Western Health and Social Care Trust on 2 specific Telemonitoring projects:

- The development of a hand-held compliance and drug dosage monitoring device for inhaled medications, which is supported through Invest NI’s Proof of Concept programme;
- A novel monitoring system for feeding tubes.

Other joint projects in the connected health area include a Brain Computer Interface (BCI) based neurofeedback for stroke rehabilitation and a brain-computer interface (BCI) that allows a disabled person to control a smart wheelchair and robotic manipulator combination by thinking. [Source: Personal communication Barry Henderson, C-TRIC Centre Manager]

4.6.8 First Stroke Patient Treated in the Midlands via Telemedicine

Stroke patients in the Adelaide and Meath Hospital Dublin, Incorporating the National Children’s Hospital Tallaght (AMNCH) are now receiving more rapid treatment at the hands of a Remote Presence (RP7) robot doctor which went live in November 2009 in the Hospital. This robot is the first of its kind in Ireland.

The Remote Presence (RP7) device will be used primarily in the Emergency Department of the hospital. It allows stroke specialists to examine patients from a remote location, via a laptop, to see and talk to the patient, observe and help conduct the assessment, view CT images and lab results and make urgent treatment decisions with no needless delays.
The emergency staff at the Midland Regional Hospital in Mullingar successfully used the “RP-7 Telemedicine Robot” or Robodoc system (InTouch Technologies, Inc. (d.b.a. InTouch Health®), a Santa Barbara, CA) to treat a patient using telemedicine. The technological breakthrough means that patients who are admitted with a stroke to Tallaght Hospital, Naas Hospital and Mullingar Hospital can access a specialist stroke physician at evenings and weekends through remote audio visual equipment mounted on the robot.

The pilot project treated its first patient in January 2010, an 81 year old woman who presented at Mullingar Hospital on a Sunday afternoon, after suffering a stroke that same day. The patient was initially assessed by Emergency Medical personnel while being transferred to the Hospital where staff were awaiting her arrival.

“The on call Physician in Tallaght, Professor Des O’Neill remotely guided the on site team in Mullingar after he assessed the patient using the remote technology, which also allowed him to assess the patients scans, before guiding the onsite doctor to administer the appropriate clot busting drugs to the patient. This is an initiative of the Adelaide and Meath hospital and linked to the Dublin Midlands Stroke Network.

4.6.9 Innovative Electronic Patient Record for Epilepsy Patients

The Minister for Health & Children, (21st January 2010) launched an innovative approach to managing chronic disease through the use of Information Technology. The secure, web-based, electronic patient record (EPR) is already helping to provide seamless care for more than 1,000 people with epilepsy who attend Beaumont Hospital. Funded by the Health Research Board, the EPR has been developed by Beaumont's Epilepsy Team and IT Department in association with Trinity College Dublin. Two of key individuals on the project were Dr Norman Delanty, Head of Beaumont’s Epilepsy Team and Mary Fitzsimons, Principal Physicist with the Epilepsy Programme,

At present, it is estimated, epilepsy affects up to 37,000 people in Ireland. A secure web-based EPR stored centrally has the potential to ensure that patient information is available when and where needed so that clinicians at any location will have access to the same single record for an individual patient. This results in benefits such as speedy liaison across all sectors (community, primary care and hospital) and shared decision making in relation to an individual’s care.

In the Beaumont epilepsy programme, the EPR can greatly reduce the time needed to review complex medical records taken over years when optimising anti-epileptic drug therapy, it supports the epilepsy nurse telephone advice line, helps identify patients meeting the criteria for clinical research studies and greatly improves communication with referring clinicians.

Research indicates that in addition to delivering significant benefits for the patient, an efficient ICT-based approach to management of a chronic condition yields important financial savings for healthcare providers by improving productivity, eliminating unnecessary investigations and reducing the length of time patients spend in hospital.

4.6.10 Roscommon-based Telehealth Pilot Project

The HSE’s Roscommon-based Telehealth Pilot Project received funding under the Department of Health’s Innovation Fund for 2008. The project had buy in at a local clinical level and there was a cohort of patients
identified. However, the project did not progress through to commencement. The team in Roscommon however, are still keen to engage with potential collaborators.

### 4.6.11 National Integrated Medical Imaging System (NIMIS) Project

The HSE National Integrated Medical Imaging System (NIMIS) project is investing over €40m between 2010 and 2012 in providing state of the art electronic radiology systems for 35 Irish hospitals. NIMIS will make Ireland’s radiological services ‘filmless’ and enable secure and rapid movement of patient image data throughout the health service. This new imaging system will allow doctors to electronically view their patient’s diagnostic images, such as X-Rays and CT Scans, quickly and easily. The rapid access and availability of patient’s records to health professionals is a significant step for patient safety.

Medical imaging technologies, from simple X-Rays to advanced CT and MRI scans are a fundamental part of modern healthcare. Around one quarter of Irish hospitals have already moved to a ‘filmless’ system where all images are captured, stored and examined using computers rather than printed film - a technology called Picture Archive and Communication Systems and Radiology Information Systems (otherwise known as PACS/RIS). McKesson won the contract.

NIMIS will introduce PACS/RIS into the remainder of Irish hospitals and will enable seamless sharing of patient data between them and the existing PACS/RIS installations through a national image archive.

### 4.6.12 COGKNOW Project

The COGKNOW project is helping people with mild dementia navigate their day. The challenging aim of the three-year project, which commenced in September 2006, was to breakthrough with research that addresses the needs of those with dementia, particularly those with mild dementia in Europe. At about 2% of the elderly population, this comes to around 1,900,000 people. In order to achieve the project aim, this means helping people navigate through their day. This entails cognitive reinforcement and may be expressed as the social objectives of the research for the needs of people with dementia, helping people to remember, maintain social contact, perform daily life activities and enhance their feelings of safety. Colleagues from University of Ulster and Queens were both involved in the project.

The Memory Clinic is based at the Belfast City Hospital (BCH), which is a major teaching hospital in Northern Ireland. The clinic provides a regional service devoted to the prompt diagnosis and treatment of persons with cognitive impairment. The clinic is led by two consultants in elderly care who hold Senior Lectureships at the Queen’s University of Belfast. The clinic has full access to the multidisciplinary team and has strong links to psychiatry and neurology colleagues as well as patient support groups such as the Alzheimer’s Society. Imaging, in the form of CT/MRI/SPECT scanning is also readily accessed.

The clinic provides a platform for research and clinical trial activity through links with the Division of Psychiatry & Neuroscience, School of Medicine, Queens University of Belfast (QUB). The division has a background in dementia and stroke research with recent projects examining the genetic factors responsible for Alzheimer’s disease, cognitive change after stroke and memory rehabilitation for persons with dementia.

BCH assisted in the development and testing of the proposed technology through the identification of target groups and detailed assessment of user needs and requirements. Patient and carer involvement followed the normal processes of ethical approval and recruitment. BCH intended to be intimately involved in the assessment and trialling of prototype models in conjunction with other European partners.
4.6.13 Telemedicine ROI

A number of telemedicine reports\textsuperscript{19, 20} have been prepared by the School of General Practice NUIG. This included Telehealthcare for Arranmore Island.

The Republic of Ireland is characterised by few urban conurbations and a highly dispersed rural population in small villages and in the countryside. Included also are significant numbers of island dwellers, particularly along the West and North West coasts.\textsuperscript{21}

Information communication technologies (ICT), including telemedicine, present opportunities to address rural health-service delivery issues. As in other countries, the recent National Health Information Strategy is regarded as pivotal to the modernisation of the Irish healthcare system. There is, however, a dearth of research about telemedicine in Ireland. The paper reports the first systematic review of telemedicine in the two regional health boards in the Republic of Ireland. Details of 11 telemedicine services, all initiated by local policy, and are presented in the paper.

4.6.14 National Centre for Neuroscience, Beaumont Hospital, Tele-Radiology

The National Centre for Neuroscience, Beaumont Hospital, provides the national service to 19 hospitals countrywide. The service enables distance clinicians to transfer CT scans and obtain second opinion from consultant staff at the Centre. As an emergency neurosurgical teleradiology system it was initially installed in the mid 1990’s.

4.6.15 St. James Hospital Tele-Cardiology

St James Hospital, a major tertiary hospital in Dublin, links with Sligo General Hospital about 220 Km away, for specialist tele-consultations on the digital angiograms of cardiac patients. The synchronised playing of the patient’s angiograms on workstations at both locations was identified as the key initial need. So the large files of patient data are transmitted overnight, prior to each consultation. Both audio-conferencing and data conferencing are involved. The innovative system was implemented during 2003 and its wider roll-out is progressing.

4.6.16 Multi-site link for Tele-Oncology

Linking of the Medical Oncology team at Sligo General Hospital (SGH) in the northwest of Ireland commenced in 2002 to expedite patient cases on a Multi-Disciplinary Team meetings (MDT) basis with specialists in St. Luke’s and St. Vincent’s University Hospitals (SVUH). Multi-site conferencing with General Hospitals in Letterkenny and Mullingar followed as multi-point bridging permitted. The results of the first 35 patient cases under MDT format after an 18-month period confirmed the potential benefits of telemedicine were being realised.
4.6.17 Tele-Primary Care-Surgical Consultations:

Killybegs Community Hospital is in the northwest of Ireland. From its Telehealth Unit, regular video-consultations are carried out between (a) patients and the primary care team and (b) a general surgeon in Letterkenny hospital some 75 Km away. In reviewing the first 60 patient cases, 90% benefited from avoiding travel, reduced waiting times and faster decision-making. The GPs and other primary care providers liked it as they could speak directly to the specialist. There is distinct potential to apply this model on a national basis to community hospitals for delivering Telehealth care services.

4.6.18 Telesynergy Multimedia Medical Imaging Workstation Network

Telesynergy is a multimedia medical imaging workstation for use within an electronic imaging environment. Telesynergy is designed for the simultaneous high-resolution display of medical images from numerous diagnostic-imaging modalities. The Telesynergy system has been installed at two locations within the Republic of Ireland (Academic Unit of Clinical Oncology – St James/TCD and St. Lukes Hospital), and at both the Radiation Oncology Branch and Clinical Centre within the National Institute of Health (NIH), Washington DC, USA.

Oncology research conducted between international groups, typified by those involved in the NCI-All Ireland Cancer Consortium, is dependent on the integration of an increasing range of core information technologies and the seamless exchange and storage of large datasets between these systems. The Telesynergy system has facilitated the formation of project teams containing the combination of clinicians and scientists in molecular biology/genetics, radiation biology, computational biology, and engineering/applications support.

The objectives of the Telesynergy program include:

- The examination, development and integration of existing and novel diagnostic medical imaging technologies
- The analysis and integration of these imaging and bioinformatics datasets using sophisticated quantification and visualisation tools
- The application and extension of Telesynergy to cancer clinical trials and translational cancer research
- The phased and planned extension of these technologies to other hospitals within Ireland
- The co-development with the NIH centre for Information Technology and the Radiation Oncology Sciences Program of new radiation oncology tools for use within Telesynergy
- The development of enhanced partnerships and projects with research collaborators at an international level

4.6.19 The Efficacy of Telemedicine in Increasing Carer Knowledge about Schizophrenia

Schizophrenia is a major public health problem affecting over 30,000 people in Ireland. Public knowledge about schizophrenia is modest. Participating in carer education programs for schizophrenia not only improves the outcome for affected relatives but empowers carers. Standardised programs for carer education are difficult to implement.
In this project, a state of the art teleconferencing research program was established between the Donegal Mental Health Services based in Letterkenny and the Cluain Mhuire Service in Dublin to determine if teleconferencing is an efficacious and viable method for carers to participate in carer education programs. The ‘state of the art’ video conferencing equipment suite in Donegal and Dublin are identical to the systems used to train Navy pilots and provides “as near as it gets” to being live in a room. It allows full screen real time video and audio two-way interaction between the two sites. Multiple cameras allow people on the carer education course to see the speakers and the slides / educational video pieces on two large screens simultaneously.

Since inception, six Carer Education Programmes have been completed (each consisting of seven weekly two hour sessions) using the telemedicine system. Experienced therapists facilitate the Programme. Each carer is referred by their clinical team and to date over 104 carers (74% of target) have participated in the carer education programme. In both Donegal and Dublin, knowledge about schizophrenia and burden on the carers is measured using standardised methodologies before the course begins and repeated at its conclusion.

4.6.20 Teleneurology23, Project in Royal Victoria Hospital, Belfast

Teleneurology enables neurology to be practised when the doctor and patient are not present in the same place, and possibly not at the same time. The two main techniques are: (1) videoconferencing, which enables communication between a doctor and a patient who are in different places at the same time (often called real time or synchronous), and (2) email, where the consultation is carried out without the patient being present, at a time convenient to the doctors involved (asynchronous or store-and-forward teleneurology). Some problems that can be solved by teleneurology include: (1) patients admitted to hospital with acute neurological symptoms rarely see a neurologist; (2) delayed treatment for acute stroke; (3) non-optimum management of epilepsy; (4) unproductive travel time for neurologists; (5) extremely poor access to a neurologist for doctors in the developing world; (6) long waiting times to see a neurologist.

Neurology is a specialty that, because of the emphasis on accurate interpretation of a history, does lend itself to telemedicine. It has been a late starter in realising the benefits of telemedicine and most of the publications on teleneurology have been in the last five years. Its uptake within the neurological community is low but increasing. Telemedicine requires a significant change in how neurologists practise. The evidence to date is that teleneurology can narrow the gap between patients with neurological disease and the doctors who are trained to look.

4.6.21 Telemedicine and Thrombolysis for Acute Stroke in Northern Ireland

An additional report on Telemedicine and Thrombolysis for Acute Stroke in Northern Ireland24 - is available from the European Centre for Connected Health.

4.6.22 Electronic Patient Record Project in St. Vincent’s University Hospital25

The Gastroenterology Department in St. Vincent’s University Hospital has used EndoRAAD from Manitex to create an Electronic Patient Record (EPR) for Endoscopy procedures, which is then available Hospital wide.
All Doctors use EndoRAAD in all procedure rooms to capture pictures and video from the procedure and then utilise these images in the creation of the EPR and the patient’s Report.

4.6.23 Electronic Patient Record Project in Mater Misericordiae University Hospital

The GI Unit in the Mater Misericordiae University Hospital has implemented EndoRAAD from Manitex. Since 2006 the doctors have used EndoRAAD in all procedure rooms to capture pictures and video from the procedure and then utilise these images in the creation of the patient’s report. This information is automatically added to the Electronic Patient Record (EPR) for Endoscopy procedures, which is then available Hospital wide.

4.6.24 Medico Cork

Because of EC Council Directive 92/29/EEC a centre was designated in each country to provide mariners with free medical advice by radio, on a 24 hour basis. Cork University Hospital (CUH) was so designated in July 2001 – Medico Cork.

A liaison agreement was drawn up between Irish Coast Guard (IRCG) and Medico Cork. In the event of IRCG requesting medical advice on behalf of a vessel the IRCG centre receiving the call will patch it through to Medico Cork. Here it is answered by a registrar or consultant, IRCG stays on the line and assists as necessary with communications. Should Medico Cork advise helicopter evacuation due to a possible threatening condition the IRCG centre will be advised immediately. If non-threatening, consideration should be given to advise the vessel to proceed to port. IRCG will co-ordinate whatever action is considered necessary by Medico Cork.

In the Emergency Department there are 2 fixed lines for Medico Cork, one at the main desk, one in the doctor’s duty room, and also a cordless phone. All ring simultaneously. A logbook is recorded at the main desk to record the data.

Air ambulance service

Medico, Cork is the HSE unit with a responsibility for providing on-line medical advice to the Irish Coast Guard. Medico, Cork has agreed to assist the air ambulance service in providing similar advice. This will apply in situations where a call for an emergency helicopter transfer is received from an off-shore Island. EMC dealing with such calls will use the following procedure:

The EMC will patch the caller through to Medico Cork at where a senior emergency care practitioner will discuss the details of the patient’s condition with the caller, give appropriate medical advice and provide a direction on the category of the medical emergency. The EMC will respond to this advice by using the resources to meet the needs of the patient concerned."

There are 4 helicopter bases – Dublin, Waterford, Sligo and Shannon. There are 4 crew members per flight –pilot, co-pilot, winch man and winch operator. The winch man and winch operator are trained to emergency medical first responder level.
4.6.25 Beacon Hospital

The private Beacon Hospital in Dublin has installed Orion’s Health Rhapsody Integration Engine to allow critical data sharing between clinical and business systems including Meditech’s Patient Administration System, GE Radiology and Information System and Picture Archiving and Communications System.

4.6.26 eHealth in action – Eircom and Crumlin Hospital

Our Lady's Children’s Hospital (OLCH) in Crumlin is a recognised centre of excellence for paediatric cardiology, neurology and oncology. But, with no telemedicine applications routinely available anywhere in the Irish health service, OLCH specialists are limited in their ability to consult with peers or meet patients from other parts of Ireland, including Cork University Hospital (CUH) 150 miles away. However, the 2007 paediatric telemedicine trial with Eircom offered a glimpse of how all of that could be changed. With the cooperation of OLCH, CUH and the HSE, and with a comprehensive technology and service solution donated by Eircom, the six-week trial demonstrated that high-quality IP videoconferencing technology can readily deliver diagnostic-quality images to Dublin based consultants assessing a Cork-based patient in real time.

This service is no longer available.

4.6.27 Centric Health – Teleradiology.

Centric health is a quality primary healthcare services provider in ROI. One of their main business interests is in teleradiology in reading x-rays, MRIs, ultrasounds digitally and sending the results straight back to the referrers desktop. They use their international reach for the delivery of their teleradiology services. They also manage the SwiftCare clinics along with the VHI. For more information see Appendix A.

4.6.28 General Practice Information Technology (GPIT) Project

The Health Service Executive and the Irish College of General Practitioners (ICGP) came together at the end of 2006 to restructure and reactivate the National General Practice Information Technology (GPIT) Group. Currently there is no secure clinical network in Ireland for GPs. There are two parts to the group and a projects section.

Education

The focus of the GPIT training programme is on practice based support.

Projects

Some example projects

- Certification of GP Practice Software Management Systems.
- Working with Healthlink and the National Cancer Control Programme on electronic cancer referrals from GP practice software systems.
- Communicating the needs of GPs and primary care to developers of information systems throughout the health services.
4.6.29 Healthlink

Healthlink is an electronic communications project funded by the Health Service Executive. The project was initiated in the Mater Hospital in 1995 but quickly evolved into a national project with the launch of HealthlinkOnline in 2003. The service is available free of charge to all GPs though some initial investment is required by Hospitals and Health Areas to become involved. The objective of the Healthlink project is to implement healthcare communications network with specific reference to Primary Care Practitioners and acute Hospital and agency relationships and data exchange.

HealthlinkOnline is a web-based messaging service which allows the secure transfer of patient information over the internet. The benefits to General Practice include:

- Reduction in phone calls to hospital lab - time saving
- Reduction in administration (and admin costs)
- Reduction in clerical errors from manually entering data
- Integration with Practice Management Systems

They have also a number of other initiatives and services available including:

- Lab order
- Neurolink
- Cancer Referral

New services are being added all the time to the Healthlink service. The following are some of those added in 2010 so far:

- Online Breast Cancer Referrals to UCHG
- New Radiology & Cardiology reports live through Healthlink from Mater Private
- Online Prostate Cancer Referrals to UCHG
- NCCP Breast Referrals now live in Mater Hospital
- Online Lung Cancer Rapid Access Service Referral Pilot with St. James's Hospital
- AMNCH Lab results now live

4.6.30 VHI Hospital in the Home HITH

Officially launched in Feb 2010 VHI HomeCare is an innovative clinical service available exclusively to VHI Healthcare members. This allows suitable patients to be treated by doctors and nurses in the comfort and safety of their own homes, where previously hospital admissions was the only option. This service was previously trialled within the HSE. The VHI have taken this on within their healthcare plans

While hospital is certainly the most appropriate place for certain patients, many people are admitted and undergo long hospital stays for treatments that, due to advances in technology and clinical expertise, are now widely accepted as suitable for treatment outside of hospital.

The initial referring hospitals eligible for cover are as follows:
• Beaumont Hospital
• St James’s Hospital
• St Vincent’s Hospital
• Mater Misericordiae Hospital
• James Connolly Hospital, Blanchardstown
• Adelaide and Meath Hospital, incorporating the National Children’s Hospital, Tallaght.

There is an interest in further developing telehealth initiatives as the service progresses and the greater use of technology solutions. The care teams will be supplied with broadband enabled net books to access patient information remotely and record details of patient visits.

### 4.6.31 Heart Rhythm Ireland

Heart Rhythm Ireland\(^{30}\) is a service provided by G-Pace, a health informatics provider, based in Ardee, Louth. It allows for web based access to cardiac patients’ information at all major cardiac units across Ireland. They provide secure access for clinicians to aid in patient assessment. There is a plan to provide this service for Irish patients when travelling outside of the country.

### 4.6.32 International Healthcare Services Centre

Dr. Joseph Dalton has proposed to set up an International Healthcare Services Centre (IHSC) to serve the globally emerging Telehealthcare market. The proposition is if Ireland can get early leadership position in this sector (there is currently no IHSC anywhere in the world), many other Healthcare Service Opportunities present themselves as Ireland will have established itself as the ‘go to’ place for Services in this space. The services would be export based and serve global markets in three main areas,

1. **Home based Clinical Telehealthcare** (healthcare monitoring and management form the home),
2. **Ageing and Independent Living Services** (allowing elderly to live in their own homes for longer)
3. **Centralisation of Healthcare Logistics and IT Operations** serving global markets (i.e. logistics, fulfillment and IT operations for hospitals worldwide can be managed from Ireland).

All three areas support cutting cost from healthcare delivery and will be important in coming years as population demographics force change in this regard. [*Source: personal correspondence with Dr. Joseph Dalton*\(^{31}\)]

### 4.7 Conclusion

It is evident that there are many connected health initiatives in various guises across Ireland. Having a consolidated effort to manage all of these comes under the overstretched public healthcare procurement bodies. There is a drive to use connected health to provide enhanced healthcare provision. Costs and risk are top most in the minds of the procurement people. How, all parties engage including indigenous organisations with the clinical community needs a thorough review and alignment to support local service and product innovation in this area.
5. BUSINESS CAPABILITY & ACTIVITIES

5.1 Introduction

For the benefit of this report, companies involved in connected health have been categorised into a number of headings:

- Personal Health Records and Health Informatics
- Medical Devices, Sensor Technology and Contract Service Providers
- Information and Communications Technology / System Integration
- Monitoring of Social Alarms, Telecare, Ambient Assisted Living, and Telemedicine
- Mobile Healthcare - mHealth

Each of the sections below illustrates the companies involved in the connected health sector. There is a huge diversity in the skills base that Irish companies and MNCs operating in Ireland can bring to the connected health landscape to aid in the promotion of the country as a whole. The activities of the companies are expanded upon in Appendix A. Some companies span several of the thematic areas and as appropriate these have been included in multiple sections. Within this section additional information is included on the submission made by the Health ICT Industry Group to the HSE.

5.2 Health ICT Industry Group - ROI

The Health Service Executive has been urged to triple its spend on healthcare IT from 0.75pc to 2.25pc of its total budget, by the Health ICT Industry Group, to enable Ireland to deliver 21st-century patient care. The industry group has estimated €195 million could be saved by treating chronic illnesses in the home.

At the 2009 November Health Informatics Society of Ireland (HISI) conference a position paper was presented to the Minister for Health on ICT’s Role in Healthcare Transformation. The group that prepared the position paper comprised representatives from 17 companies engaged in the Healthcare ICT sector ranging in size from large multinationals to SMEs. The group of 17 ICT firms includes: BT, Cerner, Cisco Systems, dabl Disease Management Systems, DMF Systems, eCom Ireland, Garivo Technologies, GE Healthcare, IBM, IMS MAXIMS, Intel, Microsoft, Oracle, PA Consulting, PricewaterhouseCoopers, Total Training and Xyea. The findings and recommendations are based on the national and international expertise and experiences of these companies and supported by the latest research in regard to delivering optimum health and social care in a safe, cost effective and efficient manner. The main thrust of the paper was

“A modern national health ICT infrastructure is the essential first step to achieving this transformation, enabling clinical information to be passed securely and quickly between practitioners, and medical instructions communicated clearly and quickly using electronic means for increased patient safety. It is no longer acceptable for Irish healthcare providers to jeopardise patient safety through poor or non-existent Health ICT systems, a practice which could be deemed to be negligent when compared with current international norms. It is noted that in the Euro Health Consumer Index report issued in September 2009, the area where Ireland performs poorest is e-health, such as electronic transfer of medical data between professionals, e-prescriptions and lab tests electronically communicated to patients. Indeed, senior clinicians have stated that investing to improve our ICT capability is now more important than additional investment in clinical facilities.”
As part of the move towards a Smart Economy, the group urged the Government to direct Enterprise Ireland to establish a healthcare technology cluster. The Government should also ensure that the public procurement process encourages R&D, experience-building and knowledge-sharing within SMEs, for example by supporting “lighthouse” applications in selected areas.

The industry group called on the Government to create a Unique Health Identifier and a national Electronic Health Record system spanning primary and acute care within three years. “These systems offer major benefit in terms of patient safety, healthcare quality, chronic disease management and financial effectiveness. They are the essential building blocks for future healthcare ICT systems.”

The report also urged that open standards are utilised to ensure interoperability into the future between different healthcare ICT systems and that a major focus is placed on developing IT skills and knowledge within the HSE. The Health ICT Industry Group provided the following recommendations:

1. The commitment to and resourcing of a modern IT-enabled healthcare system becomes a national priority for government, with leadership coming from the Minister for Health and Children.
2. The CEO and board of the HSE accepts leadership responsibility for the effective execution of the ICT programme and the related process reengineering, as essential elements in building a world-class, affordable health care service.
3. The HSE triples its expenditure on Healthcare IT over the next 3 years, from 0.75% to 2.25% of total budget, this being the level of expenditure required to bring Ireland into a median position of healthcare IT capability in the delivery of patient care.
4. The HSE’s capacity to implement IT systems is enhanced by a long term partnership with the Irish ICT industry to leverage the expertise, capability and resources available.
5. As part of the move towards a smart economy, the government directs Enterprise Ireland to establish a healthcare technology cluster. The government should also ensure that the public procurement process encourages R&D, experience-building and knowledge-sharing within SMEs, for example by supporting “lighthouse” applications in selected areas.
6. A Unique Health Identifier and a national Electronic Health Record system spanning primary and acute care are implemented within 3 years. These systems offer major benefit in terms of patient safety, healthcare quality, chronic disease management and financial effectiveness. They are the essential building blocks for future healthcare ICT systems.
7. Open standards are utilised to ensure interoperability into the future between different healthcare ICT systems.
8. A major focus is placed on developing IT skills and knowledge within the HSE. This should include widespread IT familiarisation programmes for management, clinicians and administrators, supported by education and training from the ICT industry.
9. The HSE board establishes a high level advisory group, comprising internal executives and external experts from the medical, academic and business communities to provide ongoing advice on the exploitation potential of Healthcare IT.

5.3 Industry Segments

A detailed database of all the companies in the connected health sector are include in Appendix A and are subject to restrictions.
5.3.1 Personal Health Records and Health Informatics

<table>
<thead>
<tr>
<th>Personal Health Records and Health Informatics</th>
<th>Location</th>
</tr>
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<tbody>
<tr>
<td>BodyTab Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Cerner</td>
<td>Multinational</td>
</tr>
<tr>
<td>Clintech Health Care Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>DMF Systems Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>dabl Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>GroupNos Technologies Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>G-Pace</td>
<td>Republic of Ireland</td>
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<tr>
<td>Helix Health</td>
<td>Republic of Ireland</td>
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<tr>
<td>IMS Maxims Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>iSOFT</td>
<td>Multinational</td>
</tr>
<tr>
<td>Kainos Ltd</td>
<td>Northern Ireland</td>
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<tr>
<td>Lincor Solutions Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Manitex Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>McKesson</td>
<td>Multinational</td>
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<tr>
<td>Philips Healthcare (Tomcat)</td>
<td>Northern Ireland</td>
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<tr>
<td>Sláinte Technologies Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Technical Ideas Ltd. (Socrates)</td>
<td>Republic of Ireland</td>
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<tr>
<td>Valentia Technologies</td>
<td>Republic of Ireland</td>
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Table 2: Personal Health Records and Health Informatics Companies

Additional international healthcare informatics companies including McKesson, iSoft, and Cerner are currently providing services in Ireland but details are not provided in the database in Appendix A. A brief overview is:

- iSOFT provides the IPM Patient Administration System (PAS) to the HSE. They also provide an ICM system for clinical reporting and order communication. There are a number of legacy PAS in ROI.
and these are being replaced with the iSOFT system as and when they are needed or resources allow. iSOFT have a 10 yr contract with the HSE.

- McKesson is providing the new NIMIS system.
- Cerner provide EPR system to St. James Hospital.

### 5.3.2 Medical Device, Sensor Technology and Contract Service Providers

Connected health offers the opportunity for many medical device and diagnostics companies to extend their product range to home or community based solutions. While the potential is evident, this review only deals with those that have already engaged in this process. Companies such as Medtronic and Randox Laboratories are already engaged with this process outside Ireland but are also omitted from the review as no connected health solutions or activities are evident within Ireland.

<table>
<thead>
<tr>
<th>Medical Device, Sensor Technology and Contract Service Providers</th>
<th>Location</th>
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<tbody>
<tr>
<td>Accendo Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>AMCS Medical Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Audatum</td>
<td>Republic of Ireland</td>
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<tr>
<td>Biancamed Ltd</td>
<td>Republic of Ireland &amp; Northern Ireland</td>
</tr>
<tr>
<td>BlueBridge Technologies Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>BlueScope Medical Technologies Ltd</td>
<td>Northern Ireland</td>
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<tr>
<td>Captec</td>
<td>Republic of Ireland</td>
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<tr>
<td>Garivo Technologies</td>
<td>Republic of Ireland</td>
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<tr>
<td>HeartPhone</td>
<td>Republic of Ireland</td>
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<tr>
<td>Intelesens Ltd</td>
<td>Northern Ireland</td>
</tr>
<tr>
<td>iSoft</td>
<td>Multinational</td>
</tr>
<tr>
<td>Marturion Ltd</td>
<td>Northern Ireland</td>
</tr>
<tr>
<td>Phillip Healthcare Company Ltd</td>
<td>Multinational</td>
</tr>
<tr>
<td>Robert Bosch GmbH</td>
<td>Multinational</td>
</tr>
<tr>
<td>SensorMind Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Shimmer Research Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Synchrophi Ltd</td>
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</table>
**Table 3: Medical Device, Sensor Technology and Contract Service Providers Companies**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Location</th>
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<tbody>
<tr>
<td>Tele Health Services Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Tunstall Ltd</td>
<td>Multinational</td>
</tr>
<tr>
<td>Vitalograph Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Viterion Telehealthcare Inc</td>
<td>Multinational</td>
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</table>

### 5.4 Information and Communications Technology / System Integration

Mainly companies in this area are multinationals although several Republic of Ireland companies are competing in this area.

<table>
<thead>
<tr>
<th>Information and Communications Technology and Systems Integration</th>
<th>Location</th>
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<tbody>
<tr>
<td>Alcatel-Lucent Bell Labs</td>
<td>Multinational</td>
</tr>
<tr>
<td>British Telecom</td>
<td>Multinational</td>
</tr>
<tr>
<td>CA (Formerly Computer Associates) Ltd</td>
<td>Multinational</td>
</tr>
<tr>
<td>Cisco Ltd</td>
<td>Multinational</td>
</tr>
<tr>
<td>Eircom eHealth Solutions</td>
<td>Republic of Ireland</td>
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<tr>
<td>Honeywell</td>
<td>Multinational</td>
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<tr>
<td>Hewlett Packard, Ireland</td>
<td>Multinational</td>
</tr>
<tr>
<td>IBM Ltd</td>
<td>Multinational</td>
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<tr>
<td>INTEL -Digital Health Group</td>
<td>Multinational</td>
</tr>
<tr>
<td>OpenApp</td>
<td>Republic of Ireland</td>
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<tr>
<td>Robert Bosch GmbH</td>
<td>Multinational</td>
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<tr>
<td>Viterion Telehealthcare Ltd</td>
<td>Multinational</td>
</tr>
<tr>
<td>S3 Group Ltd</td>
<td>Republic of Ireland</td>
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<tr>
<td>Valentia Technologies Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>Phillip Healthcare Company Ltd</td>
<td>Multinational</td>
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Table 4: Information and Communications Technology and Systems Integration Companies

<table>
<thead>
<tr>
<th>Information and Communications Technology and Systems Integration</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Tunstall</td>
<td>Multinational</td>
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The following are some recent press releases on some of the companies

5.4.1 S3 Group and Texas Instruments

S3 Group and Texas Instruments Deliver First Continua Certified Platform for Faster Development of Telehealth Devices

TI’s MSP430TM ultra-low power microcontrollers and S3 Group’s Embedded Agent Stack make it easier and faster for OEMs to build Continua personal health devices.

Dallas, TX (February 8, 2010) – Texas Instruments Incorporated (TI) (NYSE: TXN) and S3 Group, a connected healthcare technology solutions company, today announced the availability of the first Continua Certified™ USB-enabled platform for building agent healthcare devices. The platform consists of TI’s ultra-low power MSP430 microcontroller (MCU) and S3 Group’s Embedded Agent Stack (EAS) – an 11073 PAN device (agent) stack, which has been optimised for resource constrained platforms. The platform for agent devices will enable original equipment manufacturers (OEMs) to bring personal health devices to market quicker and easier. Both TI and S3 Group are members of the Continua Health Alliance, a non-profit, open industry organisation of healthcare and technology companies joined together to establish a system of interoperable personal telehealth solutions to better manage health and wellness. This new platform will help developers improve the quality and accessibility of healthcare by simplifying the design of USB-enabled consumer medical products such as blood glucose meters, digital thermometers, pulse oximeters and blood pressure monitors.

“S3 Group has been at the forefront of devising ways to leverage the latest technology to enable faster delivery of telehealth for years, and we are very proud to have been selected by TI for the development of this Continua Certified™ platform for device manufacturers,” John Mulcahy, general manager, telehealth, S3 Group.

5.4.2 Phillips Healthcare Company Ltd.

Phillips healthcare have a global presence in a wide range of healthcare technology. For over seven years, Philips’ award-winning telemonitoring devices enables disease management firms, home care agencies and healthcare providers to remotely monitor chronic disease patients in their homes. Clinicians can monitor vital signs and send patients short health status surveys to make more timely care decisions and help prevent unnecessary hospitalisations.

Philips National Chronic Disease / Telehealth Best Practice Project

In the US, The Philips National Chronic Disease / Telehealth Best Practice Project brought together a panel of five nationally recognised chronic disease medical experts and home care clinical Telehealth experts from nearly every state. The US National Expert Design Panel reviewed the medical realities of managing
chronic conditions, as well as all available Telehealth protocols from US national groups and the proven experience and protocols of agencies who have demonstrated success in using Telehealth with one or more chronic patient populations. Using these insights, the National Expert Design Panel systematically developed best practice parameters and protocols for addressing each of the four major chronic diseases.

The goal of the Project was to develop a set of best practice protocols for the optimal use of Telehealth services for home care patients suffering from one or more of the four major chronic diseases served by Medicare-certified home health agencies: CHF, COPD, hypertension, and diabetes. The major focus was how to use Telehealth to improve quality and reduce cost for each of these populations.

Five US most recognised, most published and most distinguished chronic disease medical leaders served as medical leaders of the project. One of the key findings in the study is that clients of agencies -- that is consumers, people -- rarely refuse Telehealth services when offered. 84% of agencies stated that fewer than one in ten patients refused such systems. 2/3 reported that fewer than 1 in 20 people refused Telehealth services.

Consumers are clearly ready for Telehealth in the home. Such services also increase patient satisfaction, according to most providers in the study. Furthermore, 89% of agencies using Telehealth report increases in quality outcomes, and 77% found a reduction in unplanned hospitalisations.

Philips has a large footprint in Telehealth. Their offerings include the popularly branded Lifeline medical alert systems, Remote Monitoring solutions for clinicians managing patients at home with chronic conditions, Home Telehealth monitoring (such as cardiac monitoring and implanted device follow up), and the recently-acquired Raytel Cardiac Services.

5.5 Social alarms, Telecare, Ambient Assisted Living and Telemedicine

5.5.1 Social alarms

Social Alarms are seen to be SMART – Specific, Modular, Automatic Rapid and Tested. At a Telecare Monitoring Centre

- Experienced call handlers available 24 hours a day, 365 days a year to provide support & advice
- They automatically know where the alarm was raised and can follow response protocols
- This ensures that the most appropriate support can be summoned immediately
- The effects of most accidents and incidents in the home can be minimised
- The outcomes are better for the individuals, for their landlords, for the emergency services and for the health and welfare authorities

Social alarm services are, in principle, available across the whole country. The services are mainly provided by private suppliers (mainly for-profit, but some non-profit also exist). There is a publicly-funded scheme providing financial support for installation costs of social alarms which operates through voluntary and community based organisations. The estimated total take up is between 60,000 – 70,000 people, representing about 13 – 15% of those aged 65 or over in Ireland. Many supported housing schemes for older people in Ireland provide social alarms to their residents. The estimated total take up for people
living in such supported housing is about 75% of all units (about 2% of older people live in this type of housing).

For services to people in ordinary homes in the community, the private sector providers set up connections either directly for older people who apply themselves or via community and voluntary organisations. Social alarms provided in this way are not linked into the mainstream care services and family members and, where necessary, emergency services are alerted by the call centre. However, consideration is currently being given to the possible mainstreaming of social alarms services and other forms of ICT-based assistive technology into care services for older people.

In case of private subscription, initial installation charges are typically in the region of 300 euro, with annual monitoring / maintenance charges of between 66 and 90 euro per year. In the case of publicly-funded provision to older people living in normal housing, the installation fee is covered under the Scheme of Community Support for Older People but users must pay annual monitoring / maintenance costs themselves (about 80 euro).

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Coverage</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Response</td>
<td>Wexford</td>
<td>26 Counties</td>
<td>Tunstall</td>
</tr>
<tr>
<td>Fold TeleCare</td>
<td>Regional Office in Clones, Co. Monaghan. HQ in Hollywood, Co. Down</td>
<td>All-Island</td>
<td>Tunstall</td>
</tr>
<tr>
<td>TASK</td>
<td>Portrane, Co. Dublin</td>
<td>26 Counties</td>
<td>CHUBB Telecare, Bosch</td>
</tr>
<tr>
<td>Eircom Phonenumber</td>
<td>Dublin</td>
<td>26 Counties</td>
<td>Eircom’s Own</td>
</tr>
<tr>
<td>Carephone Direct</td>
<td>Naas, Co. Kildare</td>
<td>26 Counties</td>
<td>Bosch</td>
</tr>
<tr>
<td>AlarmCare</td>
<td>Dublin</td>
<td>Dublin &amp; Cork</td>
<td>Unknown</td>
</tr>
<tr>
<td>Help the Aged &amp; Age Concern</td>
<td>Belfast</td>
<td>Northern Ireland</td>
<td>Unknown</td>
</tr>
<tr>
<td>Aid Call</td>
<td>Monitoring Centre is in the UK and not in Northern Ireland</td>
<td>Northern Ireland</td>
<td>Various</td>
</tr>
<tr>
<td>McElwaine Smart</td>
<td>Lisnaskea</td>
<td>All-Island</td>
<td>Mainly Bosch</td>
</tr>
<tr>
<td>Home TeleHealth</td>
<td>Belfast</td>
<td>Northern Ireland</td>
<td>Various</td>
</tr>
<tr>
<td>Friendly Call Service</td>
<td>Dublin</td>
<td>ROI</td>
<td>N/A</td>
</tr>
<tr>
<td>Home Instead</td>
<td>All Ireland</td>
<td>ROI</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Table 5: Social Alarms and Telemedicine Services Companies

The alarms usually available from these suppliers are as follows:

- Pendant trigger
- Intruder alarm
- Ceiling pull cord
- Man-down alarm
- Panic button
- Smoke alarm
- Heat detection
- Gas leak detection
- Carbon monoxide alert
- Fall trigger
- Inactivity monitor
- Hypothermia detection
- Wandering person alert
- Flood alert
- Pill dispenser
- Bed exit monitor
- Enuresis alert
- Universal transmitter
- Hard-wired interface

5.5.2 Other Senior Care Resources

Ageing Well Network

The Ageing Well Network are a network which aims to bring together all the critical leaders from the fields of policy development, academia, service delivery, advocacy as well as key opinion formers in the ageing sector – those who have the authority and influence to radically improve the quality of life of older people. They offer their members the opportunity to share knowledge and insights, learn from each other and from leading international thinkers and practitioners in an environment of trust and exploration.

Their vision is - “Of an Ireland which is one of the best places in the world to grow old”, and their four key longer-term objectives:

- To ensure that leaders across the sector, and their organisations, benefit from sharing knowledge and insights and can learn from good practice elsewhere.
- To improve the quality of supports and services, making them more responsive to the known needs of older people.
- To strengthen the capacity of the ageing sector to influence public policy.
- To enable those working in the sector to inform the research agenda and benefit from its findings.
- All this is done under Chatham House Rules, promoting an environment of trust and confidentiality where ideas can be explored openly.

Ref: www.ageingwellnetwork.ie

Friendly Call Service

Friendly Call Ire Ltd (See Appendix A) is a social service provider. This service commenced in late 2003, utilising set-up funding from the Department of Health and some operational funding from the Health Service Executive. The mission of Friendly Call is to develop, deliver and oversee the provision of a professional, quality, friendly, confidential, good neighbour and health care service, offering a range of health and social support to Older People and to all Adults who may feel vulnerable or Alone.

In delivering its service, through the medium of voice over IP technology, Friendly Call receives Client referrals from Primary Care Agents; Public Health Nurses, Home Care Services (both public and private), Social Officers, Local GP, An Garda Siochana, Community Care Projects, Concerned Family members and Self Referral.
At this time, the service provides support to 1300 Clients living in Greater Dublin, on each week-day between the hours of 9-00am and 4-30pm. This Client base is supplemented by a further 600 Clients through our associated services in North Kerry, West Cork, Limerick, South Tipperary, Leitrim, Roscommon and Wicklow.

**HOMELink**

Homelink provide a free Telephone Support Line for seniors. They also offer assistance to Seniors to source a wide range of services including: Supply and installation of safety security measures and devices; provisions of basic maintenance for house and garden; development of a database of reliable trades people for extensive home repair and landscaping services; refer you to a trusted source of companionship and home service for seniors.

**Caregiverstress.com**

Fatigue, Stress and depression are real side effects of family care giving. Caregiverstress.com is an informative website offering ways to cope with caregiver stress. Visit Caregiverstress.com to complete an online stress assessment test and identify resources allowing you to cope with your senior care related stress level. [www.caregiverstress.com](http://www.caregiverstress.com)

**The Irish Senior Citizens Parliament**

The Irish Senior Citizens Parliament is a non-party political non sectarian and non profit making lobby organisation concerned with promoting the interests of retired and older people. They identify the issues of concern to older people and then bring these issues to the attention of Government and other agencies dealing with these issues. [www.seniors.ie](http://www.seniors.ie)

**The National Council for Aging and Older People**

The National Council for Aging and Older People was established as a statutory body, with its own independent legal and administrative status. This organisation signifies a considerable long -term commitment on the part of the state towards the provision of research and advice on aging and older people in Ireland. It has a direct involvement in and the promotion of a better understanding of aging and older people in Ireland. [www.ncaop.ie](http://www.ncaop.ie)

### 5.5.3 Telecare and Telehealth

There has been very limited take-up of more advanced telecare in Ireland to date, although some private and non-profit social alarm providers and social care providers now offer telecare ‘extras’ as part of their services. However, there have been a few pilot schemes in recent years and it is expected that telecare will receive more attention at national level in the coming years. Some examples of telecare pilots are presented below.

- In South Dublin, the Alzheimer Society of Ireland (an NGO and main service provider for people with dementia and their carers), is collaborating with Emergency Response (a private telecare provider) to conduct a pilot project examining the use of telecare for people with dementia and their carers. Tailor-made packages of technology are installed in the homes of people with dementia, involving an appropriate mix of smoke alarms, fall detectors, flood detectors, temperature extreme sensors and exit/entry sensors. Other devices are installed according to the assessed needs of the individual.
Connected Health in Ireland: An All Island Review

• In the North Dublin area, a ‘Technology and Dementia’ project was conducted from 2001 to 2002, with funding from the Department of Health and Children. It involved a partnership between the (then) Northern Area Health Board (now incorporated into the HSE), NGOs in the area and WRC, an independent research company. The trials mainly involved devices and networks within the home, although one of the 12 sites involved telecare installation.

• The ‘Safe at Home’ project in 2006-2007 was conducted by RAPID Drogheda (The RAPID programme is a focused Government initiative targeting communities in the 46 most disadvantaged areas in the country) in conjunction with Emergency Response the current market leader in the social alarms / telecare field. This pilot scheme involved the provision of telecare to 25 homes in Drogheda. The telecare involved was quite limited, mainly involving enhancements to the existing social alarm system.

• In Ennis, County Clare, the carers NGO Caring for Carers is using web cams to link day care centres with a central hub in Ennis. This provides access for older people and their carers to a range of services they would otherwise not be able to avail of.

Home telehealth services are very under-developed to date in Ireland and no major national pilots or trials have taken place. There have been some isolated, local small-scale trials, although these did not focus on older people. The main telehealth/telemedicine development has been confined to telemedicine services within hospitals and amongst medical staff; examples include tele-radiology, tele-cardiology and tele-oncology.

One non-profit social alarm provider includes home health monitoring as part of its service, although this has not yet been officially launched and there is no take-up yet. The focus is on recording vital medical information on a daily basis for sufferers of chronic diseases such as COPD, heart failure, asthma or diabetes, enabling health care professionals to detect any change in the patient’s status as well as
automatically raising an alarm if their condition deteriorates. Another has plans to offer home healthcare technology to older people, although the main target market will be pharmacies.

In practice, home telehealth services for older people appear to be generally unavailable across Ireland. They are not yet a feature of mainstream healthcare services and any provision of such services would have to be privately sourced and funded by the individual. Take-up is therefore minimal. There is no national policy focusing on home telehealth.

### 5.5.4 Smart Homes / Assistive Technologies

In Ireland to date, smart homes are only being addressed in some limited trials. Computer-based/electronic assistive technologies are not extensively available beyond occupational or educational contexts. Provision and availability of assistive technology depends on the local and community supports in place, this can differ widely across the country. It also depends on the community and voluntary organisations operating locally. In general, the focus in relation to independent living for older people has tended to be low-tech rather than high-tech or ICT-oriented; although a new action-research initiative is to be implemented in this field by the main health agency, the Health Service Executive (HSE).

Some relevant trials include:

- The Technology and Dementia Project involved implementation of a range of devices and systems, including automatic clocks/calendars, alerting systems for doors and stairs, automatic lighting systems; automatic cooker shut-off devices and adapted telephones for easy use by people with dementia. These systems were implemented in 12 homes. The evaluation results were positive and continuation of the approach was recommended. No further development to date within mainstream services has occurred, however, although a new initiative on telecare has been run by the Alzheimer Society.

- The ‘Nestling Project’ in Dundalk, County Louth is exploring how ‘place-centred-ageing’ and ‘structure preserving transformation’ can be applied in a new community-oriented demonstration project for older people. Along with technologies to promote collaboration and social inclusion, the project is examining a technology paradigm geared towards early detection, diagnosis and intervention, and is based on a process of continuous assessment, preferred interventions and service delivery orchestration. It will include a ‘sensor/sensing environment’, pattern recognition and service needs analysis.

### 5.6 mHealth

#### 5.6.1 Introduction

Mobile healthcare, referred to as mHealth is the application of wireless technologies and mobile services for use in the provision of healthcare. Due to the ubiquity of mobile phones mHealth is a hugely expanding arena. The following section covers some of the local companies engaged in this space and some of the more recent announcements. It does not include details on the major mobile phone companies that are expanding into the healthcare market. The convergence of two of the largest industries opens enormous potential – healthcare and mobile phones.

Some mHealth examples include:
• Remote access to information by healthcare workers
• Mobile health related applications e.g. diagnostics and ePrescription
• Mobile data collection and transmission for use in provision of care
• Health and wellness applications to encourage health and prevent illness
• Communications to and from patients

mHealth has been categorised into four areas: Information Communication, Monitoring, Surveillance and Diagnostics. With the rapid development of 3G, 4G, LTEs, mobile broadband and the demand for mobile data many of the advanced applications requiring wide-scale high data capacity are becoming more viable. The service providers are providing reliable, robust and high-capacity networks. As many other m-services are evolving so too will mHealth. The market is expanding as a recent McKinsey & Company report indicated. Also, the United Nations has also developed the mHealth alliance to tap into this technology for healthcare uses in emerging markets. With two thirds of the 5 billion mobile devices in the hands of people living in emerging market economies it is seen as one of the preferred mechanisms to reach this population. [Source – personal communication with David Doherty, 3G Doctor]

Activities in Ireland

A number of Irish companies are dedicated to providing solutions in this space. In addition many of the system integrators have mobile communications capability and have delivered a number of solutions using mobile telephony for use in patient tracking, monitoring of vital signs, reminder systems etc. These are as follows:

<table>
<thead>
<tr>
<th>Mobile Healthcare - mHealth</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G Doctor Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>Doctot</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>eMedia Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>Fitfone Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>HeartPhone</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>Ossidian Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>Grapevine Solutions Ltd</td>
<td>Republic of Ireland</td>
</tr>
<tr>
<td>Valentia Technologies Ltd.</td>
<td>Republic of Ireland</td>
</tr>
</tbody>
</table>

Table 8: mHealth Companies
5.6.2 mHealth in the Recent Press

The following section covers a number of recent press releases and reports in the media on mHealth. There are a number of free reports available online on mHealth including the following –

- Booting Up Mobile Health: From Medical Mainframe to Distributed Intelligence (May 2009) 38
- FCC’s National Broadband Plan: Healthcare Chapter 10 (March 2010) 40
- Wireless & Mobile Health, a Triple Tree Industry Analysis (September 2009) 41

Current global mHealth opportunity is $50B 42

February 24th, 2010

According to recent report from McKinsey & Company, “opportunities” in the global mobile healthcare market are worth about $50 billion in 2010. The consulting firm pegs the US mHealth opportunity at $20 billion, or nearly half the global market. McKinsey estimated the market opportunities after conducting a survey of 3,000 consumers — 500 from each of the following countries: Brazil, USA, Germany, South Africa, India and China.

“A large proportion of the nearly four billion people using mobile phones struggle to gain access to good quality and affordable healthcare, both in emerging markets and more developed societies,” according to the firm’s release. “Mobile healthcare as a sector aims to bridge this divide, by utilising mobile phone technologies to deliver healthcare (voice, SMS, images, video, connected devices).”

McKinsey had a creative way of determining the market opportunity: It ask the survey respondents questions about four mythical but on the whole feasible mHealth services:

- **Phone Doctor**: customers call to speak with a qualified physician for remote diagnosis & advice
- **Drug Delivery**: customers order medications over the phone for last mile delivery of authentic drugs within 24 hours
- **Health Watch**: a SIM embedded biosensor watch that monitors vitals, and is connected to emergency services
- **Med Reminder**: customers receive periodic SMS reminders to follow a prescribed medication routine.

McKinsey concludes that nearly 50 percent of the opportunity is in connected bio-sensor devices, which represent about $30 billion of incremental opportunity globally. Almost 70 percent of the respondents were extremely or very interested in at least one of the mHealth products described and willingness to pay for the services was also high across all geographic groups, according to the firm. Not surprisingly, Indian and South African consumer are the most interested in mHealth and US respondents were most interested in Phone Doctor (60 percent) and Health Watch (35 percent).

The mHealth Alliance 43

*The mHealth Alliance is dedicated to enabling the delivery of quality health to the farthest reaches of wireless networks in the developing world. Its mission: to catalyse and accelerate the emerging field of*
mobile health (mHealth) and help move the needle in global efforts to reach the health-related UN Millennium Development Goals of reducing child mortality, improving maternal health, and combating HIV/AIDS, malaria and other diseases.

Launched at the GSM Mobile World Congress in February 2009 by the Rockefeller Foundation, United Nations Foundation, and Vodafone Foundation, the Alliance now includes the U.S. President’s Emergency Plan for AIDS Relief (PEPFAR) among its founding partners.

The Alliance acts as an umbrella organisation to complement, draw together, and expand upon the mHealth initiatives of multiple organisations around the world by creating research, filling gaps, making connections, and forging public-private partnerships in support of innovation and projects that address global health needs.

Today there are approximately 5 billion mobile devices in use around the world -- and close to two-thirds of them are in the hands of people living in emerging market economies. Mobile phones have the ability to dramatically change the lives of those who use them, including healthcare providers.

mHealth - the use of mobile devices in health solutions - is revolutionising healthcare delivery in much of the developing world. Innovative mHealth projects are powering the collection of health data, supporting diagnosis and treatment, and advancing education and research in even the most remote and resource-poor environments.

Healthcare highlights @ Mobile World Congress

GLOBAL GSMA and Continua partner:

The GSM Association (GSMA) is an association of mobile operators and related companies devoted to supporting the standardising, deployment and promotion the GSM mobile telephone system. GSMA announced their partnership with the Continua Alliance to promote embedded mobile devices in healthcare as part of the Embedded Mobile Initiative. Their common goal is to enable interoperability for mobile health devices and create both a scalable and viable mobile healthcare market.

GSMA estimates that remote monitoring of chronic diseases could potentially save $175-200 billion each year in OECD and BRIC (Brazil, Russia, India, and China) countries alone.

According to the ‘mHealth and Home Monitoring’ report from Berg Insight the market for home health monitoring was valued at a staggering $11 billion in 2008. Furthermore, the analyst firm estimates growth to be around 10% annually.

Berg’s research points out a few interesting figures related to the home health monitoring industry:

- An estimated 300 million people in the EU and US suffer from one or more diseases where home monitoring could be a viable treatment option
- Of these, 25% (75 million) would benefit from existing wireless home monitoring solutions
- A further 50% (150 million) would benefit from the integration of mobile handsets to existing medical devices
Europe’s Lack of Mobile Health Policy

Jaakko Aarnio, a project officer in the European Commission’s Information Society and Media directorate, offered an eye-opening revelation about the EC’s mobile healthcare policy recently. “We don’t have a policy now,” Aarnio told an international networking conference staged in Washington by the US-based mHealth Initiative. One reason he gave in his presentation is that mobile applications that go beyond simple library functions may turn mobile devices into Class 2 medical devices, which are subject to EC regulation. “There may be some regulation needed for viewing images,” said Aarnio.

The EC has very little data on m-health, though such information isn’t exactly plentiful in the US, either. US-based technology market analysts ABI Research predicted last year that there would be 15m medical devices with built-in cellular connectivity in use worldwide by early 2012. Many of these “telehealth devices,” as ABI calls them, will aid in the remote monitoring of senior citizens and other high-risk patients, as well as in the prevention and treatment of obesity.

In another study, ABI said the global market for “wearable wireless sensors” would grow to more than 400m units by 2014. In both cases, ABI said North America will account for the majority of sales.

However, the high penetration of technology into primary care settings in many European countries should mean that it is easy to transfer electronic patient data to handheld devices, Aarnio argued. He highlighted the handful of successful mobile health projects the EC has funded, including one that introduced a new phrase, “ambient assisted living.” The term, from a five-nation programme called CAALYX (Complete Ambient Assisted Living Experiment), refers to home-based and mobile monitoring technology that lets elderly and chronically ill patients live semi-independently.

Technologies generally performed well during a 2007-08 trial, but many users found the devices to be uncomfortable. CAALYX has moved into a second phase of testing, also supported by the EC, to integrate monitoring sensors into wearable garments and to prepare a market validation study. One EC-funded mobile health project that made it to the commercial market is Ericsson Mobile Health. This mobile communication platform for healthcare from the Swedish telecommunications giant grew out of an EC project called HealthService 24. HealthService 24 was founded in 2003 to develop what’s being called “body-area networks,” though Aarnio said the concept dates to 1994. Back then, Ericsson tested such technology for management of chronic obstructive pulmonary disorder, but did not have a viable business model. After researchers involved with HealthService 24 found that patient self-management of COPD increased and the number of unexpected hospital admissions plummeted after just eight weeks of testing, potential customers started taking notice. The technology closed a loop by making sure patients followed doctor’s orders when they weren’t under direct physician care. “Closed-loop management can reduce mortality and save money.” said Aarnio.

Mobile Healthcare Development Priority

Gartner believe that mobile health monitoring apps will be so popular due to their ability to reduce the costs related to chronic diseases and their potential to improve quality of life for patients. It is claimed that the mobility aspect will be particularly important in the developed world where fixed connections are not as pervasive. They note that the use of mobile phones for health monitoring has up until now been primarily limited to pilots but in future companies should be able to successfully monetise the process. The level of expectation around mobile health monitoring is put in perspective when you see that it comes above mobile advertising and was narrowly beaten by mobile browsing. The full list in order:

1. Money Transfer,
2. Location-Based Services,
3. Mobile Search,
4. Mobile Browsing,
5. Mobile Health Monitoring,
6. Mobile Payment,
7. NFC Services,
8. Mobile Advertising,
9. Mobile Instant Messaging,
10. Mobile Music

O2 launches its old folks’ phone

Accessibility is paramount when it comes to designing technology, and even more so with senior citizens in mind. Phones should be easy to read and easy to dial, as quality of sight and mobility diminishes with age. O2 has brought the Emporia Life handset to the Irish market, an uncomplicated and accessibility-friendly mobile phone with a large, orange, backlit screen for easier reading.

Following the Business of Ageing conference the recommendations for “age neutral” products is not included herein.

Bluetooth sets standard for mobile healthcare devices

Feb 2010
The non-profit, open-industry coalition for technology healthcare, Continua Health Alliance, announced that Bluetooth technology will be adopted as a healthcare device standard in version two of its guidelines for low-energy wireless communication. Bluetooth is currently the only wireless technology specification included by Continua, and was chosen after a 10-month review process. “Continua’s choice of Bluetooth low-energy technology – a specification in development at this time and expected to be adopted by the end of the year – underscores the excitement and need for this Bluetooth wireless standard in the telehealth arena,” said Michael Foley, executive director of the Bluetooth SIG (Special Interest Group).

Because healthcare devices such as fitness sensors and heart monitors are usually small and battery operated, a short-range and low-power wireless connectivity standard is ideal.

Continua certifies many telehealth devices, ranging from health-monitoring (pulse oximeter, blood-pressure cuff, thermometer, weight scale, glucose meter) to cardiovascular fitness devices to independent living monitors for the frail or elderly.

mHealth market poised for rapid growth despite fragmentation

An article in FierceMobileHealth news (Mar 2010) discusses the fragmentation of the mHealth market.

Mobile healthcare was a $1.5 billion industry in the U.S. last year, but the market is expected to triple in five years, reaching $4.6 billion by 2014, according to a new report. The growth could be even greater if pay-for-performance gains wider acceptance, says the report, from Overland Park, Kan.-based CSMG, the strategy division of consulting firm TMNG Global.

Still, like the healthcare system as a whole, the m-health market remains highly fragmented, with no real dominant players. It’s a complex sector that will require collaboration between traditional healthcare companies and new entrants, such as telecommunications providers.
"Mobile network operators, device OEMs and software providers bring technology capabilities and consumer-brand assets that current healthcare players may lack," says CSMG Senior VP Susan Simmons. "New collaborations and new business models with traditional healthcare players along with thorough evaluations on the m-health solution approach will be key to establishing the m-health industry for the long term."

Apps that offer a helping hand

The Times article, March 2nd 2010 published - Why your phone is now the doctor in your pocket. Smartphones will soon be diagnosing illness as well as advising on cures. Will we all become iPhochondriacs? They included details on the following use of mHealth technologies and others besides. There are already more than 2,000 health-related apps on offer

- Johnson & Johnson’s Lifescan unit is piloting an app that lets users upload readings from their wearable blood-glucose monitors to their iPhones
- The pharmaceutical company Novartis has agreed a £15 million deal with Proteus Biomedical to create “smart pills” that transmit data from inside your body to your phone to check you have taken medicines as prescribed. If not, you may expect a text reminding you of the physical penalties of non-compliance.
- Fertilityfriend
- An app that tells you when in the month you will be most fertile and suggests the best sexual positions for getting pregnant too
- Sleep aid
- For the sleep deprived, an app that records a person snoring and maps it on a graph. Snorers can compare their graphs to sample clips of regular snoring, and find out if they have sleep apnoea
- Unitron uhear
- If you’re worried about deafness, use this test to measure your hearing at different frequencies and your ability to understand speech when it’s noisy
- Wavesense diabetes manager
- Diabetics can manage blood-sugar levels with an app that records glucose results, carbohydrate intake and insulin doses
- Acneapp
- This light-therapy app claims to treat your spots as you chat. It shines “bacteria-killing” waves of blue and red light on to your skin
- Cry translator
- What is your baby trying to tell you? An app to interpret hunger, tiredness, irritation or boredom in his or her sobs
- Fitdeck mobile
- Your personal trainer, with more than 3 trillion workout combinations to follow at home. No equipment needed; beginner, intermediate and advanced settings
- Baby’s coming
- Keeps track of a mother’s contractions during labour, allowing her to work out when it’s time to head to hospital

Limerick doctor develops medical iPhone applications

Mar 2010
A Limerick-based software development group called DOCTOT, which stands for “Doctor’s Tools of the Trade”, has developed iPhone applications aimed at allowing doctors to use the most up-to-date download technology to access diagnostic aids during consultations.

The individuals behind DOCTOT are Prof Declan Lyons, consultant physician at the Mid Western Regional Hospital, Mr Fergal McDonnell, Software Engineer, and Mr Macdara Butler, a web designer.

DOCTOT aims to help diagnose and monitor clinical conditions, using validated rating scales, already familiar to doctors. Prof Lyons believes that “this can result in better and more efficient diagnoses, which will greatly benefit patients. Given that the supply of new biomedical knowledge is ever increasing, it isn’t always possible to deploy the current evidence-base quickly, in clinical settings. The use of Apps on the iPhone provides a very portable and accessible way to achieve this, especially for busy clinical practitioners”.

Prof Lyons and Mr McDonnell have also developed a library of clinical information systems, which can be either web or desktop-based. Mr McDonnell says that with the advent of medical iPhone Apps and tablet computers such as the iPad, computerised patient record systems and expert systems can be brought directly to the bedside or clinic, thereby making diagnoses and recording of clinical details much easier.

DOCTOT is producing a series of Applications with the support of a number of pharmaceutical companies – Servier, Lundbeck, and Menarini.

The first of these, DOCTOT Depression, already available on iTunes App Store, is a suite of the most widely used, clinically administered, depression assessment scales. Clinicians can use the App during a consultation whilst recording patient responses and then automatically generating scores that aid the diagnostic process. The App also allows uploading of these results on to computerised patient management systems so that results can be easily stored and accessed.

DOCTOT is designing similar Apps in areas such as stroke, hypertension, osteoporosis, diabetes and many other medical conditions.

5.7 Conclusion

There are a diverse set of skills across the connected health space in Ireland. Some of these indigenous organisations are now successfully exploring international connected health opportunities. Likewise some multinationals already see Ireland as a suitable location to conduct their R&D in connected health and as a market for their developed products. There is an opportunity to further develop the services around connected health. A big push is required from the agencies and the companies to help drive engagement and procurement of connected health solutions across Ireland within the public healthcare providers. As with the clinical section above connected health roll out is as much a transformation process as the technology provided is only an enabler. Only working closely with the service providers and clinical communities will yield successful results where companies can get their innovations to market.
6. ACADEMIC CAPABILITY & ACTIVITIES

6.1 Introduction

Across the island, there are 11 universities in Ireland. These are involved in carrying out the majority of research across the island of Ireland, both basic and applied. There is some research targeted specifically at connected health with some specific research groups, and many that use healthcare applications as mechanisms for proving technology concepts. The universities in Ireland are as follows:

- Dublin City University
- Queens University, Belfast
- National University of Ireland Galway
- National University of Ireland Maynooth
- University of Dublin, Trinity College
- University College Dublin
- University College Cork
- University of Ulster, Coleraine
- University of Ulster, Jordanstown
- University of Ulster, Magee
- University of Limerick

There are also a large regional college and institutes of technology across the island. From our research we identified, within these only a number of the institutes of technology including Letterkenny, Dundalk, Dublin, Waterford and Tralee have any specific activities in connected health. The details for each of them are included below in Appendix B with some specific projects highlighted.

There has been some but minimal commercialisation of connected health solutions coming out of the academic institutions. A large number of Centres for Science Engineering and Technology (CSET) and Science Research Clusters (SRC) have been funded to date by Science Foundation Ireland (SFI) which is major inter-institution collaborative efforts with industrial partners. A number of these including the Biomedical Diagnostics Institute, and Clarity have developed a number of platform technologies and sensors that can be used within the connected health area. A number of Applied Research Enhancement (ARE) programmes have some focus on Connected Health including Casala and Wisar.

The following section gives a picture of the interests and activities currently ongoing within the academic community in Ireland. A detailed academic database is included in Appendix B.

6.2 Collaborative Projects

6.2.1 Smart Ambient Assisted Living (SAAL) Group – UL, NUIG, GeorgiaTech

The SAAL group are a community of researchers whose aim is to create innovative, person-centred, technological solutions for the effective management of Health and Wellness in the home. To ensure that the systems, devices and services they aim that their developments will meet the social and health needs of users and will be effective in the management of their health and wellness. SAAL is a multi-
disciplinary team comprising, general practitioners, gerontologists & occupational therapists, electronic, mechanical & civil engineers, social marketers and computer scientists.

In SAAL, their team of researchers is drawn from three institutions: NUI Galway, Georgia Tech Ireland and the University of Limerick. This team is made up of researchers with a strong track record in ambient assisted living research and with complementary expertise who will work in partnership to create innovative and effective systems, devices and services for home health and wellness management.

Their goal is to produce world-class research in the field of AAL and to provide an effective mechanism for the translation of these systems, devices and services into commercial products. This will have the dual effect of allowing the full benefit of our work be enjoyed/experienced worldwide and of bringing significant economic benefit to Ireland’s smart economy. Georgia Tech Ireland will play a special role in the commercialisation of the work of SAAL through its network of industrial partners and through access to its parent organisation, Georgia Tech Research Institute. A number of their joint projects are included in appendix B.

6.2.2 TILDA

The Irish Longitudinal Study on Ageing (TILDA) is the most comprehensive study on ageing ever undertaken in Ireland. This ground-breaking study will explore the health, lifestyles and financial situation of 8,000 to 10,000 people as they grow older, and observe how their circumstances change over a 10 year period. The study is being carried out by Trinity College Dublin in collaboration with an inter-disciplinary panel of scientific researchers, with expertise in various fields of ageing, from Dundalk Institute of Technology (DKIT), Economic and Social Research Institute (ESRI), National University of Ireland Galway (NUIG), The Royal College of Surgeons in Ireland (RCSI), University College Cork (UCC), University College Dublin (UCD) and Waterford Institute of Technology (WIT).

The information gathered in TILDA will improve our understanding of the factors that contribute to successful ageing in Ireland. In addition, it will assist in the development of a range of economic, health and social policies that will benefit all people living in Ireland. Some of the questions we are interested in answering are:

- How do people’s health and level of disability change over time?
- What happens to people’s memory as they age?
- What are the factors that determine when people retire and how do people plan for their retirement?
- Do people have enough savings to provide for their older age?
- How do people’s activities, relationships and quality of life change over time?
- What is the relationship between people’s health status, economic situation and social circumstances?
- How does this relationship change over time?
- What are the factors that determine successful ageing?

TILDA is funded by:
The Atlantic Philanthropies, the Department of Health and Children and Irish Life
6.2.3 The Patient Journey Record (PaJR) - A Platform for User Driven Healthcare.

PaJR is a collaborative research project to build software for the patient-centred management of chronic illness. The project partners are the National Digital Research Centre (NDRC), Trinity College Dublin (the Knowledge and Data Engineering Group and the Computational Linguistics Group) and two Irish SMEs - GroupNos Technologies Ltd (www.groupnos.com) and PHC Research Ltd. A demonstration of the Patient Journey Record project concept can be seen at [personal correspondence with Kevin Smith, NDRC]

6.2.4 CAPSIL

The aging of society is the single most important aspect of health care in the 21st century. Many intriguing ICT solutions are being developed within the EU, USA, and Japan for helping older people remain independent longer. However, these solutions tend to be fragmented and heterogeneous. The CAPSIL Coordinating Support Action (CSA) team is a strategic international coalition of University and Industrial partners that already have extensive teams developing hardware / software / knowledge solutions to independent living based on user requirements. All partners of CAPSIL are already members of regional and national centres on aging engaged in the process of helping to establish public policy and international standards. This support action is to launch initiatives, coordinated and disseminated by a series of workshops in the US, EU, and Japan (two per year for two years), with three fundamental goals to:

- Develop a detailed CAPSIL Roadmap for EU research to achieve effective and sustainable solutions to independent living based on an in-depth analysis of independent living requirements and the ICT scenarios developed or under development in the EU, as well as the US and Japan (societies where the aging of the population are currently on par or exceeding the challenges that will be found within the EU).
- Support aging research by proposing procedures to incorporate all of these diverse solutions into Wiki entries (CAPSIL Wiki). These CAPSILs will enable researchers and the ICT industry to get the information they need to quickly and easily test solutions for prolonging independent living within the many and various heterogeneous communities. Only with this knowledge will the relevance and efficacy of technological solutions be maintained and be empowered with the capability to be adapted for various cultures.
- Use the CAPSIL Roadmap and the CAPSIL Workshops to help policy makers in the US and Japan coordinate research agendas and funding efforts across the three continents.

The three Irish coordinators are

- Dr. Benjamin Knapp, Sonic Arts Research Centre, The Queen’s University of Belfast
- Dr. Michael McGrath, INTEL Performance Learning Solutions Ltd.
- Dr. Brian Caulfield, School of Public Health, Physiotherapy, and Population Science, UCD, Academic Director of TRIL

6.2.5 TRIL

In 2007, the TRIL Centre was established to help tackle this challenge. Its approach is to combine high quality clinical investigation with intensive qualitative research to iteratively develop culturally appropriate technologies that enable older people to live independently at home, whilst feeling comfortable and well
connected in their communities. The multidisciplinary teams of clinicians, scientists, technologists, designers and anthropologists work with older people to invent and test in real world contexts some of the new care paradigms of the future. Demographic ageing is one of the planet’s most pressing social and economic issues; it deserves and demands attention, investment, and all of the technology innovation that can be imagined.

“We have to invent new ways to care for our ageing populations. Current health and social care systems are not equipped to face the epidemic of age-related illnesses and injuries. Information and communication technologies offer us a means to prevent disease and injury, to detect problems earlier, to help older people better manage their own health conditions at home, and to personalise care to their unique needs and preferences. All of us will benefit from these kinds of technologies, first as caregivers for our own ageing parents and, if we’re lucky, for ourselves some day.” [Source: personal correspondence with Dr. Brian Caulfield, TRIL Academic Director]

Independent living

Independent living means living a normal life; this means something different to each individual. An important factor, however, is choice – to live in your own house, to be as active as you choose in the community, to be mobile, to enjoy your privacy and to meet who you choose, when you choose. Independence also means not being a burden to family or friends, being able to care for yourself, to be confident that you can cope and that your health won’t suddenly let you down. A common set of goals emerged from the TRIL participant cohort (n=600), they want:

- To continue live their normal life: do the small things like their own shopping, cleaning and cooking.
- To remain at home as long as they can while having the mobility and capability to remain in the community, or even to provide assistance to others.
- Not being a burden or dependent on others is a vital concern while; continuing to enjoy their later years of life.

The importance of the Home

It is critical to understand the importance of the home to older people, they are symbols of independence, practical demonstrations of competency; they are where people want to live as they grow old. Homes are central in Western policies of care for ageing populations. People’s own homes have for them lots of positive associations and meanings and there is a growing recognition that for this reason they have therapeutic benefits.

User-Centred Care

TRIL is focused on promoting and ensuring the user or patient is at the centre of any new care models. There is a trend is to move care away from institutional (centralised) settings to a decentralised user centred model of care. Traditional models of care have been designed and structured to meet and the needs of many stakeholders such as clinical teams, patients, carers and family. TRIL will encourage and inform those tasked with care policy and designing models of care that a fresh approach should be taken that positions the patient at the centre of the care model which should result in improved patient satisfaction and overall wellbeing.

The home environment will play a central role in this new model of care. There is an emerging acknowledgement that care in the home is likely to be cheaper and more personalised. To achieve this new model of care, technology will play a significant role.
The Technology Research for Independent Living (TRIL) Centre is dedicated to enabling older people to live their lives as they choose. TRIL is researching a technology safety net which provides unobtrusive care in the home. Collections of non-intrusive devices and sensors will collect and analyse data about the older person’s health on an ongoing basis as well as encouraging healthy behaviour by informing the older person. Communications links will alert family, friends or doctors should the need arise.

The TRIL Centre

The TRIL Centre is a research body staffed by leading researchers from Intel, UCD, TCD and NUI Galway. The focus of our research is discovering how technology can be used to maintain and improve the health of older people, empowering them to live as they choose. TRIL technology is developed by a multi-disciplinary team of ethnographers, clinicians, designers and a range of technologists. To ensure that all the technology that TRIL designs and builds will really have the desired impact and benefit for the older person, TRIL technology research is both clinically and ethnographically informed. Ethnography is the science of understanding of how people live and what makes them live the way they do. TRIL ethnographers spend extended periods of time with older people, getting to know them and understanding their day to day lives. This helps to identify opportunities to put technologies in place which are both unobtrusive and effective in supporting health. Clinicians develop models which link particular behavioural markers to health indicators to ensure the clinical efficacy of the research prototypes.

Technologists build prototypes to monitor these markers and analyse the data collected. Designers and ethnographers ensure that the technologies developed will become an accepted part of the day to day lives of older people. A core asset of the TRIL Centre is a common technology platform of hardware and software components which are combined in different ways to support many different clinical models and research projects. The technology platform (BioMOBIUS™) saves time and effort for clinicians, who can concentrate on their research, rather than on the machinery to support it. TRIL shares this common technology platform with the global research community.

The TRIL Centre has a growing network of R&D collaborations with other research teams worldwide. These include Intel Research in the US, Harvard University, the University of Ulster, Oregon Health Science University and the University of Genoa. TRIL also has important cooperative links with hospitals, patient groups, active ageing associations, government agencies and other multinationals. TRIL takes the research out of the lab into the homes of older people. The home deployment programme has already installed research prototypes in the homes of approximately 100 older people. This drives improvements in the technology, as well as serving the ends of clinical research. Only by proving our technology in the home can we be confident of its impact on the lives of older people.

TRIL Research Structure

The TRIL Centre is structured into complementary research elements, or ‘strands’. These are

- Ethnography, which strives to develop a deeper understanding of the requirements of older persons living alone, and to inform the clinical and engineering strands from the perspective of the older person
- Falls prevention, a clinical strand focusing on the prediction and prevention of falls.
- Cognitive function, which seeks to establish and to counteract the causes of cognitive decline in older people
- Social connection, which is investigating the impact of sociality on physical and mental health, as well as quality of life
• The TRIL Technology Platform, a shared technology resource which supports the other strands by developing and deploying new technology solutions in response to ethnographic and clinical inputs.

The TRIL Clinic is an fully functioning clinical facility where the clinical assessments and data is created

A Successful Research Paradigm

TRIL has developed a unique research model. TRIL grounds its research in ethnography and clinical efficacy, builds on a common set of research tools, and takes the research out of the laboratory into the homes of older people. TRIL promotes this proven model and actively encourages others to use it. TRIL has already delivered on its potential. The benefits are clear and the future is bright.

• TRIL research looks beyond new clinical knowledge, to the translation of that knowledge into technology, its use in the home and the benefit it can bring to the lives of older people.
• TRIL looks at the bigger picture. The social and economic viability of new technologies is an important criterion for success or failure. TRIL believes that research prototypes must have a good chance of being mainstreamed by healthcare systems and deployed on a massive scale, if they are to be considered successful.
• TRIL is long-term. Our home deployments will involve hundreds of end users, over a period of several years. This lets us track the success of our research prototypes and to assess their long-term impact on older people’s lives.
• TRIL is driven by efficiency and takes an industrial approach to research and prototype development. We focus on low-cost, flexible technologies which can be repurposed to embrace new opportunities. TRIL has pioneered the use of a common technology platform across all clinical research strands.

6.2.6 GeorgiaTech Ireland

GeorgiaTech Ireland is the European office for the translational research group within Georgia State University. One of their initiatives is WALT, a planned attempt to create a US and Ireland research collaborative testbed.
**Wireless Assisted Living Testbed (WALT)**

Georgia Tech Ireland and its partners in the University of Galway, University of Limerick and in Georgia Tech, Atlanta, are in the process of developing a Wireless Assisted Living Testbed.

The objective of the testbed will be to facilitate clinician and patient mediated health technology development and assessment services, to enable a self consistent means to assess assistive technologies. Whilst many assistive technology products must meet standards of safety they often lack any supporting documentation or independent assessment or approval, which purchasers, patients, clinicians or others, can rely upon to verify compliance with the claims made by manufacturers or service providers. This can limit the utility they offer.

The centre would seek to assist companies in their development of new assistive technologies. It would also provide some certification of the performance and efficacy of devices and other assistive technological products, process and services that have been developed to support the well being of vulnerable individuals and patients and those providing their care be they family, clinicians, friends or communities across the continuum of care.

The initiative thus seeks to establish a distributed, global, industry resource centre to provide independent resources that can contribute to developing new technologies in conjunction with producers and consumers and provide credible health technology assessment for new assistive products, processes and services. The centre will seek to document, test, train, classify, certify, and promote safe, reliable and interoperable effective and efficient solutions. The provision of such an independent global resource centre will provide means to allow organisations and companies to deliver a reliable informed systematic, global roll out of solutions to patients, clinicians, step-down facilities, hospitals, medical device companies, systems integrators and solutions providers.

Being an independent collection of users, engineers clinicians and industry, the WALT resource centre will can credibly provide an independent assessment and certification of commercial solutions for the medical device industry and define, document and assist the advancement of global specifications, regulations, technical and environmental standards and best practices, developed by such organisations as the Continua Alliance, to be adopted and implemented by the medical device industry and provide appropriate testbed of users and independent test methods as well as certifying laboratories for applicable solutions introduced to global markets.

Georgia Tech will provide a technical support for the initiative and service the installations in the testbed homes and supervise the support operation of the systems supporting the deployments during studies. They will contribute to the design and development of independent test methods and procedures and assist in the execution of the clinical health technology assessment providing independent certification for solutions.  *Source – Finbar Dolan, GeorgiaTech*

### 6.3 Education Courses

Ireland has a well developed infrastructure for the traditional training of nurses at several Universities and also in the higher education Colleges and institutes of technology. In addition to basic degrees in general nursing training many specialist and post graduate nursing training is offered in specialist fields including those where Connected health applications in chronic condition management are developing - for example intellectual disability, dementia nursing, psychiatric and diabetic nursing, etc. These capabilities within the island of Ireland are very relevant to the future adoption and implementation of Connected Health in
Ireland and overseas; in that the nursing professions will be at the front and centre of all aspects of healthcare delivery including the remote delivery systems using Connected health technologies and services. It is therefore important that nursing training in the future gives regard to the IT literacy of nurses who will be expected to use these technologies. This training provision for professionals who will deliver connected health is a frequently neglected facet of CH implementation. The authors simply wish to point out that Ireland has a strong and proud tradition in nursing and also strong capabilities in IT. In future there will be a strong convergence of nursing and IT and the Island of Ireland has an opportunity to provide innovative multidisciplinary training in this direction to support the deployment of CH technologies.

6.3.1 Diploma in Social Gerontology

The ICSG aims to develop social gerontology as a subject at diploma, undergraduate and postgraduate levels, educating future policy makers, public servants and leaders of private industry on ageing issues. The Diploma in Social Gerontology is a two-year, stand-alone, part-time programme for mature students. The programme covers a broad range of economic, social and political theories relating to ageing and examines public policy for older people across a number of fields. It is designed to equip students with the professional and analytical skills necessary to understand age and ageing in an economic, social and policy context and to enhance and develop their careers in age-related fields.

6.3.2 University of Ulster Health Informatics

The Programme on Health informatics bridges the gap between informatics and the health and social care disciplines. As a healthcare professional, this programme is designed to equip you with relevant everyday skills such as enhanced information handling and interpretative abilities.

This part-time programme supports employment during and after the course in the local healthcare industry. By combining work and part-time study you are able put your learning into practice and improve your professional skills. As you progress through the modules, you are able to apply the skills, tools and knowledge that you pick up in a practical environment. The qualification will enhance professional skills relevant to the NI Professional Awards in Health Informatics, verified by the NI Recognition and Monitoring Panel (NI RMP). In addition, as a health informatics professional, you will be eligible to register with the UK Council for Health Informatics Professions (UKCHIP). The programme is recognised by the Northern Ireland Health Informatics Technical Education Board. The programme is delivered by blended learning (a combination of face-to-face learning and WebCT). The duration and mode of attendance is normally one or two years.

Modules include:

- Analysing and presenting data and Information
- Electronic healthcare
- Emerging healthcare technologies
- Information management in health and social care

6.3.3 The Health Informatics Training System (HITS)

HITS is a training and certification solution for all healthcare workers. Developed by ICS SKILLS in partnership with the Health Informatics Society of Ireland, HITS is a response to the needs of healthcare employees who require a clear understanding of the technologies used in this sector and their contribution to administrative and clinical best practice. HITS is delivered online, where candidates can also access
study aids including quizzes and a sample test. The course is self-study; approximately 20 hours study time is required. On completion candidates sit an online test in a supervised test environment. HITS certification is awarded by ICS SKILLS.

HITS Level 1 - Basic Concepts of Health Informatics covers topics ranging from data processing and electronic record keeping to decision-support systems and security. Future HITS levels are planned which will focus on specialist areas within health informatics.

6.3.4 Institute of Healthcare Informatics

The Institute of Healthcare Informatics (IHI) was established by the Mater Misericordiae Hospital in conjunction with University College Dublin to provide professional qualifications and training in healthcare informatics for healthcare professionals. In providing its courses, it draws on the resources of both organisations. University College Dublin is the largest university in Ireland and is internationally recognised for the excellence and quality of its medical and nursing teaching.
7. GOVERNMENT & BUSINESS SUPPORT ORGANISATIONS

7.1 The Government Support Agencies

The Governmental industry support agencies across the island of Ireland, Enterprise Ireland, Industrial Development Agency, Invest NI and InterTrade Ireland, and healthcare organisations are all actively engaged in pursuing connected health / converging technologies agendas.

Where converging technologies sits within the agencies has always been a difficulty for the agency and segmenting companies and providing focused support. Are they healthcare, Telecoms, Software, or some form of hybrid that no one knows where they sit? This mindset needs to and is changing.

Invest NI have been actively involved in funding the BioBusiness initiatives, European Connected Health Campus, and actively promote NI globally as a place to do connected health activities. With this drive and along with the ECCH program, this has attracted many organisations into the space in NI and Ireland generally.

InterTradeIreland has supported joint cross-border initiatives with BioBusiness— see below.

Enterprise Ireland along with IBEC has previously been involved in a number of converging technology initiatives through the support of the Meeting of Minds Conference in mid 2008. They also proactively support indigenous companies developing products and services in this space. Many listed within the business activities and university based activities are supported by EI and INI and many are client companies as applicable. They have also been very supportive of many of the companies included within this report who are actively providing connected health solutions.

The Cooperation and Working Together (CAWT) is a partnership between the Health and Social Care Services in Northern Ireland and Republic of Ireland, which facilitates cross border collaborative working in health and social care. The CAWT partners are the Health Service Executive, Western Health and Social Care Trust, Southern Health and Social Care Trust, Western Health and Social Services Board and Southern Health and Social Services Board.

The IDA is working with many of the multinationals to help drive R&D activities in ROI. Converging technologies is a core thematic area for activity within the life science division.

7.2 BioBusiness

BioBusiness (www.BioBusinessni.org) is a business association and has over 55 member companies operating in the life and health sciences sector primarily within NI but recently on an all-island level. The organisation currently represents 95% of those involved in this sector across NI and aims to increase its membership on an all island basis. BioBusiness developed the terminology ABC to acknowledge the close collaborative relationships necessary between Academics, Clinicians and Businesses (ABC) in the development of the sector. In particular BioBusiness works very closely with the Universities, FE Colleges Institutes of Technology, RCPI, HSC Innovations who manage the IP within the NI healthcare sector and HSCR&D Office who manage all R&D within the NI clinical community.
BioBusiness operate with 3 main roles – i) advocacy, ii) sector support and iii) direct business support. Business and sector support is often achieved through the delivery of a number of managed programmes to facilitate and broker collaborations and partnerships for new product development, research support, new market opportunities and use of best practice to improve commercial competitiveness. BioBusiness is delivering support across three main themed areas - Connected Health, Personalised Medicine, and Healthy Living.

One of BioBusiness’ key strategic goals is to “Enhance Innovation and Collaboration” and this has been evident from its inception in 2004, with the development of networking programmes such as BioMedIreland, ABC Collaborations, ABC Ireland, Health Technologies KTN and Medilink UK. The organisation has also been involved with European networking programmes such as Enterprise Europe and FP7. Several connected health programmes BioBusiness have/are operating include:

**ABC Collaborations**

BioBusiness were involved in the preparation of Northern Ireland Life Science Capability Study which identified Connected Health as a potential growth area. The BioBusiness ABC Collaborations programme launched in 2007 was developed as an output from the Capability Study and sought to provide 3 collaborative projects over a 24 month period along with an International Research Survey. The 3 main areas of success for the ABC Collaboration project – Phase 1 was:

- Connected Health
- Agri-Foods
- Healthcare Packaging

Each area has not only seen a collaborative project delivered but a sector-wide engagement. In addition a total leverage of direct funding into the projects from the initial Invest NI investment in the programme is now approximately £3,500,000, (a ratio of 1:23) with a significant market opportunity for the companies involved. The principle connected health project was working with McElwaine’s to build up telecare and telehealth capability to enable them to create a joint venture with Bosch and tender for the ECCH project.

Since this BioBusiness have been involved in all the connected health initiatives in NI including the ECCH, ECH campus, and more recently the Medical Devices and Connected Health project.

**Medical Devices and Connected Health (MDCH)**

Starting in April 2009, the Medical Devices and Connected health project is an Invest NI funded collaborative networks program project. This has been working with companies and researchers to aid in the development of new product and service innovations. It has included such companies in NI as Intelesens, Marturion, McElwaine Smart, and Axellis. Projects have included cardiac care in the community, and a device for monitoring lung and heart sounds.

**REMINAC - Remote Management for Asthma and COPD Monitoring 2007**

- **Role of BioBusiness:** Project Management
- **Funder:** InterTradeIreland – All Island Business Network
- **Period:** 2007 – 2009
- **Project Description:** Remote Management for Asthma and COPD Monitoring

The network represents a partnership between InterTradeIreland, BioBusiness, Marturion Limited, Vitalograph Ireland Limited, and Eirwave Ltd. The aim of the project is to address a specific market request.
for an instrument that can be used to support remote management of the world’s fastest growing diseases. This new product will permit continual tracking of a patient’s lung health in order to better target their treatment. One output from this project was a new spirometer product.

**REMCA - Remote Compliance Assessment 2008**

- **Role of BioBusiness:** Project Management
- **Funder:** InterTradeIreland – All Island Business Network
- **Period:** 2007 – 2009
- **Project Description:** Remote Compliance Assessment

The network represents a partnership between InterTradeIreland, BioBusiness, Marturion Limited, Nvolve and EFast. This is the Remote Compliance Assessment project which resulted in the development of a tracking and management solution for the medical industry utilising state-of-the-art RFID technology.

**ABC Ireland - commencing Q2 2010**

The main aims and objectives of the ABC Ireland Programme are to promote, facilitate, broker and build opportunities through collaborative networks for commercial competitiveness in 2 high priority areas within the Life and Health Technologies Sector on the Island of Ireland.

The 2 areas of Personalised Medicine and Connected Health have been identified previously in the BioBusiness Sector Capability Study and the Matrix/Horizon Panel Reports, within NI. These priority areas are also reflected within the expertise and capability in ROI. The North and South both offer strong capability and contribution with unique strengths in each region. In addressing these priority areas the objectives of the programme would be to:

- Create new products for use in the Connected Health market and create new prospects for those devices with high unmet clinical need.
- Trial new product developments within the McElwaine Smart Group/Bosch GmbH Lisnaskea or University of Ulster Smart Homes to create linkages with additional demonstration centres.
- Increase technology translation and transfer between and amongst the Academic, Business and Clinical collaborative stakeholders.
- Identify and address new business or market opportunities.
- Facilitate increased engagement with European funding and partnership programmes such as Enterprise Europe and FP7.

To do this BioBusiness will build upon the linkages between Academics, Businesses and Clinicians as previously demonstrated in ABC Collaborations.

### 7.3 European Connected Health Campus

The European Connected Health Campus (ECHCampus) brings together commercial, academic and healthcare stakeholders to deliver leadership for the development of ‘Connected Health’ markets and practice across Europe.

Their aim is the transformation of healthcare delivery and the development of the connected health economy. The European Connected Health Campus has four primary functions:

1. Promotion of Connected Health - to provide leadership, education and focus supporting European and global implementation of connected health technologies.
2. Development of Connected Health Capabilities - to secure and engage in collaborative research and development and a range of field implementation projects utilising shared workspace and support facilities.

3. Participant Support - to support the strategic and tactical marketing and business development needs of ECHCampus members.

4. Education - ECHCampus will develop and provide educational opportunities, in support of broad scale deployments of remote monitoring technologies. This will include the development and documentation of best practices across procurement, implementation and standardisation.

The ECHCampus, headquartered in Belfast Northern Ireland, is registered as a Community Interest Company (CIC) – a ‘not-for-profit’ organisation. All operating surpluses are reinvested and the constitution allows for protection of any public sector funding inputs.

The ECHCampus is currently directed by a Board that includes representatives of commercial, academic and healthcare stakeholders. The priorities and programmes of the ECHCampus are further informed by an International Advisory Panel. We anticipate that as the ECHCampus grows in numbers and influence that the governance structure will also evolve to include an Executive Director who, with the support of the Board, will lead the implementation of the strategy and oversee management of day to day operations.

Manifesto\textsuperscript{60} focus on four areas of endeavour: Governance, Engagement, Procurement and implementation. Finally, in preparedness for procurement, we should expect to see an identification and acknowledgement of the roles of different stakeholders: Patients, Providers, Payers, Politicians, and Physicians.

The ECHCampus is due to organise a connected health conference in June 2010 in Belfast which will incorporate the Ambient Assisted Living group and Continua Alliance meetings as well as a trade show.

### 7.3.1 ECH Projects

**iBurst**

Members within the campus have been trying to use iBurst cloud network being developed across NI for wireless applications. They are also working the University of Ulster and CA and trialling out the CA connected health systems. 3 devices were supplied to each of 40 homes testing. Tests were carried out daily for weight, pulse oximetry and blood pressure. At least 1 reading was taken each day for each of the devices over 12 weeks. The aim was to challenge the data transmission systems and look at user interfaces. This trial has now been completed.

**VTT Report**

The campus was involved in the Personal Health Systems/Remote Patient Monitoring and Treatment market: Stakeholders’ interviews in France, Germany, Sweden and UK. The VTT Technical Research Centre of Finland was subcontracted by the Institute Prospective Technological Studies (IPTS) under a European Commission project to help build a picture of the Remote Patient Monitoring and Treatment (RMT) and the entire Personal Health Systems (PHS) markets and provide an analysis of the roles and strategies of stakeholders in the PHS/RMT market in France, Germany, Sweden and United Kingdom. Country reports were prepared for each of the above with examples of PHS and RMT initiatives.
7.4 Centre for Ageing Research and Development in Ireland (CARDI)

The Centre for Ageing Research and Development in Ireland (CARDI) is a not for profit organisation developed by leaders from the ageing field across Ireland (North and South) including age focused researchers, academics, statutory, voluntary and community sector representatives with support from The Atlantic Philanthropies. It is overseen by a Steering Group and hosted by the Institute of Public Health in Ireland.

Mission
To advocate for and advance the ageing research agenda by identifying, coordinating, stimulating, and communicating strategic research on ageing and older people as a means to improve the lives of older people in Ireland (North and South) especially those who are disadvantaged.

Purpose
CARDI has been established to provide a mechanism for greater collaboration among age researchers, for wider dissemination of ageing research information and to advance a research agenda relevant to the needs of older people in Ireland (North and South). Operating at a strategic level and in an advisory capacity, CARDI will focus on promoting research cooperation across sectors and disciplines and will concentrate on influencing the strategic direction of research into older people and ageing in Ireland. It has been strategically positioned around the following four areas:

- Identifying and establishing ageing research priorities relevant to policy and practice in Ireland (North and South);
- Promoting greater collaboration and cooperation on ageing research in order to build an ageing research community in Ireland (North and South);
- Stimulating research in priority areas that can inform policy and practice relating to ageing and older people in Ireland (North and South);
- Communicating strategic research issues on ageing to raise the profile of ageing research in Ireland (North and South) and its role in informing policy and practice.

This work has been made possible through funding by Atlantic Philanthropies, augmented by grants from the Department of Health and Children in Dublin and the Research and Development Office for Health and Social Care, Northern Ireland and hosting by the Institute of Public Health in Ireland. CARDI are in discussions to trial a telecare initiative.

7.5 Co-operation and Working Together (CAWT)

Co-operation and Working Together (CAWT) is a partnership between the Health and Social Care Services in Northern Ireland and Republic of Ireland, which facilitates cross border collaborative working in health and social care. Their primary programme of work is to deliver the European Union INTERREG IVA Priority 2, Theme 1, “Putting patients, clients and their families first” on behalf of the Department of Health, Social Services and Public Safety, Northern Ireland and the Department of Health and Children, Republic of Ireland. They also deliver other cross border projects on behalf of their partner organisations and the Departments of Health in both jurisdictions.

They have identified a range of projects including the following:
• Cross Border Acute Hospital Services
• Cross Border GUM Services
• Cross Border Eating Disorder Network
• Cross Border Multiagency Alcohol Harm Reduction Project
• Cross Border Outcomes for Children Project
• Cross Border Older Peoples’ Project
• Cross Border Disability Project
• Cross Border Social Inclusion and Health Inequalities Project
• Cross Border Diabetes and High Risk Clients Project
• Cross Border Obesity Project
• Cross Border Workforce Mobility Project
• Cross Border Autism Project

Of specific relevance to connected health are the Cross Border Diabetes and High Risk Clients Project and Cross Border Older Peoples’ Project.

7.5.1 Cross Border Diabetes and High Risk Clients Project

Project Overview
Project Title: Targeting High Risk Diabetes care: Improving pregnancy outcomes for women with diabetes and designing and running a Structured Patient Education (SPE) for children and adolescents with diabetes

Background: Co-operation and Working Together (CAWT) is the cross border health and social care partnership, comprising the Health Service Executive in the Republic of Ireland and the Southern and Western Health & Social Care Boards and Trusts in Northern Ireland. CAWT has been successful in securing funding from the European Union INTERREG IVA programme to progress a three and a half year cross border diabetes project.

Project Description
Target Group: Women with diabetes planning pregnancy and children of all ages with diabetes and their families

Aims: To improve the care provided to women with diabetes planning pregnancy and the education available to children of all ages with diabetes in the INTERREG IVA region of the Republic of Ireland and Northern Ireland.

Objectives: To offer diabetic women of child bearing age universal access to pre pregnancy clinics
To offer women the support needed to ensure the best possible outcome in future pregnancies for mother and baby
To pilot the use of telehealth to optimise diabetes control before pregnancy
To review evidence on best practice on Structured Education Programmes (SPE) and design an appropriate SPE for children and their families
To offer children and their families and carers universal access to Structured Education Program (SPE)

Funding: €1,987,435
Duration: 3.5 Years
Location: The project will be based in the border region. Learning from the project will be widely shared across the INTERREG IVA eligible area. Providers will seek to integrate the knowledge gained into mainstream health and social care service provision.

This project received approval in January 2010 for £1.6 million sterling funding from the European Union INTERREG IVA programme to implement two innovative diabetes initiatives across the Health and Social Care Trusts in Northern Ireland and the border counties of the Republic’s Health Service Executive.

### 7.5.2 Cross Border Older Peoples' Project

It is planned to offer older people a range of telecare/telehealth services and social support initiatives thus increasing the number of older people able to be maintained in their homes. It is estimated that 67% of men and 60% of women aged 65 - 70 have a long standing illness, which has significant implications for health and social services, communities, families and individuals themselves.

#### Project Overview

**Project Title:** Promoting Independence and Providing Social Support for Older People

**Background:** Co-operation and Working Together (CAWT) is the cross border health and social care partnership, comprising the Health Service Executive in the Republic of Ireland and the Southern and Western Health & Social Care Boards and Trusts in Northern Ireland. CAWT has been successful in securing funding from the European Union INTERREG IVA programme to progress a three year cross border Older People project.

#### Project Description

**Target Group:** The project will target those aged 50+ (in line with target age groups of voluntary partners) and with particular emphasis on frail elderly and those with dementia (75-80 yr +).

**Aims:**

Develop assistive technologies available to older people within their homes and provide a coordinated network of services which will address physical, emotional and social needs of older people, enabling them to live independently within their own communities.

**Objectives:**

The service will result in four interagency locality approaches which will provide:

- A coherent, multi-agency, multidisciplinary framework to enable older people to have a comprehensive response to their needs;
- Action to address health and health inequalities for older people;
- Improved primary care and community care responses;
- 160 opportunities per year for use of telecare/telehealth (40 per locality);
- Enhanced support for carers, recognising their individual needs;
- Mechanisms to support and maintain independent living;
- A person centred approach enabling services to be developed in direct response to need and in line with individual choices.

The project will be developed across the four geographical border areas of Louth/Newry, Armagh/Monaghan, Fermanagh/Cavan and Derry/Donegal with the potential to roll-out learning and the model of
The focus will be on prevention and early intervention approaches as well as improving the health status of those with established health and social care needs. In addition, the specific needs of carers will be addressed and where possible integrated into established programmes. The project will also seek to build capacity within community and voluntary sector partners and enhance their role in local service provision.

This project seeks to create an integrated structure which will be locally sensitive, allowing for development of services specific to meeting the needs of older people, regardless of borders. This will acknowledge the infrastructure/partnerships that already exist and support action to address the gap areas where development is needed and ensure that there is an effective link to accessing existing services. It will result in the development of an innovative range of services and may necessitate the reshaping of current services and the development of new models.

Funding: €2,277,076
Duration: 3 years
Location: The project will be based in the border region. Learning from the project will be widely shared across the INTERREG IVA eligible area. Providers will seek to integrate the knowledge gained into mainstream health and social care service provision.

Note: This project has not gone out to tender as of yet.

### 7.6 Charitable Organisations

A number of charitable organisations are actively involved and interested in connected health solutions for their members. Some of these including the Alzheimer’s Society and Caring for Carers are detailed above. A detailed study into the other charities including Chest, Heart & Stroke, Diabetes groups who recently expressed their interest in these technologies, has not been undertaken within this report.

### 7.7 Conclusion

There are a number of initiatives and as with the other projects outlined within the other sections there are many interested parties and activities ongoing which illustrates the diversity of connected health.
8. AN INTERNATIONAL PERSPECTIVE

8.1 Introduction

Innovation in the systems and services of Connected Health is taking place in many countries and the market opportunities are global. Irish initiatives need to be considered within this global context, the home marketplace for CH technologies and services can provide an important foundation market and development ground for new ideas and also provide many benefits to the quality of healthcare in Ireland and reduction of risk to patients. These technological innovations, building on existing international experiences that are developed for applications in Ireland, can then be “leapfrogged” into the global marketplace.

The applications and deployment of Connected Health varies enormously from country to country and reflects the funding systems for health and social care in that country.

A global review is beyond the scope of this report, however in considering international experiences of potential relevance to Ireland it is important to keep in mind national differences in healthcare delivery, national demographics and other factors a profound influence on the ways in which CH develops and caution must be used in extrapolating experiences from one country to a potential application in another. Nearly all developed nations with the exception of the USA have some form of universal healthcare for all eligible residents covering various aspects of basic healthcare. The systems vary according to the extent of government involvement in directly funded care through taxation or via compulsory health insurance schemes.

Connected Health needs to be considered in the context of each of the following systems:

- Where health care is universally supported through government funded programs (e.g. the NHS throughout the UK, Spain, Italy and Nordic countries) where there are developed networks of hospitals and primary care centres coming under centralised control.
- Countries where healthcare is largely funded through compulsory health insurance programs (e.g. Germany, France and many eastern European countries,)
- Those countries such as Ireland with a blended system of Government funded care (The health Act 2004) supplemented by a large insurance funded private healthcare market.
- Countries where there is a patchwork of privately funded and/or charitable bodies delivering healthcare (e.g. some middle eastern countries)
- Developing world situations with acute care hospitals and community based nursing care.

The United States and the European Union are two dominant markets for the use of connected health in home care service, in part due to the high availability of telephone and Internet service as compared to other parts of the world. Within the United States, over 260 million people have a land line connected, over 190 million are cell phone users, and approximately 200 million are Internet users. The European Union has roughly an equivalent number of people connected to land lines, but prevails over the U.S. with more than 300 million cell phone users and 230 million Internet users. According to the International Communications Union, it is predicted that there will be 4 billion mobile phone users worldwide by the end of 2008.

In the more developed large countries where urban populations and small communities are often separated by great distances such as Canada and Australia particular aspects of connected health may be very well developed, in particular through the use of telemedicine to links between clinicians and remote community based nursing or home care.
The lack of a land based copper and fibre telecommunications infrastructure in the developing world has led to some very innovative applications of CH in developing nations where there is mobile phone network coverage. Mobile phones have become ubiquitous and are being used in very innovative ways in healthcare.

8.1.1 Internationally Linked in Communities

There are a many websites and linked groups connecting the global connected health communities. This is by no means exhaustive. A number of these are as follows:

- **www.telecareaware.com** is an excellent website to keep track of ongoing developments internationally in telecare and telehealth and product and service development.
- Linked in Wireless Health group are a group of practitioners interested in the application of wireless based technology in healthcare - [http://www.linkedin.com/groups?home=&gid=2181454&trk=anet_ug_hm](http://www.linkedin.com/groups?home=&gid=2181454&trk=anet_ug_hm)
- The Centre for Connected Health - [http://www.connected-health.org/](http://www.connected-health.org/) is a division of Partners Healthcare, Boston, USA
- **www.fiercemobilehealthcare.com** is a website with news of activities across the connected health arena

8.2 The European Union and Connected Health.

The European Parliament, council and commission recognising that EU citizens are getting older and increasingly living with chronic diseases have championed many different aspects of connected health and have funded many R&D and collaborative projects, throughout Europe, with the basic purpose of encouraging member states to build confidence in the use of these systems at a national and supernational level, bringing legal clarity to the use of these systems and facilitating market development and competitiveness throughout Europe, in developing countries and globally.

This European literature created a range of terms with:

- eHealth as referring to the use of ICT in all aspects of healthcare,
- Telemedicine referring to the distant provision of healthcare and
- Independent Ageing, Healthy Ageing, Ambient assisted living referring to support of ageing processes.

More recently references increasingly include the terms of on-line medicine and personalised healthcare which represent further stages of integration of the use of ICT in healthcare.

This European perspective is crucial to planning in Ireland by 2020 25% of the EU population will be over 65. Spending on pensions, health and long term care is expected to increase by a factor of three by 2050. However, these older Europeans also are important consumers with a combined wealth in excess of $3,000 Billion.

The range of initiatives is very extensive and some of the key EU reports are listed in the Bibliography. Irish researchers, clinicians and businesses have participated in many different EU projects. These provide an
important window on innovation and development activities throughout member countries. Experiences are very diverse and it is important that this knowledge be evaluated and built on to avoid duplication of efforts and to learn from past failures. Some projects with Irish involvement are included herein.

### 8.2.1 CommonWell

12 partners are cooperating in the CommonWell project, aiming to deliver ICT-enabled health and social care services in four Member States of the European Union. The integrated services are to support the effective management of chronic disease, and to address issues which affect independence, such as reduced agility, vision or hearing, in order to significantly improve the quality of life for older people and their families. Work Research Group (WRC – see note) based out of Dublin are involved in this project. A total of 400 users across four locations in Europe will receive the newly integrated services for at least twelve months. The results of evaluating the pilot operation will be used to extend service provision and promote the wider uptake of this model of care across Europe.

Milton Keynes and Eindhoven are the pilot locations that will initially address chronic disease management for older people suffering from Chronic Obstructive Pulmonary Disease (in Milton Keynes), and Chronic Heart Failure (in Eindhoven). The CommonWell services will improve communication between health and social care providers, helping to reduce anxiety and improve health outcomes for people with chronic conditions and those who need support when leaving hospital.

FASS and Johanneswerk are the sites focussing on improving services for independent living for older people. FASS currently operates the largest centre for social alarm in Europe with over 90,000 clients across Andalusia in Spain. Johanneswerk runs several hospitals, a social alarm service and provides domiciliary care. CommonWell promises to support integrated care delivery in both organisations.

### 8.2.2 Independent

WRC in Ireland are a partner in this program and are reviewing the evidence for this. As a continuation of this project, “Independent” a new EU, Competitiveness and innovation Funded program initiative has commenced. WRC will thoroughly evaluate the evidence base for telecare. Telecare services are being reviewed across the EU within this study. In Ireland the Alzheimer’s Society of Ireland telecare service will be assessed. They will assess how

- Information is coordinated and managed for the patient
- The service is integrated into the primary and community care structures
- Ethical and data protection issues are addressed.

The ultimate goals are to ensure that pilots, carried out in isolation, can be formulated into one cohesive approach, and effective evidence based evaluation research is carried. The aim is to create proper local and EU wide policy and control. The difficulty to date has been

- The lack of proper evidence,
- A need for redesigning funding mechanisms
- A lack of proper randomised control trials
- A need for a new framework for framing ethical situations that current medical ethics are not suitable for
8.2.3 Evidence for the cost-effectiveness of telecare

The following is from WRC research, Dublin [Source: Sarah Delaney, WRC, personal correspondence]

Barlow et al conducted a systematic review of home telecare for vulnerable older people and for patients with chronic conditions. They examined the potential effects of telecare in terms of benefits to individuals and system-wide benefits such as effects on costs and care processes. Primary research studies were included in the review if they examined home-based telecare services, included telecare as a core component, included information about individual or system-wide effects, included frail older people or adults with long-term conditions, and comprised randomised trials of any size or observational studies with at least eighty participants. Although safety and security monitoring is the most common application of telecare, the authors could only identify two large observational studies about the effects of safety and security monitoring on system-wide effects.

One case-control study in the UK found that a home alert system for people with dementia may help people to stay at home and improve functional status. Another observational study in Scotland compared the costs of a home alert system and call centre for 170 people who stayed at home with 170 care home places. In this study, telecare was associated with a reduction in the length of stay of care homes, a reduction in the average cost per person in the group who received telecare (£7,121 compared to £21,840 per care home place), and an estimated 3,400 hospital bed days saved.

8.2.4 The current evidence-base

Barlow et al found no studies meeting their criteria regarding telecare and individual outcomes. Overall, they concluded that there was insufficient rigorous evidence about the effects of alert systems on either individual or system outcomes. They are not alone in this conclusion, a number of reviews have drawn attention to the relative lack of evidence for the benefits of telehealth and telecare, in terms of outcomes, cost-benefit, cost-effectiveness and patient satisfaction. There are a number of factors that contribute to this situation.

Firstly, there are particular challenges in conducting research on innovation in health service delivery in general, where interventions tend to be diffuse, complex, and difficult to define. This makes it more difficult to implement the innovation and evaluate its effects. Secondly, in the case of telecare and telehealth, ‘user needs’ are especially complex because of the wide variety of stakeholders and their diffuse requirements. As well as medical efficacy, these include cost efficiency, acceptability for patients, technical reliability and fulfillment of legal requirements, and compatibility with the health and social care system. Thirdly, the existing literature on the evaluation of telecare and telehealth is organised around studies that are often methodologically unsound and which therefore do not provide reliable evidence for practice. Systematic reviews of patient satisfaction studies and economic evaluations have been highly critical of the conduct of telecare and telehealth evaluation as a field of practice. Problems identified include small sample sizes, short duration of projects, and lack of standardisation in data collection. There is little solid evidence about the usefulness and efficacy of telecare and telehealth systems that meets the criteria applied elsewhere in health services research.

In Ireland, despite increasing provision of telecare in the voluntary and private sectors, and the appearance of a number of private telecare equipment and response companies, there has been almost no evaluation of its impacts in general, or in terms of assessing cost-benefit.

Note:
WRC specialise in research on ICT and Ageing/chronic disease at European Level. We’re a social research and policy analysis company, currently involved in SOPRANO, a project looking at developing new technologies for AAL, CommonWell (http://www.commonwell.eu/), a project focusing on the integration of health and social care using ICT (integrated telecare and telehealth + case management) and Independent (developing further integration and communication structures for telecare and telehealth services). The trial in Ireland is telecare with the Alzheimer Society and Emergency Response. The directors of WRC are Kevin Cullen and Richard Wynne. Key contacts - Sarah Delaney - Senior Research Consultant s.delaney@wrc-research.ie Kevin Cullen - Director k.cullen@wrc-research.ie Richard Wynne - Director r.wynne@wrc-research.ie

8.3 Scandinavian Examples of Connected health Applications

One of the most advanced regions in uses of CH is Scandinavia. All the Nordic countries - Greenland, Iceland, Norway, Sweden, Finland and Denmark are very advanced in the use of ICT systems in healthcare and there are many interesting examples of innovation involving collaborations among public health care bodies, the universities and business. A comprehensive review of the state of development of IT in Nordic healthcare is beyond the scope of this report, but essentially there is almost universal use of digital patient records (EPR’s) and IT applications are seen in all aspects of healthcare.

In March 2007, Enterprise Ireland hosted a workshop in Dublin (IT for Healthcare –The Nordic Region Status and Strategies for the Future) where representatives of the Nordic countries provided overviews of the status of ICT in all aspects of healthcare. Since then system wide implementation has continued and these countries have the most advanced operational systems covering all facets of healthcare. These experiences are of particular relevance to the situation in Ireland, in that the Nordic countries have comparative populations to Ireland, (e.g. Norway 4.8 million and Finland 5.3 million), and their cultural background, demographics and chronic disease profiles show many similarities with high rates of cardiac infarction, diabetes, hypertension, multiple sclerosis etc).

To illustrate the relevance of these experiences to the Island of Ireland, three diverse examples of CH implementation in Norway, Finland and Denmark are reviewed because of their potential relevance to innovation in CH in Ireland.

8.3.1 Norway – use of ICT in New Hospitals – St Olavs in Trondheim and New Ahaus Oslo.

Located on the west coast of Norway, the town of Trondheim serves as a 'health hub' for the rural population of the entire region. St. Olav's IT infrastructure has been redesigned to reduce the expenses of the delivery of care by satisfying financial management concerns, but it was also to increase the quality of care by providing a more patient centred approach to healthcare delivery at the hospital. As a university and research hospital, it is also a major educational facility that produces around 120 newly qualified physicians every year. In 2002, the hospital started a new-build project to rebuild itself on the existing site, using new technologies, designed from the patient perspective, with the aim of providing unparalleled levels of patient care. This became operational in 2006. The larger Ahaus in Oslo followed two years later. Among the clear drivers of these projects were:

- Increasing the quality of patient care and creating a “patient centred” system responsive to patient needs
• Reducing annual operational costs by 20%
• Increasing patient throughputs by 35% or more
• Creating a “paper light” or paperless environment
• Ensuring total connectivity any time by fixed or wireless networks and Internet Protocol (IP) everywhere.

It is difficult to convey the full scope of such systems in a brief overview but one key message is that CH components are not an add-on but need to be considered as an integral part of the design of the entire system. [Source Rodd Bond DKIT, personal communication]

Collaborations were initiated with several large IT providers Hewlett-Packard, Cisco Systems and Cardiac (a Norwegian software provider) in 2002 towards implementing a fully “Digital Hospital”. The most important elements of this were:

From an end-user perspective:
• Patient monitoring
• Messages and alerts
• A patient portal.

From a back-end perspective:
• A integration platform
• A medical grade network A high availability computing platform

The overall idea behind the technical setup is both the vertical integration of all hospital levels (patient, medicine, nursing service, applications, communications and infrastructure) as well as the simplification of communications within one level. Every employee at St. Olav’s hospital is able to gain from this IT solution. All employees at St. Olav’s have both, an IP phone, allowing them to perform various functions (i.e. messaging, task scheduling, notifications, etc.) and also access to personal computers. Communication with these devices is made possible through the hospital’s common network, which virtually links all 11 buildings of the hospital together.

The benefits from the IT infrastructure in St. Olav’s can be seen in gains to personnel throughout the system - the physicians’ ability to view up to date patient information listed from health records, nurses’ ability to remotely monitor the condition of their patients, orderlies’ ability to efficiently distribute work, etc. Countless improvements in work processes can be made through the use of the hospital’s new IT infrastructure.

Students at St. Olav’s also benefit from the new IT infrastructure. For example, they are able to view live video broadcasts of operation procedures, thus improving the quality of the learning environment.

Many example of patient benefits of the DHI can also be found at St. Olav’s (i.e. whilst still in bed, a patient can send a digital signal for an orderly, nurse, or a physician to come to their aid, without the use of loud, disturbing alarms).

The Hospital Development project has dual ownership, being responsible both to the Ministry of Health and the Ministry of Education and Research. The IT restructuring had a timescale of ten years to completion. In 2005 a consortium of IT companies, organised and led by Hewlett-Packard completed the first technology infrastructure phase. Cisco Systems has provided the communication network for the hospital, while Cardiac Medical AS is the head medical device and software designer.
8.3.2 The National Diabetes Programs in Finland and use of Connected Health

The Finnish national strategy regarding the application of IT to healthcare and social welfare commenced in 1996 and since then Finland has seen an almost universal rollout of a national interoperable EPR by 2007 through a complex but carefully managed process with the national government providing very specific overall goals and a common vision. The almost 400 municipalities with responsibility for arranging specialised care have formed federations into 21 hospital districts throughout the country (P Hamalainen 2007). These hospital districts manage acute care provision and in addition there are some 270 primary care centres owned by the municipalities.

Within this framework there is a national digital archive of lifelong patient documentaries, examples of CH applications into all aspects of healthcare - mobile Evidence based medicine, Cochrane abstract database, drug database, laboratory diagnostic database etc. and plans for Finnish patients to access their data via the internet from anywhere in the world –this is a rich field for further innovation and integration.

In Finland, the incidence of insulin-dependent diabetes mellitus (IDDM) in children aged <15 years is the highest in the world, (Tuomilehto et al 2001 and others) and there is also a high and increasing incidence of Type II Diabetes. Both genetic and life style factors are implicated. Finland has developed comprehensive public health strategies to manage both type I insulin dependent diabetes and type II diabetes and other associated cardiac and other problems. They have also developed effective public programs to prevent the onset or reverse symptoms of type II diabetes.

In addition to the basic IT infrastructure and EPR which increases the efficiencies and a lowering of risk to patients, effective use is also made of practical telecare and telehealth systems in the management of remote diabetic patients. For example, Diabetic specialists usually based in an acute hospital can routinely consult with remote patients in a remote primary care centre and review the status of patients without the inconvenience and costs of either specialist or patient travel. This has led to significant improvements in patient care and reduction in incidences where expensive hospitalisation, surgery and aftercare are necessary through deterioration of the condition of the patient. This infrastructure of largely off the shelf IT hardware components and making use of available broadband telecommunication systems is also used in associated programs of updating nurse training in diabetic management and also to educate patients in self management and to induce life style changes that are important in risk reduction (Allin 2005 and others). Excellent working examples can be seen in the Oulu Arc catchment area of central Finland on the southern edge of Lapland.

8.3.3 MedCom in Denmark –The Danish Health Data Network

Medcom the Danish health data network developed to facilitate efficient data transfer within all elements of the Danish health and social care system. This national network allows fast information flow and data exchanges among the respective software systems of the participating healthcare providers. It originated as a co-operative venture between authorities, organisations and private firms linked to the Danish healthcare sector. In 1999 financial agreement between the counties and central government, it was decided that MedCom would be made permanent, with the objective that:
“MedCom will contribute to the development, testing, dissemination and quality assurance of electronic communication and information in the healthcare sector with a view to supporting good patient progression”.

The messaging processes include GP referrals to hospitals, prescriptions, requests for diagnostic tests, test reports, discharge letters to GP’s, notifications to community and home care services, reimbursements. The key impacts are that the network enables more effective communication among healthcare partners, and improved quality of service, significant efficiencies in record keeping and administrative overheads, and it improves communications among all elements of healthcare, community care and social care systems. The economic benefits of the system exceeded € 75 million per year by 2008 and about 80 % of the annual costs are investment in ICT and organisational change. (eHealth Impact 7.7 DG INFSO \October 2008)

Today, this network transmits more than 2.6 million messages monthly across the healthcare sector. The networks many users include all hospitals, pharmacies and virtual all general practitioners (93%) as well as more than 60 % of the specialists and 32 % of the municipalities. In 2004, the network was awarded a first prize at the European Commission IST High Level conference on eHealth in Cork, Ireland.

Within Med Com one very well developed field is the use of video-conferencing infrastructure for diverse purposes such as psychiatric treatments, second opinions, and conferencing. One sub set of this videoconferencing capability is its innovative use in the provision of interpreters when they are required. Denmark like many other countries has a large immigrant population speaking a diversity of African, Arabic and Eastern European languages, where immigrant patients are not be sufficiently fluent in Danish to communicate with health providers, interpreters are used. There are more than 150,000 interpreter sessions a year in Danish hospitals and work at Odense hospital has shown benefits of interpreter support via videoconferencing (Hulbeck 2009, www.medcom.dk ). This saves a lot of time in each interpretation session, staff time and cost of interpreter services etc. resulting in significant accumulation of benefits.

The Med Com network is closely affiliated with the Danish Centre for Telematics and the Virtual Centre for Health Informatics where the research and development work is carried out. The Virtual Centre is a formal network of co-operation between research and development groups at Danish universities, public and private companies, health care institutions, hospitals, and county councils. The Virtual Centre is supervised by a board representing these organisations and is managed by a director and a secretariat situated at Aalborg University.

8.3.4 Cross Border Collaborations in Connected health in the Baltic regions

Over the last five years the EU union has funded several interesting projects that provide models for a future EU vision of “health for all” addressing demographic changes within Europe, the flexibility of labour markets and to ensure access to quality healthcare regardless of where persons live and also to address the inequalities of healthcare delivery between urban and rural regions.

The Baltic region e-health projects have established networks for connecting exiting national and regional healthcare networks and full scale e-health trials have been carried out in radiology and ultrasound. These
projects provide excellent examples of Academic, Business and Clinical (ABC) collaborations among several countries and regions to identify networking solutions to practical problems.

8.3.5 e-Radiology

The reality in Europe today is that some regions experience a shortage of radiologists while other regions have a surplus. This inequality can be levelled out by means of e-radiology. Traditional e-Radiology uses point-to-point connections, often referred to as tele-radiology, between clients and providers. It is a well-established service but the set-up has restrictions because the number of providers, and thus the type and availability of expertise that can be accessed, is limited.

The vision of the R-Bay project was to extend traditional e-Radiology by creating an eMarketplace, a "many-to-many" connection, which would function as a commodity brokering and exchange of radiology services. Thus R-Bay facilitated the viewing and consulting of images across organisations, regions or nations. On the eMarketplace, providers can make their services available at a specified price and with standardised specifications, and the costumers will buy the services via a trusted and secure network. ([www.r-bay.org](http://www.r-bay.org))

8.4 Lessons Learnt for Ireland

The above Nordic experiences are of great relevance to the development of pathways towards Connected Health capabilities in Ireland. In different ways these Nordic examples all illustrate the following characteristics and lessons:

- They involve collaborations and structured networking among the research, innovation and clinical communities – the ABC components that are important in healthcare innovation.
- There has been a long term commitment of funding from multiple agencies –those involved in supporting, university based research, economic development and innovation and those involved in funding health and social care. These sources come together to provide integrated support.
- There is a long term commitment to implementing gradual change throughout the healthcare system from acute care to primary and social and community care, together with a clear articulation of objectives.
- The approaches are holistic, integrative and multidisciplinary;
- Concepts are built into planning processes at the outset. Technology is not an add-on to existing practices.
- The needs of the patient are placed front and centre as a basic criterion
- Innovation is not taking place within isolated silos of healthcare professionals key ICT and other needed expertise is identified and brought to the table.
- There is an implicit recognition of the potential benefits of making full use of ICT in healthcare and an openness among participants towards changes that will bring efficiencies, reduced risks and improved patient care.

8.5 Scottish Telecare Development Programme Initiative

Scotland is held up as a leading country in the deployment of such systems. A detailed report on the Scottish Telecare Development Programme (TDP) during 2006/07 and 2007/08 initiatives has been prepared by the Joint Improvement Team (JIT). These are detailed in and [http://tinyurl.com/jitreport](http://tinyurl.com/jitreport) and associated appendix [http://tinyurl.com/jitappendix](http://tinyurl.com/jitappendix).
They looked at various models as evaluation methodologies and their rationales are included. The report details the objectives of the study and their findings. The objectives were as follows:

1. Reduce the Number of Avoidable Emergency Admissions and Readmissions to Hospital
2. Increase the Speed of Discharge from Hospital once Clinical Need is Met
3. Reduce the Use of Care Homes
4. Improve the Quality of Life for Users of Telecare Services
5. Reduce the Pressure on (Informal) Carers
6. Extend the Range of People Assisted by Telecare Services
7. Achieve Efficiencies (Cash Releasing or Time Releasing) from the Investment in Telecare
8. Support Effective Procurement to Ensure that Telecare Services Grow as Quickly as Possible

The report outlines the very positive findings which will not be included herein.

An excellent video on Telehealth solutions in the Hebrides can be found at http://vimeo.com/10152084 and the clinical patient perspective.

8.6 Some Initiatives in the United States of America

Many of the large ITC companies based in the states recognise the huge market potential of Connected health and have developed substantial initiatives in this field within the USA and internationally. Only those with a presence in Ireland and engaged in CH developments in this country are covered in this report. However, because of the fundamental importance of innovation in the USA in the emergence of connected health some of the key initiatives are briefly mentioned below.

8.6.1 Veterans Health Administration

The Veterans Health Administration (VHA) is the component of the United States Department of Veterans Affairs66 (VA) that implements the medical assistance program of the VA through the administration and operation of numerous VA outpatient clinics, hospitals, medical centres and long term healthcare facilities (i.e., nursing homes to look after all the healthcare needs of all US veterans.

Beginning in the mid-1990s VHA underwent a major transformation aimed at improving the quality and efficiency of care it provides to its patients. This included eliminating underutilised inpatient beds and facilities, expanding outpatient clinics, and restructuring eligibility rules. A major focus of the transformation was the tracking of a number of performance indicators—including quality-of-care measures—and holding senior managers accountable for improvements in those measures. As a result the VA has made extensive use of all aspects of ITC in the care and management of veterans scattered across the USA. And the VA provides some of the best documented examples of the applications of all aspects of connected health including the use of EPR’s and the development of remote monitoring systems that are now applied to a very wide range of chronic conditions.

“Patients routinely rank the veterans system above the alternatives, according to the American Customer Satisfaction Index.” In 2008, the VHA got a satisfaction rating of 85 for inpatient treatment, compared with 77 for private hospitals. In the same report the VHA outpatient care scored 3 points higher than for private hospitals67.
A RAND Corporation\textsuperscript{68} study in 2004 concluded that the VHA outperforms all other sectors of American health care in 294 measures of quality; Patients from the VHA scored significantly higher for adjusted overall quality, chronic disease care, and preventive care. VHA is especially praised for its efforts in developing a low cost open source\textsuperscript{69} electronic medical records system VistA\textsuperscript{70 71} which can be accessed remotely (with secure passwords) by health care providers. With this system, patients and nurses are given bar-coded wristbands, and all medications are bar-coded as well. Nurses are given wands, which they use to scan themselves, the patient, and the medication bottle before dispensing drugs. This helps prevent four of the most common dispensing errors: wrong med, wrong dose, wrong time, and wrong patient. The system, which has been adopted by all veterans’ hospitals and clinics and continuously improved by users, has cut the number of dispensing errors in half at some facilities and saved thousands of lives\textsuperscript{72}.

At some VHA medical facilities, doctors use wireless laptops, putting in information and getting electronic signatures for procedures. Doctors can call up patient records, order prescriptions, view X-rays or graph a chart of risk factors and medications to decide treatments. Patients have a home page that have boxes for allergies and medications, records every visit, call and note, and issues prompts reminding doctors to make routine checks. This technology has helped the VHA achieve cost controls and care quality that the majority of private providers cannot achieve\textsuperscript{66}.

\textit{A recent article (Mar 2010) speculated the Department of Veterans Affairs, which already cares for 35,000 patients remotely via home telehealth technologies, would get $163 million for home telehealth programs under the Obama administration’s proposed budget for fiscal year 2011. That’s more than double the $72 million the VA spent on home telehealth in fiscal 200973.}

\subsection*{8.6.2 Centre for Connected Health\textsuperscript{74}, Boston}

The Centre for Connected Health, a division of Partners HealthCare in Boston, has pioneered many applications in connected health. The Centre engages in pioneering research in a wide range of connected health-related areas and works to advance the field through its convening and publishing activities.

Their programs use a combination of remote-monitoring, online communications and intelligence, and technology applications to improve patient adherence, engagement and clinical outcomes. Participants in their programs are patients and providers at Partners-affiliated practices and hospitals throughout New England, USA. Their programs are also being offered by large self-insured employers who wish to help employees better manage their health, to contain healthcare spending and to improve productivity and satisfaction. The centre for connected health hosts an annual conference on international developments in the field which is regarded as one of the most important. The centre has also collaborated in the founding of the European Connected health Campus (ECHC) in NI and will be presenting at this year’s event in June 2010 in Belfast.

\subsection*{8.6.3 Continua Health Alliance}

Continua Health Alliance is a non-profit, open industry coalition of the finest health care and technology companies joining together in collaboration to improve the quality of personal health care. With more than 200 member companies around the world, Continua is dedicated to establishing a system of interoperable personal health solutions with the knowledge that extending those solutions into the home fosters independence, empowers individuals and provides the opportunity for truly personalised health and wellness management. They recently signed an MOU with the GSMA to aid driving mHealth initiatives. The alliance have set-up a certification program to certify products that are fully interoperable. Their aim is
that products that carry the Continua Certified™ logo have a strong competitive advantage and provide net savings by being:

- “Future proofed” so they won’t become prematurely obsolete
- Easy to use
- Less labour-intensive
- Free of inefficient technology duplication

A number of products are listed on their website.

**Continua Connected Health vision**

**Personal Telehealth Overview** - [Source: Continua Alliance website]

Busy lifestyles that leave little time or motivation for fitness and weight management; a rise in chronic diseases; an aging population that requires escalating levels of supervision and medical intervention - these are the lifestyle, health and demographic trends that are directly contributing to skyrocketing health care costs.

- More than 1 billion people in the world are overweight, and at least 300 million of those are clinically obese\(^1\). Without action, more than 1.5 billion people are expected to be overweight by 2015\(^2\).
- Over 600 million people worldwide have chronic diseases, and the spending on chronic diseases is expected to increase\(^3\). For example, in the US alone, spending is expected to increase from $500 billion a year to $685 billion by 2020\(^3\).
- Globally, the number of persons 60 and older was 600 million in 2000. It is expected to double to 1.2 billion by 2025\(^4\).

**The personal telehealth opportunity**

In a system well-designed for improving health, people with heart disease or diabetes can transmit their vital signs - blood pressure, heart rate, oxygen saturation, glucose levels, temperature, weight, respiration - seamlessly from home to their health professional, and get real-time feedback on their condition. A busy professional is able to receive a daily electronic check-up on the health status his aging parent who lives alone, suffers from a series of chronic conditions and is on multiple medications. A traveling businessperson can have a real-time discussion about the workout she just completed with a trainer who is hundreds of miles away.

Today, technologies like these that can enable more proactive personal health exist and are being applied - but not nearly as commonly as needed to radically improve health and quality of life and eliminate unnecessary costs from the healthcare system. To become a central component of the way we manage health, personal health and medical devices must be fully interoperable with each other and with other information sources. Because broad interoperability has yet to be achieved, it is an emerging priority for health systems and for the medical and information technology industries. Creating a rich eco-system of interoperable health and fitness devices will:

- Empower individuals and patients to better manage their health by providing them with information regarding their fitness and health through personal medical devices and services.
- Allow loved ones and professional care givers to more accurately monitor and coach chronic disease patients and elderly individuals living independently.
• Enable medical and fitness device manufacturers to rapidly develop interoperable devices and services using industry developed connectivity standards.
• Enable health care providers to offer better quality care through personalised health solutions assembled from a rich marketplace of interoperable health care devices and services.

9. RECOMMENDATIONS

9.1 All-Island Opportunity in Connected Health

Ireland already has an international reputation for the quality of software and medical device companies and research. While Connected Health is very much a convergent field the predominant capabilities lie in ICT and medical devices hence underpinning the opportunity Ireland can leverage in terms of international recognition and capability. Coupled to this is the advantage of the Public Health Authority in Northern Ireland which provides a single payer system, integrated health and social care and a population where many of the chronic conditions are prevalent.

9.2 Recommendations for Connected Health in Ireland

Connected Health is an area of considerable convergence not only from technology but from social sciences, clinical diagnosis and consumer marketing. While the realisation that technology is available to implement Connected Health there will remain significant opportunities to develop innovative products and solutions when the systems are fully implemented. The main challenge at present is the policy change within healthcare delivery and the social implications of the patient at the centre of the delivery model while remaining in their home and/or community. The following recommendations are consistent and challenging with recommendations previously given in studies in this area. BioBusiness has encountered many issues in discussions with many stakeholders and in providing Connected Health programmes internally. The recommendations are also given in All-Island context and not specific to any jurisdiction.

Policy

- In public sector funded initiatives/projects special consideration should be given to engagement with small innovative companies rather than being dominated by large multinationals.
- International standards and regulations should be adopted to ensure service providers and equipment manufacturers address issues including technology interoperability, data protection (security) and healthcare protocols.
- Accreditation of service providers should be controlled to ensure the high levels of patient centric monitoring and ethics are maintained.
- Need a new model for ethical approval for connected health clinical trials. It’s a paradigm shift from standard medical ethics approval. Current ethics committees may not have the background to assess these new systems.
Innovation and Product/Service Opportunities

- In connected health the patient’s home should be seen as a consumer market and products and services developed in accordance with patient choice.
- Avoidance of medicalisation of the home should ensure the products and devices become ubiquitous, unobtrusive and accepted.
- Procurement of connected health products and services should be considered in a holistic perspective to avoid silo-budget protection. The healthcare economics advantages should be defined and implemented.
- Irish researchers, clinicians and business have participated in many different EU projects. These provide an important window on innovation and development activities throughout member countries. Experiences are very diverse and it is important that this knowledge be evaluated and built on to avoid duplication of efforts and to learn from past failures.
- The engagement and public procurement model by which the HSE or NHS interact and engage with private industry needs to be analysed and greatly modified to suit the emergence of new product and service development. This will require multi-agency involvement to formulate a new way of engaging

Government and Organisational Support

- A connected health capability database should be maintained formulating the expertise from academic, business and clinical stakeholders.
- Connected health is a patient centric healthcare model and any initiative should facilitate patient participation.
- All public sector funded initiatives in connected health should ensure that ABC collaborations are emphasised where appropriate. This will ensure maximum value is generated and risk is mitigated.
- Provision should be made to utilise and/or develop patient access demonstration centres.
- Agency support teams need to be established to support multi-sectoral, convergent technology challenges of Connected Health.

Education and Learning

- Specific connected health training should be considered within healthcare training, such as module delivery within clinical & nursing degree courses.
- Benchmark from our Nordic neighbours and others and their best in class systems
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- DMF Systems
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- European Connected Health campus
- Friendly call services
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- Grapevine
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- GS1
- Home Instead
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- Vitalograph
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