A vision for Ireland for an electronic patient referral system from primary to secondary care

By

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university.

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Ms. Efua Akumanyi (Technical Consultant, InferMed),

Ms. Gemma Garvan (Project Manager, National HealthLink project),

Ms. Jackie Caldwell (eHealth Directorate, The Scottish Government),

Mr. Kevin Gleeson (Project Manager, PA Consulting Group),

Dr. Reem Salman (Senior Registrar, Breast Health Unit, Mater Hospital)

Ms. Val Borland (Implementation Manager, NHS National Services Scotland).

Summary

In Ireland, the General Practitioner is the first point of contact for persons with health problems or medical requests. Depending on the severity of the person's medical condition, a General Practitioner may refer her/him to a secondary care hospital consultant. The process of generating a clinical referral for a patient and the resulting transfer of information from the primary care physician to the specialist and back again, defines the patient referral process, which is for most cases a paper based process.

The use of paper based referrals is however problematic and requires a solution that will offer better benefits for patient care.

The need to optimise the efficiency of daily routine communication between General Practitioners (GPs) and hospitals is vital in ensuring benefits for all stakeholders involved in the process. The adoption of electronic patient referrals in the Irish healthcare system, offers a solution to the problems with paper based referrals.

The main objective of this research was to answer the question of "what should an electronic patient referral system from primary care to secondary care, in Ireland look like?"

This was achieved by conducting an 11 week scope session with medical stakeholders to capture stakeholder functional requirements, system architecture, business benefits, and referral process. The information was taken from interviews, and facilitated workshop sessions. The scope session represents the first phase of the RAD (Rapid Application Methodology). The author also describes the state-of-the-art e-referral systems in Australia, Finland and the United Kingdom, so as to develop an understanding of the major trends, and an evaluation and lessons learned of each of the systems used in these countries.

The research provides a RAD scope document that captures user functional specifications and high level systems architecture, the research also concludes that there is a strong business case for the development of an electronic referral system in Ireland, and substantial qualitative (e.g. improve accuracy and speed of referral process, confirmation on receipt of referral, more timely assessment) and quantitative benefits (e.g. cost saving in the full adoption of electronic patient referrals over paper based referrals, reduced costs to society, increase savings per capita).

The use of e-referral systems between primary and secondary care improves access to health services and cooperation between hospitals and health centers. It also improves the quality and the effectiveness of patient care, decreases direct costs, increases productivity and cost effectiveness. Review of existing state-of-the-art projects of e-referrals, highlights the importance of implementing an approach that takes into account the practicality of real life use of electronic referral in Ireland, so as to avoid the problems that can arise from inappropriate use of e-referrals.

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Abbreviations

ACCA	Association of Charted Certified Accountants
ANSI	American National Standards Institute
ASP	Active Server Pages
BSCHSI	the Brisbane South Centre for Health Service Integration
BISEP	the Brisbane Inner South E-Referral Project
CSO	Central Statistics Office
DHSSP	Department of Health, Social Services and Public Safety
DoHC	Department of Health and Children
EPR	Electronic Patient Record
ERA	Early Referral Application
ERMS	Electronic Referral Management System
GPwSI	GPs with Specialists Interest
HIQA	Health Information and Quality Assurance
HL7	Health Level Seven
HSE	Health Service Executive
HTML	Hypertext Markup Language
HTTPS	Hypertext Transfer Protocol Secure
ICATS	Integrated Clinical Assessment and Treatment Services
LDAP	Lightweight Directory Access Protocol
NTPF	National Treatment Purchase Fund
NOHD	Northern Ostrobothia Hospital District
OECD	Organisation for Economic Cooperation and Development
OPD	Outpatient Department
OUH	Oulu University Hospital
PAS	Patient Administration System
PTR	Patient Treatment Register
PKI	Public Key Infrastructure
SCI Gateway	Scottish Care Information Gateway
SIVUH	South Infirmary Victoria University Hospital
SICP	South Inner City Partnership in Primary Care
SSL	Secure Socket Layer
VLAN	Virtual local area network
VPN	Virtual private network

WAN	Wide Area Network
XML	Extensible Markup Language

Chapter 1 Introduction

Primary care in Ireland is usually the first point of contact with the Health system. It acts as a gatekeeper for secondary care services. The current process in Ireland for most cases is a paper based process, where the General Practitioner (GP) performs a regular clinical examination, and then refers the patient to further examination at the surgical outpatient clinic. This is done by filling in a referral form, that is not standardised, and at the same time forwarding supplementary clinical information about the patient (i.e. age, sex, other diseases, clinical conditions, medication). The information is sent to outpatient clinics by fax or snail mail, within the GP's catchment area. On arrival a hospital doctor must read the referral, prioritise, and then draw up a treatment or investigation plan. A time schedule for the outpatient clinic examination is proposed on the basis of the information on the referral form and the availability of appointments for examination. In most cases the information on the referral form contains guidelines to GPs, on what constitutes an urgent and non urgent referral to a clinic. For urgent referrals, as in the case of breast cancer must be seen by a consultant within 2 weeks of the referral being made. A high level process of referral from GP to hospital is shown in Figure 1.

According to figures published by the Health Secretary Executive (HSE) there were approximately a total of 2,265,007 paper based referrals send to hospitals from GPs in 2008. The table in Appendix A provides a breakdown of outpatient referrals received in Irish public hospitals in 2008. With such high numbers of referrals being made, it seems unconceivable that there is still a reliance on paper based communication, when research findings show that paper based communication, between different health care providers is insufficient in quality, error prone, and often too slow (Westermann, R.F., et al., 1990). The cost benefit of full adoption of electronic referral in Denmark gives a potential saving of \in 3,512,146, if all paper referrals were processed electronically (Cannaby et al., 2004). This highlights the potential saving in the HSE by the adoption of e-referrals.



Figure 1: Common referral process from GP to hospital

Some specific problems associated with referrals are:

- Errors and delays linked with posted referrals (unrecorded, lost referrals).
- Unnecessary workflow of patient information from GP to secondary care and vice versa (errors in referral send, no triage or clear steps).
- Overbooking of patients in clinics.
- Lack of confirmation on receipt of referral (patient anxiety waiting for confirmation).
- Increase in administration time for GPs and hospital (delays impact patient).
- Lack of accurate OP referral figures for health services (auditing of patient data, quality assurance) (Tubridy, et al., 2006; Gleeson, 2007)

One promising area of e-health that aims to alleviate these problems associated with paper-based manual referrals is electronic referrals (e-referrals). E-referrals are used to facilitate the physical transfer of patients from one institution to another or for consultation between health care providers (e.g. GP & hospital specialist). Technically speaking e-referrals involves the secure transmission of a digital messages, or electronic documents between two points that are physically or geographically separated. Although there are various types of e-referral systems, (functional specification, and technical infrastructure), they are all striving to achieve the best possible patient outcomes.

This dissertation is motivated by the need for a nationwide electronic referral system that is scalable, incorporates stakeholder requirements, facilitates interoperability between primary and secondary care systems and uses internationally accepted standards of communication.

Although, primary care includes a range of services that are provided by General Practitioners (GPs), public health nurses, general nurses, social workers, community mental health nurses, dentists, physiotherapists, occupational therapists, and others. This study however will focus mainly on General Practitioner as the main source of contact within a primary care setting.

1.1 Research questions and objectives

The question that this study aims to answer is:

What should an electronic patient referral system from primary care to secondary care, in Ireland look like?

In order to address the research question, the author conducted an 11 week scope session with medical stakeholders to capture stakeholder functional requirements, system architecture, business benefits, and referral process. The information was taken from interviews, and facilitated workshop sessions. The scope session represents the first phase of the RAD (Rapid Application Methodology). The scope phase captures a number of sub questions that are required to create a scope document. The sub questions are as follows:

- What type of architecture and functionality can support this system, based on user referral requirements?
- What are the benefits (Quantitative, Qualitative) of e-referral systems?
- What are stakeholder's opinions and attitudes towards such a system?
- What are the current referral guidelines for GPs?
- What is the current existing referral process in Ireland today?
- Has an electronic referral system been implemented in Ireland?
- When should e-referrals be used?
- What is the current state-of -the art electronic referrals internationally?
- What are the current and future challenges faced in implementing an electronic referral system?

1.2 Motivation for selection of research topic

The author's background is in information technology, knowledge management and project management having worked with IT/ system integrators such as KPMG Consulting, Sybase, and Cambridge Technology Partners. Throughout the author's career, he has worked on a large number of IT projects, in Europe, and the wider world, in a variety of roles, such as Senior Project Manager, Functional Lead and System Analyst.

Although the current referral process in Ireland is transforming and evolving, there is still room for improvement in the communication link between primary care providers and secondary care practitioners. The motivation is to create a prototype referral system that makes use of new and emerging technologies, by capturing stakeholder's requirements, and making use of the existing state of the art referral systems internationally. Also to make use of decision support systems for certain types of referrals, that would reduce the unnecessary workflow between primary, secondary, and tertiary care providers.

1.3 Research tasks

The author undertook a number of tasks, in order to address the research questions. The tasks were as follows:

- Review and assess literature relating to operational aspects of electronic referrals in Ireland, and international state-of-the-art electronic referral projects, in order to obtain an understanding of:
 - > Manual referral process between primary/secondary/tertiary care providers
 - > Which messaging standards are used, and how they are implemented within the various national and international projects.
 - The roles and responsibilities of the various actors with the referral process (e.g. General Practitioner, Doctor, Consultant, Nurse, medical specialists)
 - The approach and strategies used in developing an electronic referral system (e.g. change management, project methodologies used, scope of the project, vision and objectives set)
 - Functionalities used in electronic referrals (e.g. decision support systems, booking appointments, reporting, consolidated view of patient data)
 - System architectures used to allow interoperability between the various systems in primary and secondary care entities.

The literature review and assessment were combined with interviews.

- A high-level review of the structure and organisation of health services in Ireland, namely:
 - The governance model (e.g. structure, role and relationship between the Department of Health and Children, Health Secretary Executive (HSE), public hospitals, primary care providers)
 - > Patient data (e.g. data ownership, data protection, transfer and sharing of patient details)
 - > Medical referral guidelines (e.g. issuing body, standardization process)
 - > Methods of patient access to secondary/tertiary care (e.g. GP or A&E services)

- A detailed review of current electronic referral services and projects in Ireland, assessed through literature, questionnaires, and interviews, from a :
 - Operational view (e.g. roles and responsibilities, GP support and training, data ownership, type of messaging services provided, process and workflow, hospitals using the system, existing types of referral, proposed referral)
 - Technical view (e.g. messaging standards used, system functionality, interoperability, information security, GP systems)
- A detailed review of current international state-of-the-art electronic referral services and projects in Australia, Finland, United Kingdom (England, Northern Ireland, and Scotland), assessed through literature, questionnaires, live system demonstrations, and interviews, from a :
 - Operational view (e.g. roles and responsibilities, project(objectives, scope, benefits, duration and costs), change management approach, government health strategy and funding, business processes and workflow)
 - Technical view (e.g. messaging standards used, system functionality, interoperability, information security, GP systems, system architecture). The transfer of electronic documents between two points requires the need to integrate/ "to talk to" other systems between the various geographical points of communication (e.g. Billing system, GP administration systems). These systems are discussed in chapter 3 (The state-of-the-art referral systems).
- Chapter 5 contains the scope document, which is the first phase of the Rapid Application Development (RAD) methodology. The scope phase is intended to capture high level user functional requirements, goals of system, system architecture, business benefits, and stakeholder opinions towards an e-referral system. In order to capture the essential requirements of the system in the scope document the author undertook a number of activities, they are as follows:
 - > Capture business processes through facilitated sessions with medical stakeholders.
 - > Map out user needed functionality based on optimised business processes.
 - Prioritise the functionality based on technical complexity, business benefits and user requirements.
 - > Capture goals and critical success factors of the system.
 - > Document key performance indicators of the system.
 - > Design of a high level architecture that can support the user's functional requirements.

Prior to the start of the RAD scope phase, the author prepared a project plan that outlined the objectives of each user session and a method explaining how the core requirements for the system were to be captured. All information captured by users was checked again for accuracy and thus

followed an iterative approach. All of the information was then written in a RAD methodology word template. Chapter 5 provides a description of the RAD methodology.

1.4 Outline of dissertation

Chapter 1: Introduction

This chapter outlines the concept of patient referral from GP to OPD, and describes some of the problems associated with a paper based referral system. It then describes the research questions and associated tasks that the author undertook to address the questions posed in the study. It also describes the motivation for choosing the topic, and a brief guide to the content of the chapters in the study; its structure and layout.

Chapter 2: Research methodology and approach

This chapter explains the research methodology, and literature review used in answering the questions. It describes the RAD methodology adopted to capture user requirements for an Irish electronic patient referral system, what will the research deliver, and the contributions it will make to enhance the delivery of an electronic patient referral system.

Chapter 3: The current practice of referrals in Ireland

This outlines information about Ireland, and provides an overview of the Irish health services (the structure and relationship between the different health organisations). It provides a description of four electronic patient referral projects currently implemented in Ireland. It then outlines an evaluation and lessons learned from these existing projects and overall conclusions.

Chapter 4: The state-of-the-art referral systems

This chapter explores state-of-the-art e-referral systems in Australia, Finland, and British Isles. It describes how these countries health services are organised, and the e-health strategies they have adopted. It describes the system functionality, system architecture used in all of these countries, and the project management methodology used to capture user requirements. It also describes the problems of paper based referrals, and how the adoption of electronic referral offers a solution to the problems with paper based referrals. It outlines the qualitative and quantitative benefits of electronic patient referral, and a summary and detailed conclusion, followed by an overall conclusion for the chapter.

Chapter 5: Scope document: proposal for an Irish electronic patient referral system

This chapter contains a scope document that outlines a proposal for an Irish electronic patient referral system developed using Rapid Application Methodology. It provides an overview of Rapid Application Methodology (RAD). It then describes the key deliverables of the SCOPE phase of the project, such as business process, goals, critical success factors, user requirements, high level technical architecture and qualitative and quantitative benefits of the system. It then provides a recommendation for the next steps of the scope phase.

Chapter 6: Conclusions, recommendations and future work

This chapter provides a summary of the conclusions and recommendations of this research and makes suggestions on required future research work.

Chapter 2 Research methodology and approach

2.1 Research Method

What follows is a description the research methodology and approach taken to address the research question(s). It also describes how user requirements were gathered to complete a SCOPE/Analysis document that captures stakeholder's process, functionality and technical architecture of an electronic referral system.

The approach taken by the author to address the research questions was to undertake an in-depth study of medical referral and its development in primary secondary care setting. A detailed literature review of referral and electronic referrals in Ireland and worldwide was carried, with a focus on:

- The actors involved in the referral process (e.g. patient, GP, consultant, nurse, clinicians).
- The step by step process in making a referral and associated workflow (e.g. process workflow from primary to secondary care and vice versa).
- Functionality used within electronic referral systems (e.g. booking patient appointment, decision support).
- The architecture used in developing electronic referral systems (e.g. web based technology).
- Messaging standards used in electronic referrals (e.g. HL7, XML).
- Medical referral guidelines

It became apparent during the literature search that there was an abundance of literature discussing information transfer, system integration and models of sharing data; however there is limited literature on electronic referral system functionality and implementation worldwide in general, and Ireland in particular. This necessitated the need to conduct interviews with key individuals, responsible for coordinating electronic referral systems in Ireland, and system practitioners who have been engaged to design and implement e-referral systems. The information captured during the interviews has been instrumental in providing an in-depth understanding of the subject matter.

From review of the literature on electronic referrals, and interviews conducted with clinicians, the topic of EPRs features prominently when discussing the flow of electronic data between two geographical points. In most industrialised countries EPRs are expected to replace paper records in due course. The advantage of this will be the potential of e-referral systems to form strategic networks for the transmission of all kinds of data between primary and secondary care, to improve access to care, continuity of care and chronic disease management. Therefore is it important to discuss EPRs in the context of e-referral systems; such as the advantages of consolidating patient data for primary and secondary care clinicians; it is however beyond the scope of the research paper to do a complete study of EPRs.

The author adopted a structured (quantitative research) and an unstructured approach (qualitative research) in answering the research questions; this is based on the need to describe, and narrate on issues, findings; to be analytical in quantifying problems associated with referral systems (manual, electronic) and drawing conclusions based on the findings. The author's main objective of the study is to deliver a SCOPE document, which contains captured user requirements of an electronic referral system. The SCOPE phase represents the first phase of the four phased Rapid Application Development methodology (Scope, Design, Development, Rollout). Scheduled interviews with stakeholders were conducted to map user requirements. The information was then documented and then presented to the users to ensure accuracy and correctness in the information captured (see Chapter 5).

2.2 Literature search

The objective of the literature search is to identify and capture knowledge of the most relevant and current subject, in order to assist the author in capturing electronic referral processes and functionality, and to address the questions posed in the research.

It became apparent from conducting a literature search, that there is limited academic literature information about e-referrals, despite the fact that there are various health-care systems experimenting with e-referrals.

The author search began with a search of relevant databases, under the link Databases & E-Books, via the online Trinity College Library website. A review of ISI Web of Knowledge, ScienceDirect, IEEE Xplore release 2.6, Medline, and PUBMED from 1995-2009 was conducted to search for journal articles appropriate for the subject area.

The Mesh database was selected, to search for Mesh terms within the PUBMED database. Two main subject headings from the concept of referral were identified, they are "Referral and Consultation", and "Physician Self-Referral" as shown in table 1 below.

Mesh terms subject headings	Record Nr using PUBMED link search	Record Nr using PUBMED major topic link search
Referral and Consultation	44410 citations	17329 citations (39% reduction)
Physician Self-Referral	593 citations	380 citations (64% reduction)

Table 1: Mesh database search

The targeted search was further refined using the string "*Referral and Consultation/organization and administration*"[*Mesh*] *AND "Internet/standards"*[*Mesh*]. In this string the subheading "standards" was selected within the main subject heading "Internet", so as to further narrow the subject area search. This Mesh database search produced 20 citations, a few of which referred to the subject area, namely (Wootton, R., et al (2003) Organizational aspects of e-referrals. *Journal of Telemedicine and Telecare.* 9(2), pp 76-

79). This article gives a good insight into the workflow, systems and standards used within the subject, as well as examples of its implementations in Helsinki University Hospital.

Within the relevant databases, the Boolean operators (AND, OR, NOT) were used in combination with search terms such as "electronic referral*", "e-referral*", "e*referral", "hospital referral*", "outpatient referral*", "tertiary referral*", workflow", "organizational referral*", "medical referral*", "XML referral*", "decision support referral*", "decision support", "XML referral*", "referral management system", "primary care referral*", "secondary care referral*", "physician referral*", "GP referral*", "General Practitioner referral*", "Internet referral*", "e*Health referral*". The search string used within the ISI Web of Knowledge between 1995- 2009 was "(*e*referral**) *OR (electronic* referral**) *OR (hospital referral**) *AND (primary care) OR (secondary care) AND (organization)*". This search produced 30 articles, a number of which were relevant to the subject area:

• <u>Title: Extending a multimedia medical record to a regional service with electronic referral and discharge</u> <u>letters</u>

Author(s): Reponen J, Marttila E, Paajanen H, et al.

Source: JOURNAL OF TELEMEDICINE AND TELECARE Volume: 10 Pages: S81-S83 Supplement: Suppl. 1 Published: 2004

 <u>Title: An effective electronic surgical referral system</u> Author(s): Dennison J, Eisen S, Towers M, et al.
 Source: ANNALS OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND Volume: 88 Issues: 6 Pages: 554-556 Published: OCT 2006

Other than the 4 databases searched, Internet search engines, Google and Google Scholar were accessed to find implementations of the subject area, other than those available in traditional journals. The author was able to find a large amount of literature regarding the Scottish Care Information Gateway (SCI Gateway). The SCI gateway is a portal that provides among other things, electronic referrals from GP to secondary and tertiary care in Scotland. The SCI gateway was implemented by the National Information Systems Group (NISG), which is part of the National Health Services Scotland (NHS Scotland). Having direct communication with this team has been useful in addressing a number of questions relating to electronic referral systems in general and the Scottish experience in particular. The information provided has been in the form of newsletters, training manuals, system functionality, and workflow description from GP to secondary care and vice a versa.

Google search was also useful in finding information on the experience in Northern Ireland developing a Referral Management System. The information on Northern Ireland was presented by PA Consulting to the Health Informatics Society of Ireland Annual Conference, on the 22nd of November 2007.

2.3 Interviews

The author conducted a number of interviews with individuals who play an active role in the referral process in Ireland, and who have experience in the development and provisioning of such services (e.g. GPs,

nurse, and consultant), and a key figure within the Department of Health in Northern Ireland. With regards to development of e-referral systems internationally, interviews were also conducted over the telephone with members of the eHealth Directorate team in the Scottish government, responsible for the development and maintenance of the SCI Gateway national referral system, and also a technical consultant in England responsible for the implementation of the ERA system. Table 2 provides a list of all the national and international participants interviewed.

Name	Designation	Date & method of interview	Subject
Dr. Alastair Bishop	Head of Change & Benefits, eHealth Directorate Scottish Government	5 th Feb, 2009 (telephone)	SCI Gateway system (Scotland)
Dr. Alex Al- Khourie	GP, Rathfarnham practice, Dublin	14 th , 15 th , Oct, 2008 (person)	Map current GP to OPC referral process
Mrs. Anna Harbison -Egan	Oncology nurse, Our Lady of Lourdes Hospital, Drogheda	6 th , 7 th November 2008 (person)	Capture referral processes and systems within OPC
Mr. Brian McKeown	Acting Director of Information Systems, Department of Health, Northern Ireland	31 st Mar, 2009 (telephone)	Electronic referral management system (Northern Ireland experience)
Ms. Efua Akumanyi	Technical Consultant, InferMed	5 th and 11 th Feb, 2009 (telephone)	Early Referral Application using decision support (England)
Ms. Gemma Garvan	Project Manager, National HealthLink project	24 th Feb, 2009 (telephone)	Healthlink project (ROI)
Ms. Jackie Caldwell	eHealth Directorate, The Scottish Government	6 th and 10 th Feb, 2009 (telephone)	SCI Gateway system (Scotland)
Mr. Kevin Gleeson	Project Manager, PA Consulting Group	3rd Mar, 2009 (person interview at PA Consulting, Herbert Park Lane, Ballsbridge, Dublin 4)	Electronic referral management system (Northern Ireland experience)
Dr. Niall Tubridy	Consultant Neurologist at St Vincent's University Hospital, Dublin	20th Jan, 2009 (person interview, at OPD, St Vincent's University Hospital)	web-based, referral service for GPs called 'Neurolink' in collaboration with Healthlink (used in St Vincent's Hospital)
Dr. Reem Salman	Senior Registrar, Breast Health Unit, Mater Hospital	2 nd , 3 rd Oct, 2008 (person)	Breast referrals send to OPC (processes and workflow)

Ms. Val Borland	Implementation Manager, NHS National Services Scotland	10th, 16th, 19th Feb, 2009 (telephone)	SCI Gateway system (Scotland)
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The main objectives of the interview were to capture, and understand the referral process, and the systems and functionality involved in making a referral from GP to hospital. All high level processes were mapped, documented, and then presented to the interviewees for review and acceptance. The process mapping exercise was useful because it provides a visual snapshot of the day and life of a patient, from the time they visit the GP until they are seen by the OPC, allowing the identification of functionality, issues and areas of optimisation. The type of interview methods used was a combination of structured and unstructured. Developing rapport between author and interviewees was essential in the collection of information. The use of the narrative technique allowed participants to describe their personal experiences, attitudes and opinions towards the referral process. Data collection through unstructured interviews provided the author with an in depth knowledge in the use and development of referrals, both as a process and system. A number of the interviews conducted were booked following a list of questions that were sent to the participants via email, prior to the interview. This allowed the author to review the answers before the interview and expand on the questions, thereby ensuring clarity and accuracy of data captured.

Chapter 3 The current practice of referral in Ireland

This chapter provides an outline of the Irish health services and the current referral process in Ireland. It goes on to describe the electronic referral projects implemented in Ireland, their use, functionality, and system architecture. The information captured in this chapter is derived from individual interviews and study of existing literature.

3.1 Outline of Irish Health service

According to the Central Statistics Office (CSO), the approx population of Ireland in 2008 is 4,422,100, an increase of more than 180,000 persons on the 2006 census figures. Life expectancy for males is 76.8 years and 81.6 years for females; although life expectancy has increased in the past 8 decades, it still remains below that of countries with a similar economic profile (HSE, 2008). In terms of health spending per capita, Ireland ranks above OECD average (total health spending accounted for 7.5% of GDP). Everyone living in Ireland and certain visitors to Ireland is entitled to free maintenance and treatment in public beds in HSE hospitals and voluntary hospitals. What follows is a description of the main organisations of the Irish health services.

3.1.1 Department of Health and Children (DoHC)

The role of the DoHC is to support the Minister and the Irish Government by advising on the strategic development of the health system including policy and legislation; evaluating the performance of the health and social services, and working with other sectors to enhance people's health and well-being. The mission of the department is:

"To improve the health and well-being of people in Ireland in a manner that promotes better health for everyone, fair access, responsive and appropriate care delivery, and high performance".

It consists of 10 divisions; the two most relevant to primary and secondary care services are:

- Acute hospitals, cancer and associated services. Acute hospitals division 1 is responsible for the policy on acute hospital services, with a particular reference to the HSE South and West areas. The division monitors and evaluates the delivery of acute hospital services in line with the HSE's National Service Plan. It is also responsible for policy on co-location which entails the development of private hospitals on the campuses of certain public hospitals. The unit objectives are:
 - 1. To develop and oversee implementation of policy on acute hospital services in the context of an integrated, person-centred health service.
 - 2. To develop and oversee implementation of policy on pre-hospital care, ambulance and patient transport and emerge planning with reference to acute hospital services (DoHC, 2008).

In 2001, the Health Strategy developed a plan to tackle the problem of waiting lists and waiting times for patient being referred by their GPs to acute hospital services. In order to tackle this problem the

National Treatment Purchase Fund (NTPF) was established, with the function of purchasing treatment for public patients from the private hospital sector. The NTPF has responsibility for the collation and management of the national waiting list data for out-patient treatment. The NTPF manages this function through a national waiting list database; the Patient Treatment Register (PTR). The PTR provides a picture of the waiting lists in 44 acute hospitals nationally which enables patients and their GP to access hospital treatment as quickly as possible. The PTR is also used as a source of improved information for hospitals for planning and development.

• Primary care and social inclusion/ public health. The function of this division is as follows:

- 1. The formulation of primary care policy
- 2. General Practitioner services for GMS clients
- 3. Medical Cards and GP Visit Cards
- 4. GP contracts
- 5. Primary care out of hours/ extended hours

3.1.2 Health Service Executive (HSE)

The Health Service Executive (HSE) was established in January 2005, as the single body responsible for meeting Ireland's health and social care needs. It employees the highest number of people in state organisation, over 130,000 people with a budget of €14.7 billion. Prior to 2005 health services were provided by regional Health Boards, who reported directly to the DoHC. All of the Health Boards have now merged within the HSE organisation. The new national structure consists of 4 administrative areas and 32 Local Health Offices, each headed by a Local Health Manager (see Figure 1) (HSE, 2007).

3.1.2.1 HSE organisational Structure

The Health and Personal Social Services are divided into three service delivery units, they are:

- **Population Health**: promotes and protects the health of population
- Primary, Community and Continuing Care (PCCC): delivers health and personal social services in the community and other settings.
- National Hospitals Office (NHO): provides acute hospital and ambulance services throughout the country.



Source: Health Service Executive website

Figure 2: Map display of HSE administrative and local health office areas

3.1.3 Hospitals (secondary care)

In Ireland there are 3 different types of hospital, they are as follows:

- Public Hospitals: these are government owned and funded by the HSE.
- Voluntary public hospitals: there is a small difference between Voluntary public hospitals and Public hospitals. Most of the income of Voluntary hospitals is paid by the government. Some of the Voluntary hospitals are sometimes owned by private bodies, such as religious orders. Other voluntary public hospitals are run by boards which are appointed by the Minster for Health and Children.
- **Private hospitals:** run by private individuals and receive no government funding.

Public and Voluntary hospitals can also provide private health care; however they must clearly differentiate between public and private beds. This also implies that medical professionals can work in both a private or public hospital. Acute hospital services in Ireland exist to diagnose, treat and care for seriously ill or injured patients. These acute services are provided in HSE hospitals, public voluntary hospitals and private hospitals. Specialist hospitals in Ireland are maternity hospitals, psychiatric hospitals, and cancer hospitals.

The larger general and regional hospitals in Ireland provide a broad range of services. There are approximately 51 public hospitals in Ireland; Figure 3 provides a list of hospital networks in Ireland.

Out-patient services in public hospitals are also free of charge but some people may have to pay an initial charge if they have not been referred by a GP.



Source: Health Service Executive website

Figure 3: Hospital network in Ireland

3.1.4 General Practitioner (primary care)

According to the DoHC primary care strategy, primary care is defined as:

"An approach to care that includes a range of services designed to keep people well, from promotion of health and screening for disease to assessment, diagnosis, treatment and rehabilitation as well as personal social services. The services provide first-level contact that is fully accessible by self-referral and have a strong emphasis on working with communities and individuals to improve their health and social well-being" (DoHC, 2001).

Primary care is the first point of contact with the health and personal social services in Ireland. The term primary care is often used synonymously with General Practitioner; however it encompasses a wide range of health and personal services delivered by a variety of professions.

Primary care services are provided by approximately 2,315 GPs, 1,414 dentists, 552 optometrists, and 1,530 pharmacists, (Woods, 2007). Table 3 provides the number of primary care professionals, by regions within Ireland.

Health Service Executive	Doctors	Pharmacists	Dentists	Optometrists
East Coast Area	216	140	88	38
South West Area	302	214	168	71
Northern Area	253	180	112	45
Midland	146	94	68	46
Mid-Western	222	146	115	40
North Eastern	167	146	91	56
North Western	141	95	60	32
South Eastern	232	170	102	62
Southern	410	241	296	68
Western	258	161	143	66
National	2,347	1,587	1,243	524
Corresponding figures for 2006	2,315	1,530	1,414	552

Table 3: Number of GPs and other primary care providers

Source: HSE-Finance Shared Services, Primary care reimbursement service-statistical analysis of claims and payments 2007.

3.2 The implementation of e-referral systems in Ireland

What follows is a description of four electronic patient referral projects currently implemented in Ireland. They are electronic referral in St.James's Hospital in Dublin, the National Healthlink project based out of the Mater Misericordiae University hospital in Dublin, the Neurolink project at St. Vincent's University Hospital in Dublin, South Infirmary Victoria University Hospital's (SIVUH) online referral system in Cork.

3.2.1 St James's Hospital

St James's Hospital in partnership with the HSE South Western Area, the HSE Shared Services Eastern Region and the South Inner City Partnership in Primary Care (SICP), have initiated Electronic Outpatient Referrals. GPs affiliated to the SICP now have the ability to send referrals via secure email to a central email address.

The way in which this process works is that a GP must first write a referral in a Word document and attached it to the email. The referral template (see Figure 4) is provided by St James's hospital or GPs can use a Word referral document generated by their own GP practice systems. In the subject heading of the email the GP should contain the name of the consultant to whom the referral is being sent to or the name of the speciality required by the GP. The emails sent from the GP are encrypted in order to maintain patient confidentiality. The emails arrive at a central email address; from there the emails are forwarded to the appropriate consultant. Once the referrals are read and an appointment is made, the GP is informed by an email to access an extranet site. Using his/her Digital ID, the GP can enter the extranet site and view time and date of the appointment, (St.James's, 2009)

Referral Template

Referral to Hospital Consultant:	General Practitioner:
	Name:
Directorate	Address:
St James's Hospital, Dublin, Ireland	Telephone:
Secretarial E-Mail:	Email:
	•
Patient Information:	Date of Birth:
Title:	Hospital Medical Record Number:
First Name:	
Sumame:	
Address:	Medical Card Yes/No:
	GMS number:
Telephone:	Private Insurance Yes/No:

Referral Date:

Clinical Information: (complete as relevant): Service/Procedure Request:

Diagnosis:

Presenting Complaint

Past Medical History:

Clinical Examination:

Investigations:

Medication:

Risk Factors: Allergies: Family History: Social History: Comments:

Figure 4: GP referral template used at St. James's hospital (St. James's, 2009)

3.2.2 Healthlink project

Healthlink is an electronic communications project funded by the HSE, and initiated in the Mater Misericordiae University hospital in 1995. It evolved into a national project with the launch of Healthlink in

2003. The main objective of the Healthlink project is to implement a prototype healthcare communications network with a specific reference to GPs and acute hospital and agency relationships and data exchange.

Prior to the establishment of the HSE, Healthlink was funded primarily by the DoHC. Once the HSE was established in 2005, all funding and sponsorship was delivered by the HSE. The same applied to the Mater hospital, which was also funded by the DoHC, and functioned independently from the former Health Boards. Currently the Healthlink project is administered by the Mater hospital and all Healthlink staff members are employees of the Mater hospital (Healthlink, 2009).

3.2.2.1 Services provided

Healthlink provides a number of messaging services in Ireland, categorised as either inbound or outbound messaging services, they are listed in Table 4.

Messaging Services	In-bound	Out-bound
Laboratory Results		 ✓
Radiology Results		 ✓
A & E Attendance Notifications		 ✓
Inpatient Admissions		 ✓
Death Notifications		 ✓
Discharge Notifications		 ✓
Discharge Summaries		 ✓
OPD Appointment Updates		 ✓
Waiting List Updates		 ✓
Co-op Discharge Summaries		 ✓
Laboratory Results		 ✓
Radiology Results		 ✓
Lab order	-	
Referral messages		

Table 4: List of Healthlink messaging services (Healthlink, 2009)

Out-bound messaging refers to messages sent from hospital to GP and in-bound refers to messages sent from GP to hospital. Healthlink services are categorised in 3 messaging services, such as Lab Order, Neurolink, which is an online referral services pioneered by Dr. Niall Tubridy (Consultant Neurologist) at St. Vincent's University Hospital, this will be discussed in section 3.2.3, HealthlinkOnline, a generic messaging system that includes referral functionality, and specific cancer referral capabilities.

3.2.2.2 Cancer referrals

The National Cancer Programme and its Director, Professor Tom Keane have approached Healthlink in July 2008, with the intention of implementing electronic cancer referrals using the HealthlinkOnline system.

Prior to contacting Healthlink, Professor Tom Keane had met with Dr.Niall Tubridy at St.Vincent's University Hospital to view the referral system used within the neurology department. Based on that presentation, Professor Tom Keane realised its use for the referral of cancer patients, (Ring, 2009).

3.2.3 St Vincent's "Neurolink" project

Neurolink was launched in December 2006 following a 6-month pilot with a group of St. Vincent's GPs. The service allows GPs direct online access to Consultant Neurologists for initial diagnosis and advice as to whether their patient should attend in person and/or what tests should be completed prior to meeting the Neurologist.

The Neurolink system, in replacing the standard referral letter, was designed to be quick and easy to use. The form itself is based on a series of drop-down menus to capture details of the patient's presenting complaint, medications, family history, examination findings and past neurological attendances. There is free-text space also for the GP to enter comments or observations that are not captured elsewhere.

Neurolink is currently working with the Practice Management System suppliers to incorporate the responses into the patient record. Healthlink has integrated the Neurolink system within the Healthlink online system.

3.2.4 SIVUH's online referral system

The South Infirmary Victoria University Hospital (SIVUH) in Cork has rolled out a new online referral systems for GPs. The idea for the project dates from 2006 when a secure online system for GPs was setup on a pilot basis for the hospital's Chest Pain Assessment Unit.

The reason for the development of the online referral system was due to the illegibility of handwritten referrals and faxes from GPs. Hand written referrals generate difficulties due to missing or illegible information and signatures. This can result in sub-optimal use of clerical appointment officer's time, decreased productivity and delay in issuing appointments. Incorrect or insufficient patient details on referral letters have the potential for serious incident to occur. Being a secure site ensures patient information is kept confidential and GP login details are verified to ensure GPs only are using the online service. Not all GPs have computers and internet access but it was hoped that the system would be used, by those who have, to help improve the overall referral process to out-patient clinics. GPs have control over their own passwords and can update their demographics on the website. Any updates made are emailed to the IT

Department where the Patient Administration system is updated with the new GP information. GPs are given access to other relevant hospital information through this web portal such as waiting times, clinic times, secretary contact information and information on consultants attached to the hospital (O'Connell, 2009).

The system has been expanded to include SIVUH's Breast clinic and a total of 16 departments with some 170 GPs across Munster registered to use the system. The PAS was setup to have one unique identifier for each patient, in order to reduce the possibility of creating a second record (Roche, 2009).

3.3 Evaluations and lessons learned

There are currently a number of electronic referral systems in use within the Irish health centers, with the probability of others following suit. It will be more appropriate to consolidate the data, resources and experience in a single national electronic referral system.

- All resources involved in ongoing e-referral projects in various Irish hospitals need to be re-channelled to assist in the development of a national Irish e-referral system (change from hospital focus to national focus).
- It is necessary to avoid duplication of effort and the creation of non-integrated silos of databases and system.
- Messaging standards being developed to date need to be unified, so as to avoid problems of interoperability between various systems.
- The need to have the same version of messaging between various systems to minimise future communication problems (HL7 has different variants, need to standardise one version for national use).
- Necessary to have all stakeholder involvement in the development of an e-referral system.
- The need to optimise the workflow between primary and secondary care in the transfer of patient referral data.
- A monitoring system of a central database that can avoid duplicate referrals, for accurate managing and auditing purposes.
- Referral guidelines and links to key resources need to be available for physicians to make appropriate referrals.

3.4 Overall conclusions

The initiative taken by Irish hospitals in developing an electronic patient referral system is recognition on their part of the benefits that e-referral provides to all stakeholders within the Irish healthcare sector. However this effort is fragmented and will need appropriate governance for conducting a large national programme for e-referral in Ireland between primary and secondary care, this will significantly improve the communication between healthcare providers, health services, and most importantly the quality of treatment and care provided to patients.

Chapter 4 The state-of- the-art referral systems

This chapter explores the state-of-the-art e-referral systems in Australia, Finland and the United Kingdom. The importance of this chapter is to develop an understanding of the major trends (e.g. system functionality, system architecture, interoperability, communication mechanisms, business benefits of electronic referral systems). The search of the literature produced details on systems in Australia, Finland and the United Kingdom, Appendix G provides a detailed description of the state-of-the-art systems, in these countries and an evaluation and lessons learned of each of the systems used.

The rest of this chapter first outlines the problems of paper based referrals (section 4.1), and then explains how the adoption of an electronic patient referral system can solve the problem posed by paper based referrals (section 4.2), and finally draws out the key issues from Appendix G (section 4.3).

4.1 Problems of paper based referrals

In Ireland, the General Practitioner (GP) is the first point of contact for persons with health problems or medical requests. Depending on the severity of the person's medical condition, a GP may refer her/him to a secondary care hospital consultant, thus a referral can be defined as follows:

A process of generating a clinical referral for a patient, and the resulting transfer of information from the primary care physician to the specialist and back again. The ultimate purpose is to ensure that an appointment is set with a specialist to treat the patient.

Another purpose for the referral could be for consultation, i.e. where the primary care physician has a general question(s) or a particular query for a specialist. Paper based referrals consist of forms that are filled by a GP and send to hospital, in three ways by post, fax or electronically (referral produced and sent electronically then treated as a paper copy by hospital) (Cannaby et al., 2004). The referral consists of a number of items of information that needs to be transferred to the hospital, such as clinical and demographic data. Referral guidelines are used to assist the GP on what type of information to send and the criteria for urgent referrals.

The use of paper based referrals is however problematic and requires a solution that will offer better benefits for patient care. What follows is a description of problems posed by paper referrals, the information captured is derived from stakeholders involved in implementing e-referral systems in Ireland, the United Kingdom and from analysts of available literature.

- Generate difficulties in legibility (sub-optimal use of clerical appointment administrator's time, decreased productivity, and delay in issuing appointments).
- Errors and delays linked with posted referrals (unrecorded, lost referrals, post delayed).
- Lack of confirmation on receipt of referral (patient anxiety waiting for confirmation).

- Increase in administration time for GPs and hospital (delays impact patient).
- Increase in society costs due to delay in patient treatment (Cannaby et al., 2004).
- Unsecure method of transfer of confidential and private patient information (data protection is compromised)
- Lack of accurate OP referral figures for HSE, this is needed for auditing of patient data and quality assurance (slow process to enter patient referral information, give rise to typing errors) (Tubridy, et al., 2006; Gleeson, 2007; O'Connell, 2009).

The healthcare sector is information intensive, where the quality of care and appropriateness of treatment administered to patients depends on the fast, reliable and accurate communication of relevant patient information to the point of care. The reliance on paper based patient referrals in Ireland and the non existence of integration between GP and hospital systems are major problems that have a negative impact on patient health outcomes.

The need to optimise the efficiency of daily routine communication between General Practitioners (GPs) and hospitals is vital in ensuring benefits for all stakeholders involved in the process. The adoption of electronic patient referrals in the Irish healthcare system, offers a solution to the problems with paper based referrals.

4.2 The adoption of electronic referral as a solution

One promising areas of e-Health is electronic patient referrals. E-referrals can be used to facilitate the physical transfer of patients from one institution to another or for consultation between healthcare providers, i.e. between a General Practitioner (GP) and a hospital specialist (Wootton, R., et al., 2003, p.77). The term electronic referral (e-referral) means the transmission of digital or electronic documents from one system to another, or as:

The electronic transmission of patient referral from one healthcare provider to another and back, in a manner that is secure and protects patient's confidential information.

The term e-referral is often used incorrectly to describe any referral process that uses an electronic device i.e. fax. The appropriate definition for e-referral is therefore any referral that is created and sent electronically and treated electronically by hospital (not treated as paper copy) (Cannaby et al., 2004).

The adoption of an electronic referral system provides a number of qualitative and quantitative benefits and offers a better solution to the problems posed by paper based referrals.

4.2.1 Qualitative benefits of electronic patient referral

The adoption of an electronic referral system provides a number of qualitative and quantitative benefits for stakeholders (patient, General Practitioner, consultant, medical staff, HSE, HIQA, admin staff) and offers a better solution to the problems posed by paper based referrals (Tubridy, et al., 2006; Gleeson, 2007; O'Connell, 2009).

- Improve accuracy and speed of referral processing (benefits all-legibility problems with faxed and handwritten referrals).
- More timely assessment of health problems (benefits patient)
- Increase patient and physician satisfaction (benefits patient and GP)
- Confirmation on receipt of referral (benefits patient and GP-reduce patient anxiety waiting for confirmation).
- Improved coordination of treatment between General Practitioner and consultants (benefits patients, GP and consultant).
- Search and select the appropriate specialist (benefits GP)
- Eliminate missing or delayed referrals (benefits Patient, GP, consultant and society-posted referrals can be delayed or lost).
- More accurate national referral figures for health services (benefits HSE and HIQA-auditing of patient data, quality assurance).
- Communication of clinical data and patient information is secure (benefits patient).
- System integrates with GP systems (benefits GP)
- Eliminate the re-typing of patient demographic data, referral letters and consultation reports (Benefits GP, admin staff and medical staff).

Study conducted by Cannaby (2004) found that some General Practitioners were reluctant to make use of new technology; the General Practioner practices that have embraced electronic communication systems for sending patient referrals found that the advantages far outweighed the disadvantages.

The advantages cited by GPs:

- Faster referral process
- No risk of referral being lost in the post
- Standard patient data already input
- Referrals automatically delivered to the right department

- Valid and complete (coherent) information
- Removes the risk of hospital staff misinterpreting the GPs request due to illegibility of handwriting
- Reduces the number of referrals returned to the GP
- Once only data entry reduces the risk of errors.
- More timely assessment of health problems (benefits patient)

The disadvantages cited by GPs:

- System failure
- Additional paperwork must be posted
- GP focus may be directed at the screen not the patient.
- No risk of referral being lost in the post
- Standard patient data already input
- Referrals automatically delivered to the right department

4.2.2 Quantitative benefits of electronic patient referral

At the request of the European Commission Information Society Directorate-General (DG INFSO), a study was conducted by ACCA (the Association of Charted Certified Accountants) and the Danish Centre for Health Informatics (MedCom), to identify particularly the quantitative benefits of patient electronic referrals the study identified the following quantitative benefits (Cannaby et al., 2004):

- Cost saving in the full adoption of electronic patient referrals over paper based referrals (significant differences in costs between electronic and paper based referrals).
- Reduced costs to society (increased patient waiting times caused by posting referral has a significant cost bearing on society).
- Increased adoption of electronic referral by GPs would potentially increase savings per capita.

Appendix H provides a breakdown of the cost benefit analysis undertaken in the (Cannaby et al., 2004) study.

Cost benefit analysis undertaken by SCI gateway in Scotland and the e-referral system in Oulu university hospital in Finland (see Appendix G) also identified the following quantitative benefits:

• A 90% Reduction in the number of phone calls to the medical records department from GP practices (inquiry about confirmation of receipt of referral or whether or not patient is on waiting list) (Borland, 2009).
- The electronic patient referral system allows more patients to be treated at lower costs, while increasing productivity three-fold (Reponen, et al, 2004).
- The reduction of medical consultation time by 44-49% compared to a conventional consultation (Reponen, et al, 2004).

4.3 Summary and detailed conclusion

What follows is a summary and detailed conclusion of the key points mentioned above and arising from Appendix G.

4.3.1 Business case for electronic referral systems

- There is a strong business case for the development of an electronic referral system in Ireland, and substantial qualitative and quantitative benefits.
- MedCom has provided evidence that adoption of electronic referrals produces significant cost benefits over paper based referrals (see Appendix H).
- Increased adoption of electronic referrals by GPs will further increase potential of cost savings (critical mass).
- Consolidation of systems and resources to eliminate unnecessary integration costs.
- Surveys conducted among stakeholders shows a high satisfaction rating for the adoption of e-referral systems

4.3.2 Standards

- Messaging standards need to be unified, so as to avoid problems of interoperability between various systems.
- The need to have the same version of messaging between various systems to minimise future communication problems (HL7 has different variants, need to standardise one version for national use).
- Need to ensure that all GP practice management systems comply with international standards.

4.3.3 Security

- Patient information is confidential and must not be sent via an open network, such as the internet.
- The use of email for consultation purposes between GP and specialist must be made anonymous or encrypted.

- The use and access of a web server for electronic referral is seen as a more secure method, as a secure connection can be established either at the network level (VLAN or VPN) or at the application level (e.g. a secure connection (SSL) with a web browser)
- The use of email for sending referrals has disadvantages that include poor security if encryption is not used.
- The use of Public Key Infrastructure (PKI) is a viable solution to ensure the security of online transactions across the health sector (Nicholson, C., et al., 2006).

4.3.4 Applications of e-referrals

- In the case of a complicated problem, when there is a need for expert opinion or when the answer cannot be found easily (access to referral guidelines and common questions that can be accessed by database or links)
- Where a GP has to follow-up on an urgent referral (in the case of chronic disease)
- Communication between various healthcare professionals and patients (e.g. communication between patient and nurse, between physicians and other specialists).
- For a multi staged referral process, with more than one healthcare professional is involved (e.g. refer from GP to hospital, where the hospital can then pass on the referral to a tertiary hospital).
- Can act as a substitute for a telephone consultation in a non-urgent situation (e.g. GP requires additional information such as physiological data or images).
- In the event that a GP needs to merge data within GPs practice management system or for links to data in referrals
- Electronic referrals are not suitable very urgent cases (e.g. when patient has to be rushed to A&E department) (Wootton, R., et al., 2003).

4.4 Overall conclusions

The use of e-referral systems between primary and secondary care improves access to health services and cooperation between hospitals and health centers. It also improves the quality and the effectiveness of patient care, decreases direct costs, increases productivity and cost effectiveness. This requires a well experienced project management team, with advanced skills in service coordination and knowledgeable in the practical real life use of electronic referrals in Ireland so as to avoid the problems that can arise from inappropriate use of e-referrals.

Review of existing state-of-the-art electronic patient referral systems, highlights that integration is one of the main challenges in implementing electronic patient referral system. The challenge is the integration of different information systems, integration of best practice between primary and secondary care, and the integration of information through electronic messaging as part of staged national electronic patient referral project. This requires strong leadership that has the political will to implement the necessary organisational, cultural and business process change required to take full advantages of a national electronic referral system.

Chapter 5 SCOPE document: proposal for an Irish electronic patient referral system

Rapid Application Development (RAD) is a software development methodology, which involves iterative development and the construction of prototypes (see Figure 5). It is a merger of various structured techniques, especially the data driven information engineering with prototyping techniques to accelerate software systems development. The RAD approach assigns a time limit to each task or subsystem. The development of software systems is achieved by (Ayesh, 2002):

- Gathering requirements using workgroups or focus groups.
- The use of CASE tools to enforce technical integrity in modeling and designing the system.
- The re-use of software components
- Development of a task structure that encourages parallel project activities.



Figure 5: RAD use of iterative development

What follows is a scope document for the electronic patient referral system.

5.1 Introduction

5.1.1 Executive overview

Medical stakeholders partnered with the author in an 11 week scope project to examine the business requirements for a nationwide electronic referral system. This study was conducted from 5th February 2009 to April 23rd 2009, at St. Vincent's hospital facility in Dublin, and at GP's practice in Rathfarnham, Dublin.

The purpose of the scope project was to examine the overall business requirements, discuss potential new functionality, and develop an implementation plan. During the engagement, stakeholder's and author discussed the need to improve the systems that support the business process.

The e-referral system will play an important role in the development and implementation of an Irish referral service, which will provide the following benefits:

- Cost savings by the elimination of paper based referrals.
- Reduce patient waiting times.
- Reduce waste and improve efficiency (unnecessary referrals, time and quality).
- Improve accuracy and speed of referral processing (legibility problems with faxed and handwritten referrals).
- Increase patient and physician satisfaction.
- Confirmation on receipt of referral (reduce patient anxiety waiting for confirmation).
- Eliminate missing or delayed referrals (posted referrals can be delayed or lost).
- Eliminate overbooking of patients.
- More accurate national referral figures for health services (auditing of patient data, quality assurance).
- Communication of clinical data and patient information is secure.

It is hoped that the e-referral scope document will ultimately act as an enabler to start the discussion among the major stakeholders in Ireland to develop a nationwide e-referral system in Ireland. The recommendations are that the following be started after the SCOPE phase:

• Immediately begin the design phase of the application. This entire effort will entail the following: **Design**

We estimate the design will require 20 weeks to complete based upon the information gathered during the project. At the conclusion of the design, the author will provide a fixed time and price for the development effort.

Development, User Acceptance Test, Pilot Roll-Out

Estimates for the development effort will be provided at the end of the design phase

5.1.2 The scope process

The Scope process consists of three main parts:

• Functionality Analysis

The functionality analysis identifies the most important capabilities needed to support the business processes. For each function identified, we describe high level features, critical data elements, data sources, and estimates (H, M, and L) for technical complexity and overall business benefit.

• Technology Analysis

The technology analysis identifies existing technology infrastructure within stakeholders and any anticipated future technology directions.

• Business Benefits Analysis

The business benefits analysis qualifies and quantifies the benefits that can be achieved by implementing a new electronic referral system

By merging the results of these three analyses, the team developed a functionality matrix that prescribes a phased implementation for the e-referral system. The functions are ranked according to a combination of their relative business benefit and technical complexity/cost to implement, recognizing that some functions are infrastructural in nature and that some may be interdependent. The goal is to maximize business benefit while minimizing unnecessary technical complexity and cost.

5.1.3 **Project objectives and deliverables**

The purpose of the project was to analyze physician to secondary care current business processes and identify, prioritize, and plan (for implementing) the functionality required to enable medical stakeholders to realize a vision of an e-referral system. This document, delivered at the conclusion of the project, serves as a summary of the project's findings. The document will be used as input into the subsequent phases of the project. It includes the following sections:

Business Context

This section outlines the business challenges facing stakeholders by examining corporate goals and critical success factors. Project goals and project success factors are discussed also, along with the essential measurements of success.

Functionality

The identified functionality is presented in a functionality matrix, prioritized by business benefits, technical complexity, and user requirements. Descriptions are provided for each cell in the functionality matrix.

Technical Architecture

Preliminary hardware, software, and network requirements of the system have been collected and have been used to develop high level architectures for the systems and the supporting infrastructure.

Business Case

The qualitative and quantitative business benefits of the functionality are identified in this section. An analysis of the business benefits permits prioritization of the functionality and confirms the business justification for proceeding with the recommended next steps.

Next Steps

A phased road map for proceeding with the implementation of the new functionality is included along with time for the recommended next steps.

5.1.4 **Project participants**

The table below lists the representative's professionals from medical field and the author who made up the project team. Throughout the project, the medical team is referred to as medical stakeholders or simply the team.

Table 5: SCOPE project team participants

Medical Team	Author
Dr. Alex Al-Khourie (GP)	Nazar Rasheed
Mrs. Anna Harbison-Egan (Oncology nurse)	
Medical Consultant	
Dr. Reem Salman (Senior registrar, Breast Cancer)	

5.2 Business context

5.2.1 Introduction

The primary purpose of the business context discussion is to outline medical stakeholder's business challenges, vision, and to highlight how the e-referral system will facilitate the team in achieving their goals.

5.2.2 A vision for an e-referral system

The vision for the new electronic referral system can be summarized as follows:

A system that incorporates all stakeholder's requirements, needed to providing patients with the best of health outcomes.

5.2.3 Goals of e-referral system

The team identified the following project goals to drive the discussions towards a solution that meets stakeholder's vision:

- A single point of contact for physicians, so that the referrer does not need to address a multiple lists of contact addresses (knowing the hospital and specialist needed)
- The system must allow the referrer to select/indicate a preference for a specific speciality or specialist (ensure patients see the appropriate specialist)

- The physician must obtain an acknowledgement that the hospital has received the referral information.
- The ability to track the progress of the referral form
- Reduce waste by unnecessary referrals
- Improve medical staff efficiency and workload
- Provide accurate outpatient figures for HSE
- Access to patient medical history (patient record)

5.2.4 Critical success factors of e-referral system

Critical success factors (CSFs) are those actions that must be done, for the project to realise its goals. The following list contains the critical success factors of the electronic referral system project:

- Government commitment in sponsoring the project by doing the following::
 - The creation of a steering committee-a group of executives who along with the executive sponsor, make the "go/no go" decisions, approve project expenditures, and ensure availability of expert resources. The steering committee also provides a forum in which project issues can be aired, problems can be reviewed, and staffing and scoping concerns can be discussed.
 - The creation of a group of stakeholders, who have a stake in the success and behavior of the health sector, and engaged in all aspects of the e-referral project.

5.2.5 Key performance measure of e-referral system

The group identified several key performance measures to use in evaluating how well the proposed application will achieve the success the team envisioned. To be successful, the e-referral application must:

- Access and availability of specialised care (based on the estimated patient urgency).
- Number of e-referrals dealt with.
- Number of referrals answered definitively within a specified time limit.
- Measure median time to definitive answer
- Average waiting time for patient to see specialist.

5.2.6 What are the current referral guidelines for General Practitioners?

Referral guidelines provide General Practitioners with comprehensive information that enables informed referral and other management decisions relating to:

- Suspected cancer referral (The report "A Strategy for Cancer Control in Ireland 2006" recommended the development of GP referral guidelines for cancer) (HSE, 2006).
- Cardiac rehab referral
- Endoscopy referral

- PET/CT referral
- Adult mental health referral
- Respiratory referral
- Spirometry referral
- Warfarin clinic referral

GP referral guidelines and associate forms can be accessed from Hospital in the Republic of Ireland, and the HSE.

5.3 Business process and functionality

5.3.1 Introduction

This section outlines the high-level business process for the electronic referral system. The process diagram and description documented in this section have been created from the existing referral process and user-input from the scope sessions.

The high level business process begins with a patient visiting their GP and the process description of how the referrals are handled and referred to secondary care. As a result of the business process, the team was able to map the functionality needed for phase 1 and subsequent phases of the electronic referral project.

5.3.2 Help on how to read a process flow

The following is an overview to help you read the Process flow by explaining each of the main symbols within a flow.

5.3.2.1 Process flow

A process flow is a graphical representation of a Business Process or a sub-process within a business process.

Symbols

The following symbols are used to diagram a Business Process:





Step Nr	Description	Actor
1.	Process starts with patient visiting GP	Patient
2.	GP examines patient, and decides whether or not patient requires referral. GP also decides if the referral is urgent or non urgent, depending on referral guidelines	General Practitioner (GP)
3.	If the patient does not require a referral, then the GP treats patient by prescribing medication. Patient might require follow-up on treatment	General Practitioner (GP)
4.	To enter referral GP must first log onto referral system. The referral can be accessed from the GP system. Once logged into the referral system, the GP can view patient record which is populated from the GP system and also access referral guidelines for the specific specialty. Irish GP practice management systems used are: HealthOne, Dynamic GP,GP Clinical, Helix Practice Manager, GP Mac, Socrates, CompleteGP, Medtech	General Practitioner (GP)
5.	GP clicks on new referral, and enters hospital location, specialty, service or consultant name	General Practitioner (GP)
6.	The GP can click on the "Attach" button and attach relevant supporting documentation to the referral. Here the GP can also enter clinical data and past medical family history. Medication used by the patient can be either entered by GP or automatically populated from the patient record. This tab allows GP's to enter areas of risk such as smoking history, alcohol, exercise history and other information that are deemed to be a risk to a patient's health. GP's can enter areas of risk such as smoking history, alcohol, exercise history and other information that are deemed to be a risk to a patient's health.	General Practitioner (GP)

7.	The administration information contains information on the name and details of the referring GP, the name and address of the hospital that the patient is being referred to, and the classification of the referral.	General Practitioner (GP)
	GP can access appointment booking system, and book time and date of appointment. Although this step is desirable it requires a full booking system and will be implemented in a future phase.	
8.	and then attaching the referral form, which can be in either word or pdf format. The referral form is attached in the same manner as attaching a document to an email. The last step in a confirmation from the hospital for the appointment that the GP has booked.	General Practitioner (GP)
9.	Once GP has entered all relevant information he or she presses send to send the information to the specified hospital. The referral application is automatically recorded in the GP practice management system and noted in the GP worklist. Once referral is received by the hospital, the GP will receive confirmation and booking confirmation (assuming booking system in place)	General Practitioner (GP)
10.	On receiving referral the hospital can view referral and prioritise referral based on information submitted by GP. Referrals can be redirected to other hospitals (tertiary hospitals). Once appointment is booked with patient, hospitals inform GP (if booking system operational then hospital does not need to confirm appointment). Once appointment is confirmed with patient then hospital informs GP. The reply to GP could be based on a consultation query or service.	Nurse (hospital)

	GP receives incoming referral from hospital based on	
	service query or on the appointment booked for the	
	patient (assuming that booking system is not	
11.	operational). The reply referral can be printed, saved or	GP
	imported into GP practice management system. The GP	
	can then inform patient of appointment or consult with	
	patient.	

5.3.3 Functionality

The functionality discussions began with a brainstorming session on the first day of the Scope project. This session gave the team, composed of representatives from healthcare (consultants, GPs, nurse), and author, the opportunity to discuss current processes and practices and to identify potential areas for improvement. These ideas, in conjunction work to date in this area, were synthesized into the functionality matrix (see following page), a graphical summary of the proposed functionality. The first column of the matrix represents the major functional areas, which are then detailed along the respective rows.

Discussions were held over the next several days to further detail each cell in the functionality matrix, focusing on the features and interactions involved, and those sessions resulted in the creation of a functionality description for each cell. Once the descriptions were completed, the team focused on identifying the qualitative and quantitative business benefits associated with each cell in the functionality matrix. As a final step, the teams attempted to prioritize the detailed functionality matrix.

5.3.4 Functionality matrix

To facilitate the discussions about application phasing, the team addressed the prioritization of the functionality from several perspectives: user requirements, business benefits, and technical complexity.

By combining each of these measures, the team was able to develop a preliminary phased functionality matrix. The phasing of the functionality matrix is indicated by the shading of the cells: no shading indicates the first phase, light gray shading indicates the second phase, and dark gray indicates the third phase.

5.3.4.1 User requirements

The team analysed each cell for its importance to the application from the user's perspective. The team used the following rating system:

High Critical functionality, must be in the first implementation of the applicationMedium Functionality is important to the application, but not immediately necessary; a manual process exists that can be used in the interim

Low Nice to have functionality, but not critical

5.3.4.2 Business Benefits

The team examined the potential benefit of each cell in the matrix for each of the identified benefit categories (see business case section for more details on the benefit categories.) By combining the resulting scores for each of the cells, a relative business benefit rating was assigned to each of the cells. The team used the following rating system:

5.3.4.3 Technical complexity

Separate discussions were held to explore the technical complexity of each cell. The team used the following rating system:

High	Extremely challenging, complex business rules,
	significant performance issues, requires new
	technology
Medium	Extensive business rules, some technical risk involved
Low	Minimal technical challenges, little or no connectivity

		1	2	3	4	5	6	7	8
A	GP-Patient referral	CRUD New Referral	Attach documents	View referral guidelines	Select referral destination	Select referral specialty	Print patient information	Book patient appointment	CRU administration
В	Secondary care-Patient referral recipients	Cancel/ Delete referrals	Print patient incoming referrals	Filter patient referrals	Search patient referrals	Reporting on KPIs			
С	Workflow management	CRUD rules for workflow	Referral Management	Re-direct referral					
D	Integration	Connect to GP system	PAS	Electronic Patient record	Appointment system				
Е	System administration	Backup and recovery	Base table maintenance	GP profile maintenance					

5.4 Functionality specifications

The following Functional Matrix Description Template describes the information recorded for each function:

Function:

Function Name (Functionality Matrix Cell (row/column))

Description:

A brief description of the function.

Features:

Special features of the system

Sorting functionality, etc.

Data Needed	Data Sources
General group of data or particular data	Specific source of data (new data,
element	legacy system, etc.)

User requirements:

A rating (High/Medium/Low) for its importance to the application from the user's perspective.

Business benefits:

An overall rating (High/Medium/Low) and identification of the *potential* quantitative and qualitative benefits. Each of the individual categories of business benefits that apply is listed along with a measure of how much the functionality impacts the benefit category

Technical complexity:

A rating (High/Medium/Low) of the technical complexity of the function was applied along with a short reason for the assigned rating. A function's technical complexity was based on the following criteria:

- Complexity of business rules and logic
- Availability of data
- Volume of data
- Performance considerations
- Number of data access points
- Unknown/Risk

Notes:

Any notes for this sub-module

5.4.1 A-GP Patient Referral

5.4.1.1 A1-CRUD new referral

Description:

The function areas CRUD new referral will enable the GP to create, read, update and delete any information on the patient. The functionality allows GP to enter patients past medical and family history, medication used by patient, and areas of risk such as smoking history, alcohol, exercise history and other information that are deemed to be a risk to a patient's health. The patient data that the GP will enter is listed as follows:

• Demographics (name, address, dob, sex, marital status, phone number, religion)

Features:

Data Needed	Data Sources
Patient demographics	GP system, patient record
Patient past and family medical history	GP system, patient record
Health risks	GP system, patient record

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Medium

Notes:

GP's can type in the information needed for this cell, or the information can be populated from GP system or patient record

Issues:

• The issue is that there is currently no consolidated patient record in Ireland.

5.4.1.2 A2-Attach documents

Description:

This functionality allows the GP to attach relevant supporting documentation to the referral. The attached documents can be in any format Word, Excel, Pdf, Jpeg, Bitmap etc.

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Medium

5.4.1.3 A3-View referral guidelines

Description:

Allows GPs to access, national medical guidelines, for the referral of patients. Key messages can be included along with links to national guidelines

Features:

Data Needed	Data Sources
GP referral guidelines for suspected cancer	Irish College of General Practitioners http://www.icgp.ie/go/archive/AB67F2 32-D5AB-5C10- 71B7BE59FBDF1899.html

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Low

Notes:

The HSE's, Regional Oncology Programme's Office, have published a *General Practitioner Cancer Referral Guidelines*. This provides referral guidelines for all types of cancer disease.

5.4.1.4 A4-Select referral destination

Description:

Provides the GP with the ability to selects the destination that the patient will be sent to (the name and location of the hospital)

Features:

Data Needed	Data Sources
Hospital name and location	Health Service Executive

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Medium

Notes:

The HSE has organized all the services it provides (primary, community and continuing care, as well as the National Hospitals Office) in four networks on a national basis, each serving a catchment population of approximately one million people. This implies that a GP must referral a patient within his or her catchment area. (Source: a strategy for cancer control in Ireland)

5.4.1.5 A5-Select referral speciality

Description:

The function allows the GP to select the speciality or service required. Also has the ability to select consultant name. The type of specialties is as follows:

- Ear, Nose & Throat (ENT), Endocrinology and Diabetes, General Surgery
- Geriatric Medicine, Gynecology, Haematology
- Neurology,Obstetrics,Opthalmology
- Oral Surgery, Orthodontics, Paediatrics
- Physiotherapy, Plastic Surgery, Renal Medicine
- Rheumatology, Trauma and Orthopaedic surgery
- Urology

Features:

Data Needed	Data Sources
List of hospital medical services	HSE (service by hospital)
Name of specialist (consultant)	List of names provided by HSE hospitals

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Low

5.4.1.6 A6-Print patient information

Description:

Selected referrals and associated attachments can be printed or saved in desired folder.

User requirements:

Overall: High

Business benefits:

Overall: High **Technical complexity:** Overall: Low

5.4.1.7 A7-Book patient appointment

Description:

On completing the referral form, the GP can access the appointment system, which will allow him/her to book a time and date for the patient.

User requirements:

Overall: High Business benefits: Overall: High Technical complexity: Overall: High Notes:

The ability to be able to book appointments for patient requires a purchase or development of an online appointments booking system. Although this functionality is desirable it will be implemented in future phases.

5.4.1.8 A8-CRU administration

Description:

This functionality allows administration information to be created, read, and updated. The administration information contains name and details of the referring GP, the name and address of the hospital that the patient is being referred to and the classification of the referral (urgent, non urgent)

Features:

Data Needed	Data Sources		
GP (name, address, practice name, registration number, telephone number, fax number)	Information populated from patient record within GP system		
Referral classification (date of referral, referral type, referred by)	Information populated from patient record within GP system		
Referred to (hospital name, hospital			

Data Needed	Data Sources	
address, hospital specialty)	Information populated from patient	
	record within GP system	

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Medium

5.4.2 B-Secondary care patient referral recipients

5.4.2.1 B1-Cancel/delete incoming referrals

Description:

This functionality allows staff within the hospital to take a number of actions on incoming referrals. The actions are cancel or delete of incoming referrals. Referrals can also be directed to another location, service or specialty.

User requirements:

Overall: High Business benefits: Overall: Low Technical complexity: Overall: Medium

5.4.2.2 B2-Print incoming patient referral

Description:

Provides the ability, to print incoming referrals and associated attachments.

User requirements:

Overall: High

Business benefits:

Overall: Low

Technical complexity:

Overall: Low

5.4.2.3 B3-Filter patient referrals

Description:

This functionality allows the user to filter a list of incoming referrals, by a number of filtering criteria.

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: Low

Notes:

A number of filter criteria can be used such as Printed, Pending, Appointment booked, Directed to tertiary or acute care.

5.4.2.4 B4-Search patient referrals

Description:

Allows complete list of referrals to be searched by patient, a range of dates, or any of the filterable data items.

User requirements:

Overall: High

Business benefits:

Overall: Medium

Technical complexity:

Overall: Low

5.4.2.5 B5-Reporting on KPI's

Description:

This is a reporting functionality on key performance indicators identified. The key performance indicators are:

- Access to care, based on the estimated patient urgency.
- Number of e-referrals dealt with.
- Number of referrals answered definitively within a specified time limit.
- Measure median time to definitive answer
- Average waiting time for patient to see specialist.

Features:

Data Needed	Data Sources
KPI criteria	HSE

User requirements:

Overall: High **Business benefits:** Overall: High **Technical complexity:** Overall: Medium

Notes:

The need for KPIs is to be able to provide auditing information to the responsible body and provide accurate outpatient figures to health services

5.4.3 C-Workflow management 5.4.3.1 C1-CRUD rules for workflow

Description:

This functionality provides for the creation, viewing, modification and deletion of rules, which will be used to determine the workflow in the handling of patient referrals. This would also include escalation rules (event/ classification of referrals (urgent, non urgent)

User requirements:

Overall: High **Business benefits:** Overall: High **Technical complexity:** Overall: High

5.4.3.2 C2-Referral management

Description:

This is the automatic linking and prioritization of referrals by the system

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: High

Notes:

It is complex to automatically link and prioritise incoming referrals, it would require artificial intelligence

5.4.3.3 C3-Re-direct referral

Description:

This involves the process where a referral is transferred to another hospital location or specialty.

User requirements: Overall: Medium Business benefits: Overall: Low Technical complexity: Overall: High

5.4.4 D-Integration

The different systems that require integration are listed here for completeness. For descriptions on the integration, please see the individual cells that have functionality that requires integration of a system.

5.4.4.1 D1-Connect to GP system

Description:

The ability to connect GP systems, to referral system. This will allow GP to populate information from his/her system to referral form and capture specific patient information from the referral system into GP's system

Features:

Data Needed	Data Sources
Patient information (demographics, medical etc)	GP system
Patient information from secondary care	Referral system

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: High

Notes:

GPs in Ireland capture patient records in Practice Management Systems. The requirement is to have these systems connected to the referral system. Systems in use are:

- HealthOne, Dynamic GP, GP Clinical
- Helix Practice Manager, GP Mac, Socrates
- CompleteGP, Medtech

5.4.4.2 D2-Patient administration system (PAS)

Description:

The referral system must be able to connect to the Patient Administration System (PAS).

Features:

Data Needed	Data Sources
Patient information (demographics, medical etc)	GP system
Patient information from secondary care	Referral system

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: High

Notes:

The PAS is a computerized system that records patient activity relating to Inpatients, Outpatients, and Waiting Lists, and A&E. It also has the capability to generate reports, for example bed occupancy, and produce statistics for the HSE

5.4.4.3 D3-Electronic patient record

Description:

This functionality allows GP to populate information from patient record. Information populated from patient record is:

- Current and repeated medication
- Clinical risks
- Patient demographics

Features:

Data Needed	Data Sources
Patient information (demographics,	C D overterm
medical etc)	GF System

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: High

Issues:

• The issue is that there is currently no electronic patient record in Ireland.

5.4.4.4 D4-Appointment system

Description:

Integrate to an appointment booking system.

Features:

Data Needed	Data Sources
Scheduling of personnel	Appointment system

User requirements:

Overall: High

Business benefits:

Overall: High

Technical complexity:

Overall: High

Notes:

The appointment booking system is a separate standalone product that can be integrated to the referral system.

5.4.5 E-System administration

This section captures task associated with supporting, installing and maintaining servers and computer systems.

5.4.5.1 E1-Backup and recovery

Description:

A plan must be made on how to handle backup and recovery of the system

User requirements:

Overall: High

Business benefits:

Overall: Low

Technical complexity:

Overall: High

5.4.5.2 E2-Base table maintenance

Description:

Base tables should be maintained through simple maintenance screens

User requirements:

Overall: High

Business benefits:

Overall: Low

Technical complexity:

Overall: High

Notes:

System base tables are the underlying tables that actually store the metadata for a specific database. The master database is special in this respect because it contains some additional tables that are not found in any of the other databases.

5.4.5.3 E3-GP profile maintenance Description: Information on GPs should be maintained User requirements: Overall: High Business benefits: Overall: High Technical complexity: Overall: Low

5.5 Technical architecture

5.5.1 Introduction

This section identifies the basic technical architecture required to support electronic referral system. This architecture supports the implementation of the functions and services described in the Functionality section. This architecture was determined through a high level analysis, which defers specific tool and vendor selection until the application design phase. The topics covered in this section include:

• Proposed systems Architecture for electronic referral system

5.5.1.1 Process overview

The technical discussions focused on the current network topology and a possible future network topology; current sources of data; corporate technology standards (e.g., security and software); current IS skill set in an open systems environment; the electronic referral system technical architecture and a technical complexity assessment of each cell in the functionality matrix.

The technical complexity for each cell in the functionality matrix has been rated as high (H), medium (M), or low (L). The following factors represent the evaluation criteria used in assessing technical complexity (refer to the Functionality section for Technical Complexity details):

- Complexity of Business Rules and Logic
- Performance Requirements/Considerations
- Unknown Factors/Risk
- Availability of Data
- Volume of Data
- Method of Data Access
- Integration with other Systems/Packages
- Integration within this System

5.5.1.2 Proposed architecture for electronic referral system

The following subsections describe some of the infrastructure requirements for electronic referral system. Hardware and software options for each layer of the three-tiered architecture are discussed and some initial recommendations are made.

The hardware and software architecture discussed in this section refers to the application in a production environment. Development is performed in a similar environment.

Hardware/Software Architecture



Figure 6: Conceptual hardware architecture

Figure 6 provides conceptual hardware architecture for the electronic patient referral system. While no final decisions have been made as to the tools required to build and use this application, the software architecture is structured based on the general three-tier client/server architecture described previously.

5.5.2 Technical requirements

This section gives an overview of the technical environment, such as hardware specifications, protocols, security and overall software system attributes.

5.5.2.1 Hardware specifications

Table 6 provides a listing of required hardware specifications.

Table 6: Hardware specifications

Server	Hardware	Software
Web server	Sun systems	Apache Web Server 1.3.22, Sun Solaris 8, Resonate Central Dispatch
Administration Server	Sun F4800 and F6800 (1 Domain)	Oracle 9i Application Server, Sun Solaris 8
Database Server	Sun E10K	Oracle 8i, Sun Solaris 8
Appointments Server	Sun F4800	Oracle 9i Discoverer, Sun Solaris 8

5.5.2.2 Protocols

In addition the system must be HL7 and XML compliant, so as to allow it to interface with standard hospital system. HL7 is accredited by the American National Standards Institute (ANSI), and specifies a number of standards, guidelines, and methodologies by which healthcare systems can communicate with each other.

5.5.2.3 Database requirements

The proposed and preferred RDBMS for the e-referral system is Oracle database 11g Enterprise Edition (EE)

5.5.2.4 User system requirements

- Web browser (Microsoft Internet Explorer 7+, Google Chrome, Firefox 3.5+)
- PC specifications (1GB RAM, 2 GHz processor)
- Virus protection software (McAfee, Norton, Kaspersky, Webroot, G Data)

5.5.2.5 Security requirements

Security of data is paramount in accessing the system. The web portal involves the transfer of confidential patient information across the internet. Therefore, security of data is of vital importance in developing the system architecture.

In order to secure access the portal will use the following protocols:

- HTTPS: Hypertext Transfer Protocol Secure, which is a communication protocol, used to transfer encrypted information between computers. HTTPS is HTTP using a Secure Socket Layer (SSL). SSL is an encryption protocol called on a web server that uses HTTPS.
- 2) Browser certificates: Certificates are the digital equivalent of an ID card, and are installed on user's personal computer.
- 3) Firewall: The system architecture uses a firewall to guarantee secure access.
- 4) Session management: If there is no interaction with the portal within a specific time frame, the user's session is automatically disconnected.

5.6 Business case

5.6.1 Introduction

The high level business case section describes the quantitative and qualitative benefits for implementing the electronic referral system. It provides an overview of business case information gathered during the scope phase. This business case

- Provides financial justification
- Ensures focus on delivering business value
- Guides phasing decisions

The high level business case was developed to quantify business value associated with the ereferral application and associated processes

5.6.2 Quantitative benefits

In addition to the quantitative benefits identified in this section, the referral project will also provide a variety of qualitative benefits; these benefits will be listed in section 5.6.3.

This section outlines the quantifiable cost benefits related to the development of electronic patient referral system. The team identified cost saving benefits in improved efficient and costs associated with paper based referrals. The quantitative benefits are:

- Cost savings by the elimination of paper based referrals.
- Reduce patient waiting times.
- Reduce waste and improve efficiency (unnecessary referrals, time and quality).

5.6.3 Qualitative benefits

It is difficult to estimate the positive impact qualitative benefits have on an organisations bottom line, but this does not mean they are unimportant. They support the goals and objectives of the system. The team identified the following qualitative or strategic benefits of electronic referral system:

- Improve accuracy and speed of referral processing (legibility problems with faxed and handwritten referrals).
- Increase patient and physician satisfaction.
- Confirmation on receipt of referral (reduce patient anxiety waiting for confirmation).
- Eliminate missing or delayed referrals (posted referrals can be delayed or lost).
- Eliminate overbooking of patients.
- More accurate national referral figures for health services (auditing of patient data, quality assurance).

- Communication of clinical data and patient information is secure.
- System integrates with GP systems

Electronic referral system will enable stakeholders to provide more informed and timely response to patient medical needs. In addition, electronic referral system will provide enhanced information on patients and their unique medical requirements.

5.7 Next steps

Recommendations

The team concluded, during the project, that stakeholder's should pursue the development of electronic referral system.

Next Steps

Although we have detailed an overall project plan for the entire initiative, we recommend that stakeholder's immediately begin the design phase of the application. This entire effort will entail the following:

Design

We estimate the design will require 20 weeks to complete based upon the information gathered during the project. At the conclusion of the design, the author will provide a fixed time and price for the development effort.

Development, User Acceptance Test, Pilot Roll-Out

The development effort will be provided at the end of the design phase (see Figure 7)



Figure 7: SCOPE phase diagram

Chapter 6 Conclusions, recommendations and future work

This chapter provides a summary of the conclusions and recommendation of this research and makes suggestions on required future research work.

This is the first research that provides a consolidation of different electronic patient referral systems in Ireland and internationally in one study. The scope document provides an initial blueprint of how a national electronic patient referral system might look, thus paving the way for follow up work in design, implementation and roll-out.

6.1 Research objectives

The aim of the research was to answer the question of "what should an electronic patient referral system from primary to secondary care in Ireland look like?"

The author adopted an 11 week scope session with medical stakeholders to capture stakeholder functional requirements, system architecture, business benefits, and business processes. The scope sessions represent the first phase of the RAD (Rapid Application Methodology). The scope phase captured a number of sub questions that were required in the development of a scope document, listed in Chapter 5 of this dissertation.

The research successfully addresses the main research questions and associated sub questions in sections 1.1 and 1.3. The research also identifies many important and useful lessons from existing e-referral projects in Ireland listed in section 3.2 and state-of-the-art electronic referral systems in Australia, Finland and the British Isles in Appendix G.

6.2 Main conclusions

Based on the overall conclusions and detailed conclusions described in sections 3.4 and 4.4, the main conclusions of this study are as follows:

- The adoption of electronic patient referral systems between primary and secondary care improves access to health services and cooperation between hospitals and health centers. It also improves the quality and the effectiveness of patient care.
- There is a strong business case for the implementation of national electronic patient referral system in Ireland. Cost benefit analysis undertaken by Denmark, Finland, and Scotland have identified significant quantitative benefits (e.g. cost savings in e-referral over paper based referrals, increase savings per capita, increase productivity, lower costs to society, 90% reduction in calls medical record dept).

- Initiatives taken by Irish hospitals in developing an electronic patient referral system is recognition on their part of the benefits that e-referral provides to all stakeholders within the Irish healthcare sector. The necessity is to avoid duplication of effort and the creation of non-integrated silos of databases and systems.
- The need to have a unified messaging standards (e.g. HL7 has different variants, need to standardise one version for national use) between various systems is vital to minimise future communication problems.
- The successful development of electronic patient referral systems in Australia, Finland, and Scotland demonstrate that a key factor in project success was due to government leadership and commitment in providing funding, resources and guidance.
- The use of web server for electronic patient referral is seen as a more secure method in making sure that patient information is secure and remains confidential.

6.3 Recommendations

What follows is the author's recommendation on the possible steps which could be taken to implementation an Irish electronic patient referral system.

- An e-health information strategy whose goal is to introduce a national electronic patient referral system. The strategy should outline the funding, project implementation steps, and timeframes. This is a task that can be owned and driven by the Department of Health and Children.
- The HSE should explore the potential benefits of the e-referral solution provided by the Scottish SCI gateway system identified in Appendix G. SCI gateway is operational in Scotland, with future planned implementation in Northern Ireland, and a current pilot underway in Wales, making it a popular e-referral system for the British Isles. This means that Ireland could learn from their experiences in determining the best way forward.
- A detailed business case for an electronic patient referral system that is formally documented and distributed to the Department of Health and Children, to demonstrate the qualitative and quantitative benefits of developing the service in Ireland. Section 4.2.1 provides qualitative benefits of adopting an electronic referral system, and section 4.2.2 provides quantitative benefits based on the study conducted by ACCA and the Danish Centre for Health Informatics.
- The creation of a national standard body responsible for the creation of a national messaging standard, and to coordinate and leverage the work currently undertaken in e-referral projects in Ireland. This task could be owned by key stakeholders HIQA and the HSE.

• The HSE's National ICT Directorate should consider stakeholder requirements and system architecture as outlined in the RAD Scope document in Chapter 5, when considering the implementation of a national electronic patient referral system.

6.4 Limitations of work

All of the academic literature analysed within the subject area were limited to literature published in the English language.

6.5 Future work on research topic

Based on the research undertaken for this study, the following areas related to implementing a national electronic referral system in Ireland, could benefit from further research.

- A definition of electronic referral in Ireland. Electronic referral can be defined in a number of ways, the author found no appropriate definition of e-referral in Ireland.
- From audit of existing e-referral systems in Ireland against international standards.
- A change management methodology that focuses on Irish healthcare (e.g. organisational behavior, culture change, workflow practices).
- Implementation of knowledge management strategies that explores the tangible benefits in knowledge sharing among healthcare professionals.
- Consolidation of patient medical data, and use of electronic patient record in the e-referral process.

This agenda would most appropriately be tackled by the HSE's National ICT Directorate.
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Appendix A- Number of Outpatient referrals in Ireland (2008)

Hospital	Location	Nr. Of Outpatient Referrals (2008)
Bantry General Hospital	Bantry, Co. Cork	11,302
Beaumont Hospital	Dublin	149,559
Cappagh National Orthopaedic Hospital	Finglas, Dublin 11	8,118
Cavan/ Monaghan Hospital Group	Cavan, Monaghan	81,894
Children's University Hospital, Temple street	Dublin 1	53,389
Connolly Hospital Blanchardstown	Dublin 15	57,882
Coombe Women's Hospital	Dublin 8	81,920
Cork University Hospital	Wilton, Co. Cork	134,470
Cork University Maternity Hospital	Wilton, Co. Cork	66,108
Galway University Hospital	Galway, Co Galway	175,060*
Kerry General Hospital	Tralee, Co. Kerry	56,613
Letterkenny General hospital	Letterkenny, Donegal	78,623
Lourdes Orthopaedic Hospital, Kilcreene	Kilcreene, Kilkenny	4,887
Louth County Hospital	Dundalk, Co. Louth	26,270
Mallow General Hospital	Mallow, Co. Cork	10,979
Mater Misericordiae University Hospital	Dublin 7	186,053
Mayo General Hospital	Castlebar, Co Mayo	50,835
Mercy University Hospital	Cork	37,955
Mid Western Regional Hospital, Dooradoyle	Dooradoyle, Co. Limerick	120,316
Mid Western Regional Hospital, Ennis	Ennis, Co. Clare	12,295
Mid Western Regional Hospital, Nenagh	Nenagh, North Tipperary	9,976
Mid Western Regional Maternity Hospital	Limerick	21,559
Mid Western Regional Orthopaedic Hospital	Croom, Co. Limerick	8,621
Midland Regional Hospital	Mullingar, Co. Westmeath	70,454
Midland Regional Hospital	Portlaoise, Co. Laois	44,645
Midland Regional Hospital	Tullamore, Co. Offaly	77,459

Naas General Hospital	Naas, Co. Kildare	36,565
National Maternity Hospital, Holles Street	Dublin 2	80,754
Our Lady of Lourdes Hospital	Drogheda, Co. Louth	110,844
Our Lady's Hospital	Navan, Co. Meath	36,644
Our Lady's Children's Hospital Crumlin	Dublin 12	84,935
Portiuncula Hospital	Ballinasloe	39,462
Roscommon County Hospital	Roscommon	39,462
Rotunda Hospital	Dublin 1	83,126
Royal Victoria Eye and Ear Hospital	Dublin 2	37,652
Sligo General Hospital	Sligo	81,888
South Infirmary-Victoria Hospital	Cork	55,415
South Tipperary General Hospital	South Tipperary	46,858
St Colmcille's Hospital, Loughlinstown	Loughlinstown, Co. Dublin	44,479
St James's Hospital	Dublin 8	195,870
St John's Hospital	Limerick	13,345
St Luke's General Hospital	Kilkenny	51,804
St Luke's Hospital, Rathgar (cancer services)	Rathgar, Dublin 8	58,353
St Mary's Orthopaedic Hospital	Cork	11,580
St Michael's , Dun Laoghaire	Dun Laoghaire, Co. Dublin	18,847
St Vincent University Hospital, Elm park	Dublin 4	226,493
Tallaght Hospital	Dublin 24	226,493
Waterford Regional Hospital	Waterford	122,837
Wexford General Hospital	Wexford	56,562
TOTAL		*3,397,510
* One third of the number of outpatient referrals are	revisit/return patients	, therefore a more approx

number of first time referrals are 2,265,007

Appendix B-Making a GP referral, using the BISEP eReferral desktop.

What follows is a description of the steps that a GP takes; in booking an appointment in real-time, and sending the eReferral. Each step is described, with an associated screenshot of the BISEP desktop icon (Nicholson, 2006).

Description	Screenshot			
1) GP needs to send an electronic referral would first navigate to the appropriate web page, through the BISEP desktop icon. To access the system, the GP must enter user name and password in the login screen.	Monday, 9 August 2004 BISEP Links Help Centre Our Team Contact Us Mater Home Integration of the second secon			
2) On entering user name and password GPs are presented with the referral details screen. Supposing it is a new referral the GP would click on the "Make New Referral" link in the Referrals row	Matrix Referral List Notices Help Centre Log Off Preview Brisbane Inner Southside eReferrals Project - BISEP eReferrals Desktop New Referrals Brisbane Inner Southside eReferrals Project - BISEP eReferrals Desktop New Referrals Brisbane Inner Southside eReferrals Project - BISEP eReferrals Desktop New Referrals Brisbane Inner Southside eReferrals Project - BISEP eReferrals Desktop Administration - Marigiation Links Practice Details - Edit Practice Details Nervigation - Edit Practice Details Nervisation - Edit Referral datais Nervisation - Edit Referral Nervisation - Edit Referral Nervisation - Edit Referral Nervisation - Marke New Referral New Current Referrals - Oncel Acive Referral Very Current Referrals - Oncel Acive Referral Variation - Eactel Acive Referral - Edit Mobile messgaing details Update Referral - Oncel Acive Referral - Edit Mobile messgaing details Update Referral - Oncel Acive Referral - Edit Mobile messgaing details Update Referral - Oncel Acive Referral - Oncel Acive Referral			

3) On selecting new referral from screen 2, the GP is presented with the appointment booking screen. Here the GP follows a step by step instruction on how making an appointment, by booking time and date, and then attaching the referral form, which can be in either word or pdf format. The referral form is attached in the same manner as attaching a document to an email. The last step in a confirmation from the hospital for the appointment that the GP has booked.



Appendix C-Making a GP referral using a clinical protocol (template)

What follows is a description of the steps that a GP takes; in sending a referral in SCI Gateway from a GP system. Each step is described, with an associated screenshot of the system (Borland, 2009).

Description	Screenshot	
1) GP's in Scotland can access SCI Gateway via various GP administration systems. In this screen, access to SCI Gateway via GPass (General Practise Administration for Scotland). By clicking on the SCI tab, the GP will have access to the Gateway. Other GP practise systems in Scotland that interact with NHS Gateway, through the web based referral application are EMIS, InPS Vision and Ascribe	Consulting Room Patient: Eliteren Ackland Import Import	
2) GP's can enter the SCI gateway by clicking on the NHS Scotland logo.	Consulting Room Patient - Eilleen Ackland Image: Elleen Ackland Ver Heb Elleen Ackland Hoghsis P Socremigis Weights Hoghsis Name: Elleen Ackland Elle 2007/80/43 BP. [12] Height (100 m, Belly: [0] Des: 2007/9787 See F Image: Ellevin Ackland Addext: 123 Anywhen Struct Ellevin Ackland Ellevin Ackland Addext: 123 Anywhen Struct Ellevin Ackland Ellevin Ackland Addext: 123 Anywhen Struct Ellevin Ackland Ellevin Ackland Des: 2007/9787 Allergy: 1 If 'I':: perioditin aflergy Previous Encounter History Care Management SCI DES ALD CALM Reminder Weckonse to the SCI Gateway Socretion Socretion Socretion Socretion Socretion	







12) Under the Examination tab, the GP can enter information relating to patient examination	Stateway - Referrat - Microsoft Internet Explorer For Message: Petery examination Additional Circle Data Past Medica / Penny History Medication Relat/Alertia Denographics Administration Camination Weight Loss Additional Circle Data Past Medica / Penny History Medication Relat/Alertia Denographics Administration Weight Loss Additional Mass Rectal Lesion Postbore FOB Anaema Hib level Other Comments Protocol Verified* Protocol Verified*
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13) This tab allows GP's to enter additional clinical data, with GP's name and practice address.	Image: Start Image: Medical Content of the Start Image: Start Imag
14) This tab allows GP's to enter patients past medical and family history.	Sci Cateway - Beterral - Microsoft Internet Explorer (ery Message: Hatory teamation Addonait Clinical Date Part Media (Freely Hatory Media Rein Reinfarder) Act Colverse Lat Protocol (VR10-3.2) Past Medical / Family History Pre-existing Conditions (High and Medium priority) Conductor Istan Diabetes mellius Network in Braid (Internet Explorer) Conductor Istan Diabetes mellius Network in Braid (Internet Explorer) Conductor Istan Diabetes mellius Network in Braid (Internet Explorer) Conductor Istan Diabetes mellius Network in Braid (Internet Explorer) Conductor Istan Diabetes mellius Network in Braid (Internet Explorer) Conductor Istan Diabetes mellius Heigh priority<



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Appendix D-Hospital as recipient of GP referral worklist

This appendix describes the functionality available to hospitals as recipients of GP referrals, in handling the patient work list within SCI Gateway (Borland, 2009)











Appendix E-GP practice referral worklist

Appendix C describes general functionality available to GP's within SCI Gateway, in working with worklist referrals (Borland, 2009).









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Appendix F-Making an electronic referral using Early Referral Application

ERA is a web-enabled electronic referrals system with a decision support module to support General Practitioners in identifying those patients with suspected cancer that should be referred under the two-week standard outlined by the Department of Health's "Referral Guidelines for Suspected Cancer". ERA is being integrated with hospital and primary care computerised systems to form part of the NHS Information Authority's electronic cancer referrals project. What follows is a step by step description in making an urgent suspected cancer referral from GP to secondary care (InferMed, 2009)

Description	Screenshot	
1) To make an urgent referral for a suspected cancer. The GP would first access the ERA website.	28. Exp to former & Optications Windows Returned Explore Implified on the Application ERA - Early Referrals Application Implified on the Application ERA - is an web-mailed decision: referrals system with a decision support module to support Support Office of Early is a support of the MSD Extension and the optical system of the Application Important notice: Important notice: The chical guideline constrained for the SND Extension and the SND Extension and the for and the optical system of the SND Extension and the former is a second of the SND Extension and the second of the SND Extension and the second of the SND Extension and SND Extension	
2) To log into the ERA application, the GP must enter password	State for future information wires close to any inexplores information any Image:	





Appendix G-List of the state-of-the-art referral systems

Overview of Australia's Health Services

Australia's healthcare system is based on a 3 tiered partnership between the Australian federal government, the six states and two territory governments, and local governments based on geographic areas. The Department of Health and Ageing (see Figure G), provides a range of services, such as national policies and outcomes, national leadership, and funding of national and local services. Among the department's responsibilities is to develop a National Primary Care Strategy to ensure that the population are provided with the care required. The strategy should address how best to deliver healthcare to families across the country, with priorities that include:

- Better rewarding prevention.
- Promoting evidence-based management of chronic disease.
- Supporting patients with chronic disease to manage their condition.
- Supporting the role GPs play in the health care team.
- Addressing the growing need for access to other health professionals, including practice nurses and allied health professionals like physiotherapists and dieticians.
- Encouraging a greater focus on multidisciplinary team-based care, (Australian Government Department of Health and Ageing, 2009)

The primary source for health funding in Australia is from taxation. There are a large number of services, regulatory bodies, and funding bodies. Services are provided by hospitals, health professionals, medical practitioner, government and non government agencies. Healthcare funding is provided by the Australian Government, health insurers, individual Australians, state and territory governments, and a number of other institutions. The Australian Government funds approximately 70% of total health expenditure in the country, two-thirds of which is provided by the Australian Government, and the other third from the state, territory and local governments, (Australian Government Institute of Health and Welfare, 2004).



HEALTH AND AGEING ORGANISATIONAL CHART May 2009

Source: Australian Government, Department of Health and Ageing

Figure G: Structure chart of department of health and ageing (Australian government department of health and ageing, 2009a)

The Brisbane Inner South E-referral Project (BISEP)

The Brisbane Inner South E-Referral Project (BISEP) developed an application which allowed General Practitioners, from their desktop, to successfully search for and book an available hospital outpatient appointment for patients with suspected cancer, send the referral electronically, and inform the patient of both the appointment and referral during the consultation. The start of the project began by establishing the Brisbane South Centre for Health Service Integration (BSCHSI), to act as Queensland's GP-Hospital Integration Site in 2003. The project had the collaboration of multiple organisations involving Queensland Health, through Brisbane South Community Health Service, the Brisbane Inner South Division of General Practice and Mater Health Services. All of these organisations worked to facilitate the development of an integrated health care approach. An important component of the integrated information management process for the BSCHSI was to capture requirements from hospital and community, to offer suitable access to appropriate hospital assessment and care for patients with suspected cancer (Nicholson, C., et al., 2006).

IBA Health Ltd was commissioned by BSCHSI in 2004 to pilot an electronic online referral and booking system. The pilot project was named "the Brisbane Inner South E-Referral Project (BISEP), and funding

was provided by the Commonwealth Department of Communication, information Technology and the Arts. The existing process of referral from GP to hospital (see Figure G1), was a manual and time consuming process. The initial goal in the pilot was to examine the feasibility of electronic referral and booking from General Practioner PCs to the Mater's outpatient department (OPD) (which specialises in acute oncology assessment and referral). The main function of the system is to allow GPs to refer and make urgent bookings for patients that were deemed Category 1 patients (these are patients with suspected cancer, which need to have an appointment made within 30 days) within the Mater's specialist OPD, book and confirm the appointment, while the patient was still with the GP, and then attach to the appointment an electronically generated referral, for the appropriate hospital specialist. The main objectives of the BISEP were as follows:

- Improve effectiveness in health service delivery, via the creation of an effective means to e-refer and ebook from the GP PC.
 - o Decrease the time taken to access an initial appointment when the provisional diagnoses is cancer
 - Improve information sharing
 - Decrease duplication of tests
- Improve the patient experience by decreasing anxiety around accessing appointments.
- Improve health professional satisfaction with health service delivery, for GP and OPD clinicians and administrative staff (Nicholson, C., et al., 2006).



Source: Mater clinic presentation: Building electronic linkages between hospital and community healthcare providers. Caroline Nicholson, Business Manager.

Figure G1: Manual referral process (Nicholson, C., et al., 2006)

Functional features

A total of 20 General Practitioners from, the Brisbane Inner South Division of General Practice, were invited to participate in the project. The common profile, of each of the GPs invited, was that they had broadband access and used clinical software applications in their consultations. In order to participate 19 out of the 20 GPs agreed to have their PCs configured by the Divisional Information Technology Officer. The duration of the BISEP was 12 months, consisting of three separate phases:

- Design phase-creating user interface screens, electronic storyboards, detailed technical architecture, API definitions and logical/physical data models.
- Development phase-final user interface, develop code, integration test, system test.
- Deployment phase- final launch of application.

All three phases listed above were completed in an eight month time period. Training for GPs and hospital OPD staff took 2.5 months to complete, and 1.5 months for reporting and evaluation of the system. The system was tested between the 12th of January 2005 and 18th of February 2005. The system went live on the 18th of February 2005, with training for GPs, and installation of the system continuing until early May 2005.

The introduction of the BISEP system required that all stakeholders, GPs, GP administrative staff, clinicians, and hospital OPD, adapt to changes in the way that information is transferred from GP to hospital OPD, and the administration of that information. Changes to the way staff worked posed significant challenges for the Project Manager and project sponsor. To ensure project success, the project manager met with all stakeholders to highlight the benefits of the system in providing patients with easier and faster access to specialist appointments and assessments. Stakeholder's involvement and input was instrumental in developing best practice clinical guidelines, and optimising the current process, by re-engineering GP, OPD workflows (see Figure G2). The project also introduced referral guidelines, which were adapted from the NHS "Guidelines for urgent referral of patients with suspected cancer", (Department of Health, 2009). The redesign and incorporation of the referral guidelines involved input from all stakeholders, including cancer services, Directors of Medicine, Surgery and cancer services, OPD staff, and Mater Leadership team. The referral guidelines were finalised in January 2005, having been fully agreed by all stakeholders.



Source: Australian Health Review August 2006 Vol 30 No 3

Figure G2: Optimising current referral process (Nicholson, C., et al., 2006)

Technical features and architecture

One of the requirements of the electronic referral systems is to give GPs access to the Mater appointment management system. This access would allow the GP to view available clinic time slots, book an appointment for the patient and upload their referral details.

To implement this requirement irwinSolutions was commissioned, to make use of their scheduling product, SmartAPPOiNT, which is a rules based scheduling tool. The architectural set-up of the system consisted of a server within the Mater demilitarised zone, which hosts the SmartAPPOiNT scheduling application. GP access to the scheduling product is facilitated by a firewall, which also works to protect Mater's local area network. The client computer represents the GPs access to the scheduling product via a firewall. Mater's Plexus appointment system is linked to SmartAPPOiNT via a web service. Plexus provides GPs with real time information on available slots for specific OPD clinics (see Figure G3).



Figure G38: BISEP architectural framework (Nicholson, C., et al., 2006)

Other than booking an appointment, GPs are also capable of uploading their patient's referral into SmartAPPOiNT. The security of the system consisted of a 2 part authentication process, as follows:

- Lightweight Directory Access Protocol (LDAP) authentication, and
- Public Key Infrastructure (PKI) web certification. All GPs participating in the project had their PCs installed with Medicare Australia's Health eSignature Authority (HeSA) PKI.

With the new system in place, GPs wanting to refer a patient to the Mater OPD, would click on the BISEP desktop icon (see Figure G4); enter their user name and password. The system would then allow the GP to book a date and time for the patient in real time, and then attach the referral document and send it electronically to the hospital. See Appendix B which provides a detailed screen description of a GP making a referral via the BISEP eReferral desktop.


Source: Mater Clinic presentation, "Building electronic linkages between Hospital & Community Healthcare providers", Caroline Nicholson, Business Manager.

Figure G4: Online access to BISEP (Nicholson, 2006)

Evaluation and lessons learned

This section evaluates the system and outlines the main lessons identified.

The three main objectives were evaluated by means of an audit and survey. The responses were scored on a Likert-type scale of 1-5, with "strongly disagree"=1 and "strongly agree"=5 (neutral=3).

A pre-evaluation audit was undertaken of new referrals categorised as urgent in the 2002-2003 financial year to the clinics that would be targeted in the BISEP pilot (n=301). The audit demonstrated that the referrals took, on average, 5.0 days to achieve an OPD booking.

The average percentage of DNA (did not attend) for the initial appointments for clinics targeted in BISEP was calculated at 27% (Nicholson, C., et al., 2006).

A post-pilot evaluation was conducted and included the following:

- GP satisfaction survey
- Patient satisfaction survey
- Hospital specialist staff satisfaction survey
- OPD audit of patient referrals (n=6) sent via the BISEP application

Evaluation of the 3 main objectives: (Nicholson, C., et al., 2006)

• Objective 1: Improve effectiveness in health service delivery.

Over the 11-week live phase of the pilot, a total of eight GPs attempted online booking and referral. All real patients (n=6) were successfully booked an appointment electronically and had an e-referral attached. The e-booking and e-referral to Mater OPD was achieved instantly compared with five days of the pre-pilot.

• Objective 2: Patient satisfaction

Patients agreed that they understood what was planned for their care at all times; received information from health care professionals that was easy to understand; believed that staff maintained confidentiality and respected their privacy; that their GP was up to date with issues relevant to their health; and that their GP had received all relevant information about their condition from the Mater hospital (see Table G).

Table G: Patient satisfaction survey (Nicholson, C., et al., 2006)

Satisfaction criteria Mean (SD)

Regarding the care you have received for your condition from health care staff at the hospital or in your general practice related to your recent referral and assessment:

I understood what was planned for my care at all times	4.5(0.837)		
The information I received from the health care professionals was easy to understand	4.33(1.211)		
I was sometimes anxious not knowing if I had an appointment or not at the Mater hospital	3.17(1.472)		
I needed to have a number of my tests repeated at the Mater hospital because the results were not available from my GP	2.67(2.082)		
I believe staff maintained confidentiality and respected my privacy	4.80 (0.477)		
My GP has been up to date with current medical information/ issues relevant to my health problem	4.67(0.516)		
I believe my GP got all the information that he/she needed about my condition from the Mater hospital (e.g. test results)	5.00(0.00)		
General satisfaction			
I am satisfied with the care I received for this condition in the past 6 months	5.00(0.00)		

I believe the necessary information about my condition was smoothly transferred between my GP and the Mater hospital health care team

• Objective 3: Improved health professional satisfaction

GP satisfaction: GP satisfaction with BISEP was high overall all (see Table G1).

Hospital specialist staff: Four of the five consultants returned a completed questionnaire (response rate, 80%). Hospital specialists, while supportive, noticed little difference in the processes from their perspective, as most of the change related to processes before consultant assessment. There were a high proportion of "not applicable" items in all questionnaire areas. In four questions (See Table G2) there was a response rate \geq 50%. Hospital specialists agreed that BISEP had increased their confidence that referrals were being efficiently auctioned, and that it made the referral process as easy as possible for the patient.

Table G1: GP satisfaction survey results (n=16) (Nicholson, C., et al., 2006)

Satisfaction criteria	Mean (SD)			
Being involved in the e-booking and referral project				
Increased the amount of collaboration I have with members of other health professions/sectors/my division of general practice	3.88(1.025)			
Supported more efficient information sharing between hospital and community providers	3.94(0.998)			
Promoted an approach which values teamwork between health professionals in the hospital and community	4.13(0.885)			
Has saved me time in referring my patients to the Mater OPD	3.75(1.612)			
Promoted an attitude of respect for the opinion of health professionals in other health settings	3.88 (0.885)			
Contributed to a feeling of increased trust between hospital and community	3.88(0.806)			
Tools for this project have				
Given me an improved form/referral template for patients with suspected cancer	3.75(1.183)			

Provided me with useful guideline to assist in booking urgent appointments for patients with suspected cancer	4.19(0.981)			
Provided me with a new electronic OPD referral approach that is technically easy to use	4.06(0.929)			
Through participation in the project				
I have been adequately prepared/trained for this new approach	4.38(0.518)			
The new approach to the Mater OPD booking reduces test duplication for the patient	4.13(0.835)			
The new approach to Mater OPD booking s makes the best use of health professionals time	3.88(1.246)			
I believe the new process delivers best patient care	4.38(0.744)			
I believe the new process improves the timeliness of Mater OPD bookings	4.62(0.518)			
The BISEP process has				
Increased my confidence that my referral is being actioned	4.50(0.535)			
Made the referral process as easy as possible for my patients	4.62(0.518)			
Made little difference to booking a Mater OPD appointment	1.75(0.707)			
Improved the quality of information sharing between hospital and community providers relevant to patient care and safety	3.88(1.356)			

Table G2: Hospital specialist survey results (n=4) (Nicholson, C., et al., 2006)

Satisfaction criteria	Mean (SD)
The BISEP process	
Has increased my confidence that referrals are being efficiently actioned	4(1.00)
The information I received from the health care professionals was easy to understand	3.67(0.577)

I was sometimes anxious not knowing if I had an appointment or not at the Mater hospital	3.33(1.528)
I needed to have a number of my tests repeated at the Mater hospital because the results were not available from my GP	3(1.00)

There are some key lessons to be learned from the implementation of BISEP.

Change Management

- 1) Effective communication between project manager and key stakeholders (hospital administration staff, clinical staff, and project sponsor) is vital in embracing new approaches and changes to organisational practice.
- Involvement, commitment and collaboration of clinicians, managers and administrative staff contributed to the business process re-engineering, the development of best practice clinical guidelines, and mapping both current and proposed OPD workflows.
- 3) A change management plan that can demonstrate the realisation of IT benefits and to identify stakeholders whose commitment/ action is needed to achieving these benefits.

Overview of Finland's Health Services

The health care system in Finland is entirely financed by compulsory taxes, which covers all of the health demands of the country's population. The central government and municipalities are the key actors in the organisation of health care. At the national level, the Ministry of Social Affairs and Health, is responsible for creating healthcare and social care legislation and ensures that they are monitored. At the local level, the three main actors are the executive board, municipal health committee, and council, who are responsible for making decisions on the planning and organisation of care (see Figure G5). Municipalities are also responsible for health promotion and disease prevention, primary medical care, medical rehabilitation and dental care. There are 20 hospitals districts, located within the country, each of which is a federation of municipalities responsible for arranging and coordination specialised care within their area (WHO, 2008). Currently there are 448 municipalities. These municipalities receive a subsidy from the government in order to organise the services they are responsible to provide.



Source: WHO regional office for Europe, 2008. Health systems in transition-Finland health system review.

Figure G5: Finland's health care system (WHO, 2008)

Oulu University hospitals e-referral system

Oulu University hospital is a tertiary hospital that lies in the north of Finland. It is one of the three hospitals of the Northern Osrobothnia Hospital Districts, and is responsible for the treatment area of 5 hospital districts, (see Figure G6), and thus covering the largest responsibility area in the country, nearly half of the Finnish country, and extending its services to the arctic regions (Reponen, 2004). The NOHD is made up of 39 member municipalities, with more than 386,000 people living within the NOHD, and 729,000 live within the special health care region. The existence of large areas of land and sparse population has made Oulu University Hospital become pioneers in the development of Telemedicine and ehealth services in the country.

The creation of a regional health services network between primary and secondary care is an important strategic target for Oulu University Hospital (OUH). The strategic focus has included the development of e-consultation tools such as:

• Teleradiology.

- Video consultation services
- E-Learning services for clinicians, and
- Electronic communication between primary and secondary care.

OUH has identified electronic referrals as being an important tool in the sharing of multidisciplinary patient information between primary and secondary care providers (Reponen, J., et al., 2004).



Source: Northern Ostrobothnia Hospital District Website

Figure G6: Northern Ostrobothnia Hospital district (NOHD, 2009)

Functional features

OUH's main purpose in implementing an e-referral system was for the selection of patients who needed to attend secondary care. Helsinki University Hospital also developed an e-referral system with the same purpose of making an electronic transfer of patients from primary care to secondary care (see Table G3)(Wootton, R., et al., 2003, p.77).

The OUH primary care referral and consultation network project was developed within the public healthcare system. What started initially in 1991 as a teleradiology consultation network, expanded later in 1999 to take into account e-referral services between EPR systems at the university hospital and primary care centres of the region. The e-referral provided by OUH for patients covers referrals in paediatrics, radiology, ophthalmology, neurology, psychiatry, dermatology, and gynaecology. E-referrals in psychiatry and surgery are combined with real-time video consultations. The electronic referral service has extended to a number of general practice offices and other hospitals in the Oulu region, with 12 out of the 17 different university clinics providing e-referral services. The rollout of the e-referral services has been successful, due to the planning, education and training, provided by a special team made up of a primary care physician, university hospital physician, and a nurse, to clinics in the region. Their focus has been on providing training for the changes to the workflow, from primary to secondary care (Reponen, J., et al., 2004).

System Operator	Approximate starting date	Purpose	Number of referring sites (type)	Number of specialists	Number of e- referrals per year
Oulu University Hospital (Finland)	1991(extended 1999)	Transfer and consultation	10 (primary care centres)	100	2000
Helsinki University Hospital (Finland)	1990 (extended 2002)	Transfer and consultation	200 (General Practitioners)	100	60,000

 Table G3: Finland's e-referral systems (Wootton, R., et al, 2003)

Technical features and architecture

There are two different ways to use the OUH e-referral and discharge letter services; either in the form of a standardised XML language message between the EPRs, or as a secure web link. The current XML message for e-referrals, e-consultations and discharge letters has been adapted by all of the major EPR suppliers in Finland. The primary care physician can use his own EPR to type in the e-referral and patient consent, and can also attach additional information in the form of PDF files. After the message is sent, the physicians at the university hospital can read the information using their own web-browser EPR. An ereferral can be turned into an e-consultation, sent further to another department, or returned to the sender. After the treatment, the referring physician receives an electronic discharge letter into his, or her, own system, provided the patient has allowed that. The alternative Web link interface gives the primary care physician extended access to patient information in the hospital information system. If the patient has given his or her permission, the physician can read all of the multimedia information relating to a particular hospital visit. All narratives, laboratory results and full resolution radiological images are available on-line. The web links also make it possible to follow the referral workflow and waiting time. All of the connections are protected from intruders. The primary health care centres are connected to the university over either a virtual local-area network (VLAN) or a virtual private network (VPN) (Reponen, J., 2004). See Figure G7, which outlines the functionality of the e-referral system and system architecture.



Source: presentation by Jarmo Reponen MD, eHealth 2005, Tromsoe, Norway. "Mobile Solutions in the health sector in Finland. © Jarmo Reponen 24.5.2005

Figure G7: E-referral system architecture (Reponen, J, 2005)

Evaluation and lessons learned

This section evaluates the system and outlines the main lessons identified.

Based on the findings of a user questionnaire submitted to all users of the Oulu University hospitals ereferral system, e-referrals have saved time and increased productivity in the referral management of patients. The advantages of the system are as follows p

- E-referrals improve the quality of management: each is now registered electronically and its progress can be followed.
- Secure communication of data using nationally agreed standard XML and SSL for encryption.
- Physician can answer a consultation from anywhere in the hospital network without visiting their own office.
- The direct access of the hospital patient record provides an overview of each hospital visits and serves as feedback mechanism to the primary care physicians.
- The reduction of medical consultation time by 44-49% compared to a conventional consultation.
- The system allows more patients to be treated at lower costs, while increasing productivity three-fold.

There is however areas of improvement needed for the Oulu University hospitals e-referral system; they have been identified as follows:

• Workflow development is still immature

- A comprehensive regional database would be better alternative for storing additional information to the separate PDF attachments.
- There is no official electronic signature in Finland, patient consent forms have to be stored on paper at the originating site.
- More harmonisation is needed between the guidelines from different clinics.
- Challenges in providing adequate user training due to the many integration solutions changes undertaken during the roll out process.

United Kingdom

Overview of Scottish Health Services

Scotland's e-health vision and strategy

Since the SCI gateway is a component of the overall e-Health strategy in Scotland, it is therefore imperative, to get an overview of the countries vision and strategy in terms of delivering healthcare to the wider public.

The NHS Scottish vision is based on the Better Health Better Care action plan, initiated by Nicola Sturgeon, MSP Deputy First Minister and Cabinet Secretary for Health and Wellbeing.

"This vision takes advantage in general of information technology and in particular electronic information to ensure that patients receive the appropriate care, at the right time, with the appropriate health care professionals, to achieving the right outcomes." The vision is therefore a combination of optimising current processes and adaptation of technology (Scottish Government, 2008).

NHS Scotland has identified 6 strategic principles that will support the work needed to achieve the vision, they are as follows: (Scottish Government, 2008)

1. Confidentiality safeguards are an obligation

This deals with measures to find a balance between the security of information systems, and their availability. Electronic records can address the problem of paper based records, which are not secure, easily lost or misplaced, and accessed by the wrong person.

Electronic records, albeit effective introduce new challenges, such as protecting access to authorised people within the organisation, and the creation of profiles of people who have restricted or full access to these records. In order to adhere to patient confidentiality and data protection, the following points are part of the ongoing initiatives of designing and delivering improvements:

- Access to information must be based on legitimate reason and the interests of the patient
- Key stakeholders are the public, patients and healthcare professionals

2. Continuing an eHealth journey, exploiting what exists and filling gaps

The approach to eHealth is based on taking small incremental approach, as opposed to taking on a larger national IT project. So it will work by addressing the existing gaps, by replacing the large number of existing paper-based processes, and older systems that do not meet NHS Scotland goals. This will require integration with existing systems, and a priority of the eHealth project.

3. Focus on benefits, supported by technology and change

Patient benefits before technology – eHealth see technology as a tool to assist patient care, and is driven by the clinicians and healthcare professionals who provide the benefits. They are also the stakeholders in designing and using the technology to improving outcomes of care. NHS has already invested in training and change management initiatives to support stakeholder involvement and adaptation of change projects.

4. Virtual, not a large single database, electronic patient records (EPRs) in direct care

Health care professionals require comprehensive patient information. Currently patient information is captured in a number of EPRs. There are a number of approaches to solve this challenge. One is to create a single national database that can be accessed by all clinicians. However the approach adapted by NHS Scotland is to develop a clinical portal that extracts all required patient information from existing EPRs and presents those as one consolidated view. This is based on the incremental approach, and gives NHS Scotland more insight on the types of information clinicians find useful.

5. Technology development, standardisation and convergence

The subjects supporting the development of the technology and standards which support eHealth will be:

- focus on ease of use;
- convergence on fewer and more re-usable, cost-effective IT systems;
- integration between systems, internal to the NHS and with partner agencies where appropriate;
- common data standards and terminology across information systems;
- value for money;
- Whether a national service or local choice will be considered on a case by case basis.

6. Collaborative approach to delivery, drawing on best expertise (Scottish Government publications, 2008).

This is discussed in detail in section 1 of the Better Health, Better Care action plan. This outlines how both national and local organisations need to work together for the common good, and how NHS Scotland targets improvements in eHealth.

Scottish Care Information Gateway (SCI Gateway)

The SCI gateway application is a national portal, created to facilitate clinical communication between primary and secondary care, and communication within health care organisations. The SCI gateway was implemented by the National Information Systems Group (NISG). The NISG group is part of the National Health Services Scotland (NHS Scotland), and the SCI gateway is a fundamental deliverable of the Scottish e-Health Strategy 2008-2011. The SCI Gateway project, although it commenced in January 2001, is still ongoing, and became operational in June 2001. The SCI Gateway is made up of a national Steering Group, which is made up of team members from each of the fourteen Health Boards (see Figure G8), who act as a bridge in linking local user groups to the national development team



Source: Scottish Government Publications, www.scotland.gov.uk/publications/2008/04/01091641/11 Figure G8: Map of Scotland showing health board regions (Scottish Government publications, 2008a)

Functional features

The SCI Gateway application is hosted by Atos Origin Alliance, who is NHS Scotland's services partner. The project structure is made up of SCI Management group, the Steering Group, the Infrastructure Project Board, and Atos Origin Alliance. The Steering Group and Infrastructure Group are linked together by SCI Management Group. The relationship with Atos Origin Alliance is administered by the Infrastructure Project board.

The SCI Management Group also coordinates all activities to ensure they are in line with the national strategy, and ensures that there is compliance with the SCI programme. The project methodology used is PRINCE2 (PRojects IN Controlled Environments) is a process-based methodology for project management. Project implementation is conducted by the fourteen eHealth Project Managers, and their teams. The Project Managers in turn are supported by two implementation Managers. The Project Managers are responsible for the development of referral templates, and the administration. The main source of funding has been regional public, with an estimated project size of implementation between \in 1,000,000 and \in 5,000,000 (Caldwell, 2008).

Making a referral using a clinical protocol (template)

The current version of SCI Gateway is 12.1, which now allows the referrer to record favourite destinations in a similar way to Internet Explorer. The use of the term "protocol" within SCI Gateway is misleading as in this context it refers to an information template, not a protocol in the clinical sense of the word.

The SCI Gateway product enables electronic communication of clinical data between organisations within the NHS Scotland. These communications take the form of XML (eXtended Mark-up Language) messages compliant with published NHS XML schemas.

Currently six such schemas have been established.

- "referral.xsd" for Referral messages
- "discharge.xsd" for Discharge messages
- "general.xsd" used by both the referral and discharge schemas
- "eGPFR-Request.xsd" for eGPFR request messages
- "eGPFR-Response.xsd" for eGPFR response messages
- "eGPFR.xsd" used by both the request and response schemas

A method that the SCI Gateway implements to create these clinical messages is known as "protocol-based



Figure G9: How protocols are used by the SCI Gateway (National Services Scotland, 2007)

referrals", but can be applied equally well to other communications such as discharge messages or responses. A "protocol" is the definition of the data requirement and structure for these clinical communications. With SCI, protocols are defined as XML documents that are "transformed" to web data entry forms (see Figure G9). The protocol definition contains a set of questions that capture the demographic and clinical data required for the communication. The SCI Gateway transforms the XML into an HTML data entry form. See Appendix C which describes a GP referral using a SCI clinical protocol

(template) (National Services Scotland, 2007). Appendix D, and Appendix E describe how hospital use the referral GP worklist and the worklist sent from hospital to GP respectively.

Technical features and architecture

There are two components to SCI Gateway:- a messaging system, which uses the National Services Directory as essentially a set of mailboxes and a web based referral application. The messaging system uses 128 bit Secure Socket Layer (SSL) encryption and is accessed via NHS net or N3 connections. Messages can be sent from third party systems via SCI Gateway either as an xml message generated within the third party application or via the web based referral application. The messages can contain structured and unstructured information and are validated against various schemas in use in Scotland. For example, the national Bowel Screening Service (BoSS) software is able to generate a referral message, without the use of the web based referral application, and send this to the appropriate service within each Health Board via SCI Gateway.

The GP practice systems in Scotland (Gpass, EMIS, InPS Vision and Ascribe) interface to SCI Gateway through the web based referral application. The referral application contains a number of xml referral templates. These templates are locally configurable and are "owned" and developed within each Health Board. All of these templates are pre-populated with patient data from the GP practice system. Much of this is configurable and will generally contain: (Borland, 2009)

- Patient demographics
- Registered and referring GP details
- Past Medical History (filters can be applied to dates and Read codes to include or exclude specific information)
- Family History
- Current and recent medication (filters are template specific so can be customised e.g. prescribed within the last 60 days, 90 days etc.)
- Risks and alerts e.g. smoking, alcohol consumption
- Allergies

Unwanted information is easily deleted prior to sending the referral and additional information quickly and easily added. Key data items can be made mandatory e.g. CHI – the patient identifier in Scotland.

The most common referral template is known as the "generic or general" template, which contains the above information plus a free-text area to record the details of the referral. This fits well with the standard business practice of the GP dictating the letter, the secretary typing it up allowing the GP to check it prior to sending. In addition, many Health Boards have developed additional referral templates for specific clinical conditions, suspected cancer being a common one. The template can include tick boxes, radio buttons, dynamic tables, drop-down values and free-text areas. Supporting documentation can also be attached to the referral message e.g. test results, photographs, word documents and so forth. Although the majority of the referrals are completed by practice administrative staff following the GP's dictation, an increasing

number of GPs are completing the referral themselves, particularly where the clinical condition based templates consist of tick-boxes, radio-buttons and drop-down lists (Borland, 2009).

The application also supports the redirection of referrals delivered to the wrong service or location and tertiary referrals. Tertiary referrals can either be generated by logging onto the application stand-alone i.e. not through another application so populating all the information from scratch or, if a GP or other referral to the secondary care service already exists, this can be used to partly populate the tertiary referral template with the original referral letter being sent as an attachment. So, for example, if a GP sends a referral to Glasgow Royal Infirmary and the consultant at GRI decides to make a tertiary referral to the Beatson West of Scotland Cancer Centre, he/she can access the GP referral on the SCI Gateway worklist and attach this to the new tertiary referral. The tertiary referral template will also be pre-populated with the patient demographics and GP details. The advantage of this is that the tertiary centre will receive the consultant and the GP letter at the same time. This can be of enormous benefit where target waiting times are applied.

Because the information sent via SCI Gateway is validated against the relevant schemas, it can be harvested by downstream systems. A copy of the message can be automatically sent to administrative and clinical systems, reporting tools and data repositories including local storage systems.

Each message sent appears on the SCI Gateway work list and contains a "status" and flags, which indicate the position of the message in terms of patient flow. Some of these are set automatically by the application and some are configured locally. When the send button is pressed the message is immediately available to the recipient which speeds up the patient journey. When the message is viewed or printed by the recipient, the sender can see this on their view of the work list. Third party systems can also provide additional information. For example, when the referral is vetted or the patient added to a waiting list, the outpatient management system can automatically send a status update of "Vetted" or "Waiting List" to the record on the work list. The GP practice will be able to see this status as soon as it is applied by the recipient. Although basic, this functionality enhances two-way communication. Some acute hospitals apply a status to indicate when an appointment has been made for the patient and have estimated that this has reduced the number of telephone calls to the medical records department from the GP practices by up to 90% (Borland, 2009).

Access to patient information on the SCI Gateway worklist is controlled by various permissions and access protocols. These are managed locally within each Health Board as is the user administration. The message itself is stored on a central database. A single web based system means that everyone is on the same version. Upgrades are dealt with centrally which minimises client maintenance. Through interfacing with other systems, both within and out with the NHS, SCI Gateway enables the immediate delivery of a wide range of message types including Referrals, Inpatient Discharges (Immediate and Final Discharge Letters), Outpatient Clinic Outcome Letters, Department of Work and Pensions GP Factual Reports, Clinical Advice messages and much more (Borland, 2009).

Evaluation and lessons learned

SCI gateway is a component of the overall e-Health strategy in Scotland, it is a national portal, created to facilitate clinical communication between primary and secondary care. What follows is an evaluation of SCI gateway and lessons learned. The analysis is based on information gathered from interviews and literature review.

• Messaging standards

 The use of electronic documents that comply with nationally agreed standards and national XML information definitions.

• Secure communication

 SCI gateway uses secure internet technologies such as HTTPS and HTTP Secure Socket Layer (SSL), for data encryption.

• Schema and template based referrals

- 3) The templates within SCI gateway allow physicians to enter demographic and clinical patient information.
- 4) Clinical referral guidelines and key on-line resources are available for physicians to assist in their patient referrals.
- 5) Data can be populated form GP system, which minimises the need to manually type data into the referral form.
- 6) The system supports multi-user workflow functionality to assist primary care working practices.

• Integration (General Practitioner systems)

- 7) The SCI gateway can be available from within the GP system.
- 8) Patient clinical and demographic data can be auto inserted from the GP system and into the referral form.

• Integration (hospital PAS and SCI portal)

- 9) The system can provide the GP with instant confirmation of appointment booking, thus providing the patient with a printed appointment letter before leaving the surgery.
- 10) The physician has the ability to book an appointment before a full clinical data is transmitted
- 11) The system is scalable to send discharge information to the GP including essential clinical information.

There are some key lessons to be learned from the implementation of the SCI gateway system.

• National e-Health vision and strategy

- 12) Government commitment and leadership are vital in creating a national e-health strategy that would include a strategy for a unified Irish electronic referral system.
- 13) The creation of a steering committee, whose executive team include sponsors from government and the HSE, who are responsible for driving the strategy, project goals and providing a forum in which all political issues are resolved.

- 14) The creation of a group of stakeholders, who have a stake in the success and behaviour of the health sector, and engaged in all aspects of the e-referral project (Involve clinical stakeholders and keep them informed).
- 15) Adopt an honest approach acknowledging risks and working together on solutions.
- 16) The need to capture, and resolve all political and organisational issues.
- 17) Political will is mandatory to implementing a change management programme that will focus on making necessary cultural, business process and overall organisational change.
- 18) All resources involved in ongoing e-referral projects in various Irish hospitals need to be rechannelled to assist in the development of a national Irish e-referral system. This is necessary in avoiding duplication of effort and the creation of non-integrated silos of databases and system.

SCI gateway is operational in Scotland, with future planned implementation in Northern Ireland, and a current pilot underway in Wales, making it a popular e-referral system for the British Isles.

England- Early Referral Application (ERA)

The Early Referrals Application (ERA) is a web-enabled referrals processing system, designed to support Trusts in managing requests for urgent appointments. It was developed in the context of the 2-week standard for the referral of patients with suspected cancer, although the underlying technology is intended to give the potential to support referrals for other conditions.

The application was initially piloted in Southampton and Leicestershire Hospitals. Leicestershire hospitals supported four Cancer referral forms: Lung, Breast, Colorectal and Upper Gastrointestinal Cancer. Southampton Hospitals had access to all the twelve cancer guidelines. The ERA application was developed by InferMed, a company specialised in providing software and services to the healthcare, and clinical research sectors. One of its main software products is Arezzo which is a decision support system used in the Early Referral Application.

Functional features

The main impetus for developing the ERA, was driven by the United Kingdom (UK) Government's white paper "The new NHS – Modern, Dependable" (Department of Health, 1997), which guaranteed that all patients with suspected cancer would be able to see a specialist within 2 weeks of their General Practitioner (GP) deciding that they need to be seen urgently and requesting an appointment. In their role as gatekeeper to the UK's secondary care services, GPs must identify those patients with a significant

possibility of having cancer, so that these patients can be referred while avoiding overloading hospital clinics with patients at lesser risk. The Department of Health publication "Referral Guidelines for Suspected Cancer", (Department of Health, 2009), is intended to help GPs identify those patients at greatest risk. These guidelines specify, for each of twelve cancer groups, clear criteria defining which patients should be referred under the "two-week" standard (Bury, J., et al, 2001).

The project ERA is the brainchild of Professor John Fox of the Advanced Computation Laboratory of the Imperial Cancer Research Fund (ICRF) and software development company InferMed Limited. The ERA took less than 12 months to develop, combines decision support with Department of Health Guidelines. The steps in using the system are as follows:

- 1. Patient consults General Practioner: During a consultation, a General Practitioner may be concerned a patient could have cancer. To access the ERA decision support system, the GP clicks on a button on the Electronic Patient Record which accesses a central located website. When the browser reaches the website, encoded information from the GP's machine automatically transfers the GP and patient details to the ERA server
- 2. **ERA guidelines displayed to GP:** The list of cancer referral guidelines is then displayed to the GP. Guidelines are available for several different cancer types. The GP can also select information about the content of the guidelines and about the cancer type.
- 3. Clinical Information entered into the guideline: When the GP selects a guideline, relevant patient details such as age and gender are automatically inserted into the guideline. The remaining clinical questions are presented as tick boxes that only require the GP to mouse click on the appropriate responses.
- 4. Clinical Information processed by decision support: The clinical information is then processed by the AREZZO decision support engine, which provides advice about whether and how quickly the patient should be referred.
- 5. Patient referral is transmitted to hospital clinic: If the GP chooses to make a referral, the ERA web server creates an email, including the GP and patient details, clinical information, referral decision and the rationale for the decision. The email is send to the referring hospital, directly to the team responsible for processing urgent cancer referrals. Copies of the email are also sent to the General practitioner and to the surgery.

The ERA can also be used to provide decision support for non cancer referrals, by adding guidelines as applied to cancer referral (Advanced Computational Library, 2001). See Appendix F which describes the steps and associated web screen shots in accessing the ERA and making a referral.

Technical features and architecture

The system architecture of the ERA consists of browser, web server, Arezzo software, which acts as the clinical decision support, guideline, and patient database. The application client and server interactions are managed via ASP and JavaScript. Figure G10 outlines all the components of the ERA architecture.



Figure G10: ERA system architecture (Akumanyi, 2009)

Point of care referrals are provided by the internet, by means of standard web browsers, that are driven by PRO*forma*-based decision support, guidelines, and care pathways. On the definition of PROforma, Sutton, D.R., et al. (2003,pp.433-443) states 'PROforma is an executable process modelling language that has been used successfully to build and deploy a range of decision support systems, guidelines, and other clinical applications.' The PRO*forma* language supports four main classes of task:

- *Action:* any unitary task required for a patient's care, ranging from a simple injection to a complex surgical procedure.
- *Enquiry:* an action whose principal function is to return information, from data entered in a form on a screen to a complex computer-based imaging function.
- *Decision:* any kind of medical choice, such as a decision about a patient's diagnosis, treatment, prognosis, level of risk, need for referral, etc.
- *Plan:* a set, or a sequence, of tasks carried out over time, to achieve some clinical objective. PRO*forma* is defined recursively over plans so that an application can include a hierarchical task structure of any complexity.

PROforma applications are developed using an integrated set of graphical design and testing tools, as illustrated in Figure G11.



Source: Humber, M., et al (2001). Medical decision support via the internet PROfroma and Solo [Online] Available from: ttp://www.acLicneLuk/lab/PUBLICATION/Sims36

Figure G11: PROforma design and testing tools

Solo was developed as a generic communications infrastructure, which allows clinical guidelines driven by PROforma enactment engine to be run in distributed environments such as the internet.

Solo consists of three main components, each of which helps control and validate the communications flow between the WWW client and server engine running the application. Figure G12 provides an overview of the architecture.



Source: Humber, M., et al, Medical Decision Support via Internet: PROforma and Solo. Advance Computation Laboratory, Imperial Cancer Research Fund, London, UK.

Figure G12: Solo architecture

Evaluation and lessons learned

The ERA system was developed to assist GPs in the context of the 2-week standard guidelines for the referral of patients with suspected cancer. The benefits of incorporating clinical referral guidelines and

protocols have been found to improve clinical practice and are recognised as an important means by which evidence based practice can be translated into routine healthcare (Grimshaw, 1993). Also evident is the technical feasibility of incorporating the referral guidelines using the PROforma format and of using the knowledge representation to support a web-base decision support tool.

From a purely technological perspective, it is clear that the ERA system is technically feasible; the underlining issue is the effectiveness of using decision support systems in the daily practice of patient referral. Some of the pitfalls in using decision support for ERA are:

- Manipulation of the system, i.e. once physician learn how the decision support system works, they are then capable of manipulate the outcome of the referral by entering over evaluated information.
- Litigation, i.e. physicians will be liable if misdiagnose patient and delay their early management through urgent referral.
- Uncertainty, i.e. when a physician is not sure about patient complains he/she will create an unnecessary urgent referral, to avoid jeopardising patient prognosis.

Inappropriate urgent referrals have adverse effects on the health system by misuse of resources (specialist time, medical and clerical staff). The system can minimise these adverse effects by providing training, education, awareness and feedback to referring physicians, through a monitored auditing process.

Northern Ireland-"Electronic" GP Referral Management System

Back in April 2007, plans to introduce a new referral system in Northern Ireland were put in place in order to reduce health service waiting lists for nearly 190,000 patients in Northern Ireland.

The scheme which cost €50.8 million is aimed to ensure that no patient waits more than 13 weeks for a consultant's appointment or treatment. In 2006 there were 187,000 (one in nine) people in Northern Ireland waiting for an outpatient appointment and treatment, 40,000 of these patients have been waiting more than 12 months since first seeing their GP (O'Reilly, 2006). There may be significant numbers of people suffering from conditions that may be life threatening, life limiting or at the very least have an adverse impact on quality of life. Adverse outpatient waiting figures were affecting a number of groups:

- Patients waiting considerable time for a first appointment
- Medical staff frustrated with the volume of work
- GPs trying to get their patients seen in a timely manner
- Politicians responsible for the metrics of the service
- Availability of accurate outpatient figures to health services, (Gleeson, 2007).

The then minister Shaun Woodward declared that the current system had failed both patients and health practitioners. He warned that health boards in the North could have their funding cut if they failed to provide necessary services. In April 2006, the health service in the North introduced a referral system, called the Integrated Clinical Assessment and Treatment Services (ICATS).

What is ICATS?

ICATS is a key strand of the DHSSPS elective reform programme. It introduces new arrangements for managing referrals into secondary care from GPs, and involves the use of multi-disciplinary teams to assess and, in many cases, treat patients. By performing these functions, ICATS is carrying out some of the work previously done by specialist hospital consultants, thereby ensuring that only those patients who really need a consultant will be referred to a consultant. The aim of ICATS, as part of a wider elective care reform programme, was to help reduce outpatient waiting times to 13 weeks by April 2008.

The problem areas identified and targeted were Orthopaedics, Ophthalmology and Urology. NHSSB also planned to developing ICATS models in ENT, Dermatology, Plastic Surgery, Rheumatology, Pain Management, General Surgery, Gynaecology and Cardiology. The ICATS team consists of individuals drawn from GPs with specialist interests (GPwSI), Specialist Nurses, Allied Health Professionals, and both Consultant and non-Consultant Hospital doctors, (Health and Social Care, 2009), The Services provided by ICATS include:

- Assessment
- Treatment
- Diagnostic and
- Advisory services

The following functional feature describes the ICATS process, and explains how SharePoint technology works within the ICATS process.

Functional features

Once the referral is received they are logged onto an ERMS (Electronic Referrals Management System). Referrals are then triaged by an ICATS team. Urgent referrals are booked onto consultant outpatient schedules whilst routine referrals suitable for ICATS are subject to 5 possible outcomes. The 5 possible outcomes are as follows:

- 1) The referral may require diagnostics to determine what should happen. The ICATS team will arrange the tests, review the results and determine the next step.
- 2) The referral may be suitable for direct treatment.
- 3) The team may simply provide advice to the referrer in appropriate circumstances without seeing the patient.
- 4) The referral will require a face-to-face assessment of the patient and the team will deliver this and decide the outcome

5) The referral will require a consultant opinion either routinely, or after diagnostics or direct treatment or face-to-face assessment, or because the initial referrer has appealed a decision to deliver another option. In all cases once the referral has been logged on the ERMS, and the initial triage carried out, the patient will be informed and given a telephone number to enable them to track the referral through its stages. Appointments can be made to suit the individual rather than the system, which should help to reduce DNA rates, (ICATS, 2009). Figure G13 summarises the general ICATS process flow.



Source: ICATS, 2009. Introduction to Integrated Clinical Assessment and Treatment Services. [Online] Available from: http://www.nhssb.n-i.nhs.uk/ICATS/docs/Introduction% 20to%20ICATS.pd [Accessed 23 May 2009].

Figure G13: ICATS process flow

The Electronic Referral Management System (ERMS) was deployed in order to assist the launch of ICATS services. The objectives of ERMS are: (Gleeson, 2007).

- Support the reduction of outpatient waiting times
- Support the new ICATS processes and referral management workflows
- Provide a central repository for all GP outpatient referrals
- Facilitate the targets of reviewing a referral within 3 days and advising the patient on the next step within 5 days
- Provide GP referral management functionality

- Facilitate the reporting and management of referral activity by GP, service requested clinic, consultant, and hospital trust.
- Provide for better management and reporting capabilities.

PA Consulting based in Dublin, were engaged by DHSSPS to implement the ERMS, and to deliver the following:

- A business case for an Electronic Referral Management System
- Specification of requirements for ERMS
- Assist in the design of ICATS processes and ERMS workflow
- Manage the procurement and vendor selection of an ERMS solution
- Implement ERMS for DHSSPS

The project commenced in February 2007. The total capital cost of the project was in the region of £500,000 (€581K). The project went live in August 2007, and is currently used in the Orthopaedics (McKeown, 2009).

Technical features and architecture

The ERMS solution is Microsoft's SharePoint 2007. SharePoint is an extensible and scalable web-based platform comprised of tools and technologies that collectively form what's known as SharePoint Products and Technologies. In the ERMS solution system architecture, see Figure G14, the ERMS database runs on Microsoft SQL, and uses Windows Server 2003, which is a Microsoft operating system.



Figure G14: ERMS system architecture

SharePoint includes a number of components and elements that are used within the ICATS process. What follows is a brief overview of these components and how they are used within the ICATS process.

- SharePoint Lists: Lists act as the store for the information and the vehicle for creating, adding, and sharing information from the store.
- SharePoint Libraries: Libraries are much like lists with one major difference: their intended content. Whereas lists store information about items such as events, contacts or announcements, libraries store documents. You can think of libraries as super folders that help users find files faster and easier, through the use of special properties or keywords like patient number, owner, and appointment date. Once a number of properties are added to documents, users can create special views or reports to filter, sort, and organise documents based on the properties set. GP referral letters and forms are scanned and saved within the SharePoint system as lists which are stored within libraries.
- Workflow: A workflow automates an organisation process by breaking it into a set of steps that users
 must take to complete a specific business activity, such as approving content or routing a document
 from one location to another. Automation eliminates manual tasks and reduces the chance of data
 entry errors or documents getting lost in the system. Patient information can be sent to Orthopaedics or
 clinics for assessment via the workflow in SharePoint.

Evaluation and lessons learned

The ERMS system was deployed to support the launch of ICATS services, with the main objectives of: (Gleeson, 2007).

- Supporting the reduction of outpatient waiting times.
- Supporting the new ICATS processes and referral management workflows.
- Providing a central repository for all GP outpatient referrals.
- Facilitating the targets of reviewing a referral within 3 days and advising the patient on the next step within 5 days.
- Providing GP referral management functionality.
- Facilitating the reporting and management of referral activity by GP, service requested clinic, consultant, hospital trust etc.
- Providing for better management and reporting capabilities.

Analysis of the ERMS system functionality and effectiveness was conducted by reviewing the existing literature published, interviews with Mr. Kevin Gleeson (ERMS project manager) and Mr. Brian McKeown (acting director of information systems, Department of Health, Northern Ireland). Based on this analysis the author has made the following observations:

 The ERMS is purely a referral management system that uses SharePoint technology to support the ICATS services; there is no electronic referral of information from physician to hospital. Physician send referral letter to hospital administration team, who in turn enter the referral information into the referral management system (SharePoint), therefore the term electronic is a misnomer in this context.

- 2) The fact that referral letters are send by post to the hospital implies that there is no instant physician notification of receipt of referral as in the case of an electronic referral that use email or web application. Furthermore posted referrals are prone to delay and errors such as legibility and accuracy.
- 3) There is no available information to demonstrate how the ICATS measurement criteria are used to calculate waiting times; it is not clear whether or not patients entered into the referral management system and subsequently assessed by the ICATS team are considered waiting, or not, bearing in mind that patient application can remain with the ICATS team until such time that they are seen by a specialist (pseudo impression of short waiting time).

Discussion is currently underway between The Department of Health in Northern Ireland and eHealth Directorate of the Scottish government to explore the potential of incorporating the SCI gateway portal in Northern Ireland.

Appendix H-Summary report: the cost benefit of electronic patient referrals in Denmark

What follows is a (Cannaby et al., 2004) study conducted by the Association of Charted Certified Accountants (ACCA) and the Danish Centre for Health Telematics (MedCom), at the request of European Commission Information Society Directorate-General (DG INFSO).

Purpose of Study

There is no doubt that applying information and communication to healthcare (eHealth) delivers qualitative benefits to patient care, but do they bring any cost benefits? This is the question that the European Commission Information Society Directorate-General (DG INFSO) asked the ACCA and MedCom to investigate. The study was focused on only the quantifiable cost benefits associated with the operation of electronic patient referrals in the Danish healthcare system.

The study shows that full adoption of electronic referrals will give a potential savings of €3,512,146 or €0.65 per capita.

Scope of the study

A full analysis of the cost benefits of electronic patient referrals to hospital in the Danish healthcare. Nearly 60% of patient referrals to hospital in Denmark are still sent on paper, so the study examined the difference in costs between electronically transmitted referrals and referrals by post or fax.

Findings

Comparison of the costs of each of the three ways that GPs can send referral forms to hospital (post, fax, electronically), to find an answer to the question: what is the cost difference between patient referrals that are transmitted electronically and patient referrals that are sent by post or fax?

Comparison of costs

The study found that there were significant differences in costs between electronic and paper based referrals (see Table H1).

Table H1

The difference in handling costs between the three referral process

Total handling costs €

Referral produced electronically and sent by post or fax	4.33
Referral produced and sent electronically then treated as paper copy by hospital	1.46
Referral produced and sent electronically and treated electronically by hospital	0

Table H1 shows that the handling cost of a referral sent by post or fax is \leq 4.33 more than a fully electronic referral. As 59% (or 542,899) of all referrals in Denmark are currently sent non-electronically, this suggests a potential saving of \leq 2,350,753 per year if all paper referrals were processed electronically.

Society cost

Costs linked to postal rather than electronic referrals: the cost if delay in treatment for the patient. The study found that 217,160 referrals per year are sent to the hospital by post and that these take an average of 1.33 days longer to reach the hospital than an electronic referral or fax. GPs estimate that between 5% and 10% of patients referred to hospital are classed as unfit for work at an average cost to society of €93 per day. This suggests that the increased patient waiting times caused by posting referrals could cost society approximately €1,343,026 per year.

Conclusion

Initial findings from this study suggest that widespread adoption of electronic patient referrals would be of significant cost benefit to the Danish health economy. Table H2 describes how the potential savings grow as the number of referrals sent electronically increases. The total savings to date in direct costs, with 41% of referrals sent electronically, is estimated at $\leq 1,168,825$ or ≤ 0.22 per capita.

Table H2

Potential savings	% of electronic referrals	Savings from direct costs €	Less equipment costs €	Savings from direct costs less equipment costs €	Saving per capita €
No of referrals sent electronically	0	0	0	0	0

41% of referrals sent	41	1,650,175	-481,350	1,168,825	0.22
electronically					
Additional 59% of referrals sent electronically	59	2,374,641	-31,320	2,343,321	0.43
All referrals sent electronically	100	4,024,816	-512,670	3,512,146	0.65