

**AN ANALYSIS OF HOW INFORMATION TECHNOLOGY CAN
CONTRIBUTE TO REDUCING ACUTE HOSPITAL ADMISSIONS AND
LENGTH OF STAY**

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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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Summary

Information Technology (IT) has been a part of healthcare for almost thirty years. What started out as an administrative tool to aid management and financial processes has become more and more patient centred in recent years. Huge advances in technology enabling newer ways of treatment are complimented by systems, which ensure that these technologies are supported by efficient safe procedural management. In addition information has provided a completely new way of helping to make patient care safer and more patient focused.

Increasing demands for healthcare today mean that patients cannot spend as long in hospital as in previous times. There is a need to ensure that patients have as short a length of stay as possible while at the same time ensuring that they receive the best available care and treatment. Information technology can play a significant role in helping to achieve this.

Objective: To research the contribution of IT to reducing acute hospital admissions and length of stay (LOS). The methodology is to research what efficiencies in acute healthcare provision can and have been achieved using IT, if efficiencies are quantifiable in terms of LOS and if they result in a reduction in the need for acute hospital care.

Main Findings: The research has shown that the use of IT in both primary and secondary care does reduce the need for acute hospital care. Hospital admission can be avoided by managing patients' care at home with the aid of technology. Process efficiencies can be made which reduce LOS. Application of best practice can be achieved resulting in better, safer care and a reduction in adverse events

Conclusions: In order to have the ability, going forward, to provide best practice healthcare to our growing and greying population there is a need to generate changes and efficiencies in the way we do things. IT has a very significant role to play in achieving these objectives. By using IT to facilitate best practice we observe a reduction in adverse incidents, an increase in process efficiencies, a change from reactive inpatient care to proactive outpatient and/or home based care – particularly in the area of chronic disease management. But most importantly we observe a healthier more satisfied patient.

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CHAPTER 1

INTRODUCTION

Healthcare has been described as an information-based science. Much of clinical practice involves gathering, synthesizing and acting on information. Medical informatics is the field concerned with management and use of information in health and biomedicine (Hersh 2002).

As well as being a science, healthcare is a continuously evolving industry, one which is essential, but not always available to those in need. Factors such as increasing life expectancy and growing populations make it a constant challenge to meet healthcare requirements worldwide. The worlds' population is currently running at over six and a half billion people and is expected to rise to over 9 billion by 2050 with 32% of that number being over sixty years old at that time (UN 2004). Irelands Central Statistics Office (CSO) predict that its population will increase by 19% to over 5 million people by 2020 and that a gradual aging of our population will occur resulting in ongoing increase in health need.

The resulting overall effect is a greater dependence on healthcare going forward. The longer people live, the more likely we are to see increases in incidence of chronic diseases as well as the need for increasing elderly care. Population growth is likely to result in greater need for obstetric and paediatric services and potentially an increase in requirements for trauma services. Demand for healthcare will also increase as a result of new research and technology, which continues to provide new invasive and non-invasive cures and treatments, previously unavailable, allowing people to live longer and further increasing requirements.

All of this comes at a price. The healthcare market, because of its essential nature and increasing demands, is a costly one, and costs continue to rise. This, either directly or indirectly, is often cited as one of the primary reasons for lack of availability. This holds true either in countries' where healthcare is provided either as an insurance-based service (e.g. USA) or as a publicly funded service (e.g. Ireland). In an insurance-based service, hospitals are managed as businesses and there is a motivation to have good a throughput and to ensure that nobody stays in hospital any longer than necessary. In publicly provided services this motivation also exists but as the costs are not as much at the cold face of public care provision, the interest in efficiency is less obvious. What is recognised by all care providers is that cost is a

major factor and if efficiencies and value for money are not achieved, then patient care will be adversely affected.

Acute hospitals have a responsibility to be vigilant in the way in which they manage their resources. Information Technology (IT) can be a very valuable asset in this regard. Through its use, processing can be streamlined, bed utilisation can be reduced, non-acute needs can be directed to community care, human-error and adverse incidents can be avoided and/or reduced.

With this in mind the focus of this dissertation is to research the contribution of IT to reducing acute hospital admissions and length of stay (LOS). The methodology is to assess what efficiencies in acute healthcare provision can be achieved using IT, if efficiencies are quantifiable in terms of LOS and if they result in a reduction in the need for acute hospital care.

A full literature review has been carried out focusing on the Health Information Technology in general, but more specifically on areas of health IT such as Electronic Health Record (EHR), Adverse Incident Management, Computerised Provider Order Entry (CPOE), Clinical Decision Support, Telemedicine, Radiology Information Systems & Picture Archiving and Communications Systems (RIS/PACS), eHealth, Chronic Disease Management, Radio Frequency Identification (RFID) and IT in Surgery all of which have an impact on acute hospital admissions and LOS. Research findings are discussed under each section and further discussed later in the documents conclusion.

In addition, IT in acute hospital care within the Irish Health System is reviewed in relation to hospital length of stay and bed utilisation. Some comparisons are made with other developed countries in this regard. The development of IT in acute hospital care in Ireland to assist reduction in hospital admissions and LOS is explored and recommendations in terms of its current status and future plans are made, being mindful of the Irish Information Technology strategy, on international trends and on best practice. An interview with Damien McCallion, Head of Information Technology, HSE, provides insight into the current status of Health IT in Ireland.

1.0 Acute Hospital Care

Acute Hospital Care (or secondary care) is a level of healthcare provided in a short-term hospital that has facilities, medical staff and all necessary personnel to provide diagnosis, care and treatment of a wide range of acute conditions, including injury. Major acute hospitals are usually also teaching hospitals affiliated to universities and

are sometimes at the cutting edge of new clinical research, new technology and specialist care, making them sought after places to receive treatment.

Secondary care is usually accessed either through primary care or emergency services. A patients' initial encounter with secondary care is often the most costly period of the inpatient episode, and as recovery progresses, daily costs diminish. Baring this in mind it seems that the longer a patient stays in acute care, the less it should cost the provider. However, specialist care providers do not wish to be idle and in many of these centres there are not enough resources to meet the needs of those requiring care, hence the need to become more and more efficient in how care is provided.

IT plays a vital role in facilitating this efficiency by supporting clinicians and managers. Using various information applications, technology has been able to assist with patient centred care, disease management, decision-making, research information, error prevention, organisational structures, efficient processing and more... The resulting efficiencies contribute to spending less time in hospital either by admission avoidance or by reduced LOS.

1.1 Cost of Acute Hospital Care

The typical average cost of a bed day in an acute teaching hospital in Ireland is currently approximately €994. This cost increases significantly for an Intensive Care Bed to €2010, with a High Dependency bed costing €1419.

By its nature acute care has high-level operating costs and is therefore an area where attempts are constantly being made to become more efficient, without compromising patient safety and quality of care. Creating efficiencies often means that costs increase by virtue of the fact that the efficiencies result in increases in throughput and therefore increases in service utilisation, leading to greater costs. However these resulting efficiencies mean that more people are treated in a timely manner, and potentially, before they become more acutely ill resulting in unnecessary hardship for the patient and, in the long run, possible unnecessary increased demands on available services or more costly treatment.

1.2 Average Length of Stay (ALOS) and Bed Occupancy

A well-established and widely accepted performance indicator and measure of return on investment in the acute setting when examining throughput, service level provision

and resource management is ALOS. Even fractional reductions in lengths of stay can be measured monetary terms and have a significant impact on an organisation's financial picture (Chaiken 2003).

ALOS is measured based on hospital discharges and computed by dividing the number of days stayed (from the date of admission in an in-patient institution) by the number of discharges (including deaths) during a specified period. In most hospitals this is measured in detail on a monthly basis. Information can be provided by specialty, by consultant, by disease/treatment classification, by patient age, by source of admission and more.

Optimum length of stay for many conditions is based on best practice and international comparisons. It is linked to patient diagnosis using the Diagnostic Related Groups (DRG's) system. This is an internationally recognised system used to classify hospital cases into one of approximately 500 of groups, referred to as DRGs, which are expected to have similar hospital resource use. This system is used to compare the length of stay for similar conditions in similar hospitals and serves as a performance indicator.

The OECD, as part of their efforts to improve the health of societies, collects and analyse health data. In collecting information on LOS, comparisons using DRG's are made and used to inform and decision-make.

The ALOS for countries varies. The OECD average is currently about 5.6 days.

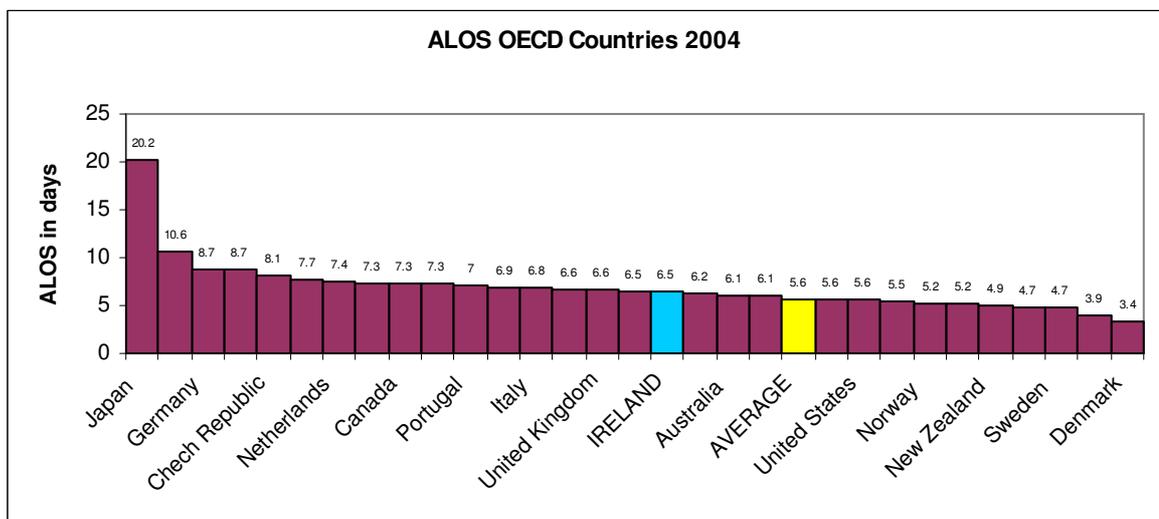


Fig 1.1 Average Length of Stay - OECD Countries - 2004

Acute care is generally provided for in acute hospitals and long-term care in Nursing Homes, however in Japan, most of the long-term care is provided in hospitals, which may explain their high ALOS. (Ikegami N 1994) In France, because of the lack of post acute facilities, the average of length of stay is generally greater than in the United States (Lang, Heitz et al. 2006).

Many OECD countries have reduced the number of hospital beds while increasing both the capacity of hospital and the wider health system. They have achieved this by seeking to develop a new model of care, which seeks to optimise care across the whole health system. In many cases, this means both shifting services to be delivered in the community and delivering efficiencies within hospitals (HSE 2007).

Ireland has a relatively young population, which results in lower relative demand for acute health services. Despite this, we have delivered the second lowest reduction in length of stay of any OECD over the last ten years and we have the fourth highest bed occupancy rate for OECD countries In comparison to other countries, older people in Ireland use significantly more bed days and medical and surgical inpatients have a relatively higher ALOS (HSE 2007).

Average length of stay for acute care, 1990 and 2005

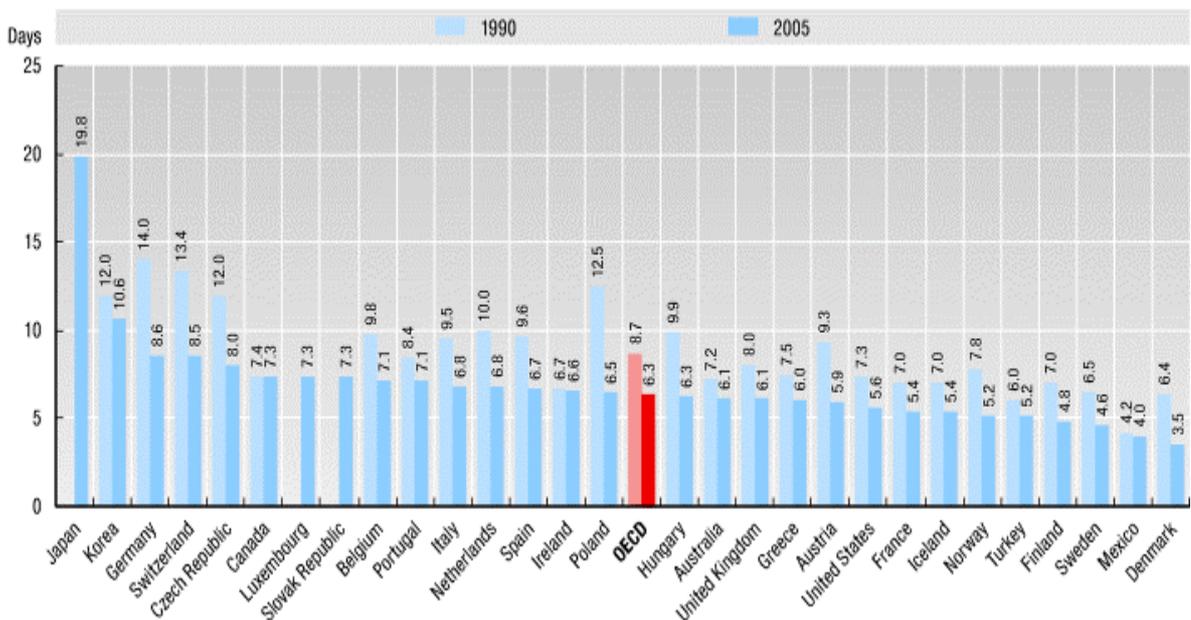


Fig 1.2 Average Length of Stay for Acute Care - 1990 and 2005
(OECD 2007)

There are currently in total 11,660 public patient beds and 2,461 private patient beds in public hospitals. OECD data shows that Ireland has 30% fewer acute hospital

inpatient beds per capita. But when private capacity is added this reduces to 20% (OECD 2007)

The number of hospital beds in a many countries is steadily decreasing while inpatient activity has been increasing (HSE 2007).

In the OECD, the total number of inpatient beds has decreased by an average of 8% for each country since 1990. During this same period, countries have delivered an average increase of 27% in inpatient activity. However in Ireland since 1990, the number of acute beds has increased by 2% and inpatient activity has increased by 37% (HSE 2007).

Acute care hospital beds per 1 000 population, 1990 and 2005

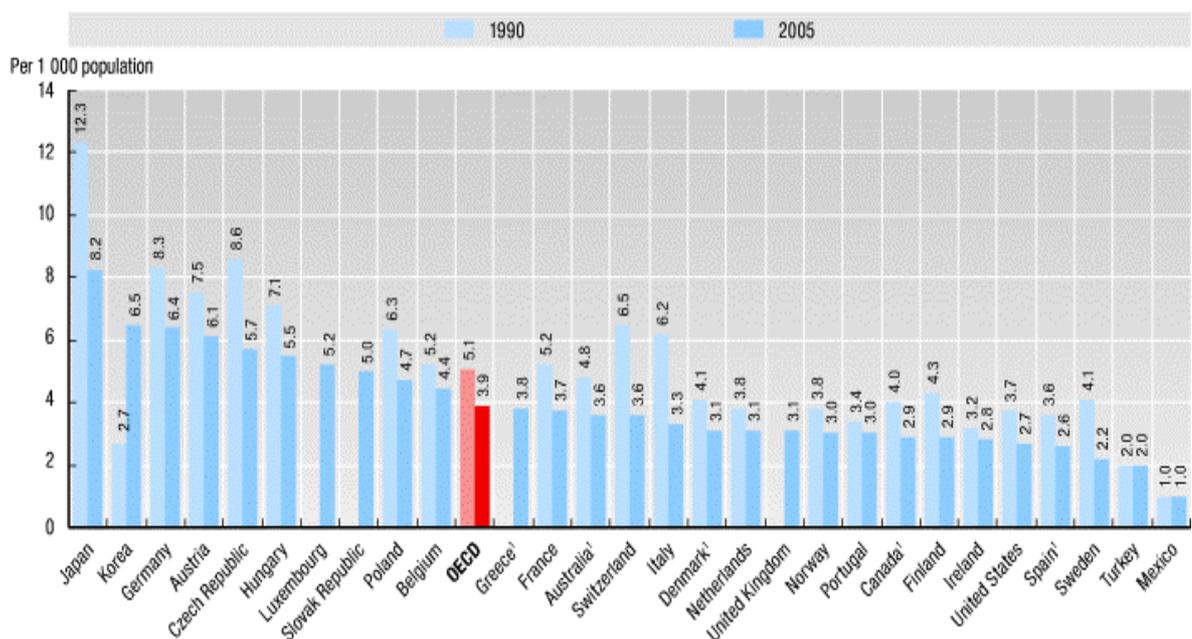


Fig 1.3 Acute care hospital per 1000 population - 1990 and 2005
(OECD 2007)

In comparison to the United Kingdom, Ireland has a slightly higher overall ALOS. However, given the younger Irish population, the difference should be greater. Medical inpatients typically spend an additional 0.7 days and surgical 1.2 additional days in hospital than in the UK. (HSE 2007).

The HSE, in their analysis of the Irish Acute hospital Bed Capacity have found that Australia, the United Kingdom, Finland, Denmark and Canada would deliver the same throughput in their health system with 2,000 – 5,000 less hospital beds (HSE 2007)..

Based on existing practice, Ireland requires 12,778 acute public patient beds to meet existing demand. – a shortfall of 1,118 beds, but with the implementation of the new model of care – “The Preferred Health System” this could be reduced to 8834 acute beds. This model of care will require significant IT input (HSE 2007).

1.3 Benefits of Minimising Inappropriate Acute Hospital Admissions and Reducing ALOS

The Irish Health Service is currently unable to meet the health needs of its population in secondary care. Acute hospitals constantly operate at close to 100% capacity and beyond. This results in patients having to wait lengthy periods of time for urgent treatment. Hospitals cite the lack of available beds as one of the main contributors to this problem. However it has been shown that up to 30% of acute beds are sometimes being inappropriately used.

Reducing LOS will allow for timely treatment for patients, perhaps resulting in lesser care requirements. It will allow for treatment to be provided in a more appropriate setting.

We know that acute healthcare needs going forward will increase, that costs will increase and therefore there is a need to plan for this. A large part of this plan will include increasing efficiencies. This will result in a change in the way we do things in acute care. Information Technology can facilitate a large part of this change.

Health care is growing increasingly complex, and most clinical research focuses on new approaches to diagnosis and treatment. In contrast, relatively little effort has been targeted at the perfection of operational systems, which are partly responsible for well-documented problems with medial safety. If medicine is to achieve major gains in quality, it must be transformed, and information technology will play a key part, especially with respect to safety (Bates DW 2003)

CHAPTER 2

FACTORS AFFECTING HOSPITAL LENGTH OF STAY

2.0 Introduction

Acute hospital length of stay is predominately determined by a patient's condition and the treatment required to manage an acute phase of illness. For many patients, once this period has been completed there is no longer a need to remain in hospital. However unexpected events, either during or subsequent to treatment, can result in unnecessary extension of the patients hospital stay. The outcome for hospitals is an increase in ALOS.

Extended unnecessary LOS in hospital can have adverse consequences for patients. The risk of contracting a hospital-acquired infection is increased. The potential to become institutionalised and dependent is more likely especially in the elderly. The risk of complications resulting from inactivity or prolonged bed rest is increased. The likelihood of an adverse incident such as perhaps a fall or a drug error also increases. Socially, the lack of ones usual, normal social environment may lead to decreased motivation and perhaps depression.

The factors, which contribute to increased hospital admissions or LOS during or following treatment, are predominately lifestyle, adverse incidents, in appropriate use of acute hospital beds, process inefficiencies, and primary care deficits.

2.1 Lifestyle

Lifestyle is changing. The increase of adverse health indicators such as the growth in obesity and alcohol consumption as well as an increase in stress related diseases all impact on health need.

In Ireland, the body mass index of the population is increasing. The WHO projected obesity rates in Ireland are likely to increase by around 13% over the next ten years, resulting in an increase in the health need. In particular, it will result in an increase in chronic diseases, such as diabetes.

As a nation, we continue to be amongst the highest consumers of alcohol in the world (European Commission 2002). Alcohol has been shown to be the third detrimental risk factor for European ill health and premature death – higher than high cholesterol and being overweight, and three times more important than physical inactivity (WHO

2004). One in four Irish citizens continue to smoke cigarettes (Office of Tobacco Control 2005). Cigarette smokers have more acute and chronic illness (HSE 2007).

2.2 Adverse Events

International literature reports that the most common adverse events in healthcare can be classed into similar types of event categories.

- Due to medication events
- Due to hospital – acquired infections
- Due to surgical complications
- Related to falls (DoHC 2008)

In 1999, IOM published “To err is Human: Building a Safer Health System,” which attributed between 44,000 and 98,000 deaths annually to medical errors (Heins JE 2002). They define an adverse event as:

“An injury resulting from a medical intervention, or in other words, it is not due to the underlying condition of the patient” (Institute of Medicine 2000).

Extensive studies demonstrate the extent of adverse incidents in healthcare and their effect on healthcare utilisation. Common errors include adverse drug events and transfusion errors, wrong-site surgery and surgical injuries, restraint related injuries, hospital related infections, falls, burns, pressure ulcers and mistaken identity (Institute of Medicine 2000).

From the studies it is thought that incidents are generally under reported and that there is an ongoing need, internationally, to improve reporting. (Institute of Medicine 2000).

The IMO quoted extensively from two large studies, one conducted in hospitals in Colorado and Utah and the other in hospitals in New York (The Harvard Medical Practice Study). They found that adverse events occurred in 2.9 and 3.7 percent of hospitalisations, respectively. More than half of adverse events resulted from medical errors, which could have been prevented. 6.6 percent led to death in Colorado and Utah hospitals, and 13.6 percent in New York hospitals. Those, manifest by prolonged hospitalisation or disability at the time of discharge or both, occurred in 3.7 percent of the hospitalisations. The majority of adverse events occurred in the hospital and the proportion that was preventable was 53 percent. The IMO state that little or no

research has focused on errors or adverse events occurring outside of hospital settings. (Institute of Medicine 2000).

More recently, the Agency for Healthcare Research and Quality (AHRQ) Patient Safety Indicators (PSIs) were used to identify medical injuries in 7.45 million hospital discharges from 994 acute-care hospitals across 28 states. Increased LOS attributable to medical injuries ranged from 0 to 10.89 days (Zhan C 2003).

In UK studies, 10.8% of patients on medical wards experience an adverse event of which 46% were judged to be preventable. One third of these lead to greater morbidity or death. Each event leads to an increase average of 8.5 additional days in hospital. When applied across the NHS, this translates into costs of £1.1 billion per annum (Vincent, Neale et al. 2001). An extrapolation of this report by Deloitte and Touche in Ireland, suggested that there could be as many as 937 deaths annually in Ireland as a result of preventable clinical error. This implies that more people will die in Ireland from preventable clinical error (937) than from breast cancer (612) (Information Society Commission 2004)

The IMO report examined the impact of adverse events on patient safety and in doing so highlighted the costs of these events to health outcomes and healthcare resources. One of the key resources affected by adverse incidents is bed capacity and additional bed days used as a result of these events. Adverse incidents can lead to patients experiencing longer hospital stays and physical and psychological discomfort (Institute of Medicine 2000).

Medication-related errors are the most common type of adverse incident and occur frequently in hospitals. They affect millions of patients each year and are responsible for up to 5% of hospital admissions (Juurlink DN 2003). In a 7-year study to determine whether elderly patients admitted to hospital with specific drug toxicities were likely to have been prescribed an interacting drug in the week prior to admission Juurlink et al. found the following:

- 3.3% of the hospital admissions for hypoglycaemia in elderly patients receiving glyburide could have been prevented if the simultaneous use of co-trimoxazole had been avoided. The ALOS for hypoglycaemia was 4 days and 1.3% of patients died while in the hospital.
- 2.3% of the hospital admissions for digoxin toxicity could have been prevented if the simultaneous use of clarithromycin had been avoided. ALOS for digoxin toxicity was 5 days and 3% died while in the hospital.

- 7.8% of the hospital admissions for hyperkalemia in elderly patients receiving ACE inhibitors could have been prevented if the simultaneous use of potassium-sparing diuretics had been avoided. The ALOS was 3 days and 4% died while in the hospital.

The authors believe that many of the hospitalisations identified could have been avoided with closer patient monitoring or the use of alternative medications. (Juurlink DN 2003).

Although not all result in actual harm, those that do are costly. It is estimated that the numbers of lives lost to preventable medication errors alone is more than 7,000 annually and that this increases hospital costs in the US by about \$2 billion nationwide (Institute of Medicine 2000; Beagley B 2002).

Other studies have shown that adverse drug events in the US can cost hospitals anything from \$2,300 to \$4,685 per event with a total cost estimated to be about \$2 billion annually with the majority of these incidents thought to be preventable (Lewis 2002). Juurlink et al. have estimated the cost of medication errors to be more than \$16,000 per hospitalisation (Juurlink DN 2003).

Bates et al., in a study carried out in two major teaching hospitals, found that about two out of every 100 admissions experienced a preventable adverse drug event, resulting in an increase in ALOS of 4.6 days and average increased hospital costs of \$4,700 per admission or about \$2.8 million annually for a 700-bed teaching hospital (Bates DW 1997; Institute of Medicine 2000). Similarly Classen et al. found that adverse drug events complicated 2.43 hospital admissions per 100 which was associated with an increased LOS of almost two days (Classin DC 1997)

Mayor et al concluded that hospital admission leads to drug errors (Mayor 2005). A study in Canada demonstrated that in over half of hospital admissions of elderly people, drug errors occur at the time of admission (Cornish, Knowles et al. 2005). Researchers from the University of Toronto looked at non-elective admissions to 1000 bed teaching hospital over a three month period and found that (54%) had at least one medication related error, with the most common being the omission of a regularly used medication (64%) (Mayor 2005).

Fieschi et al tells us that US National Committee on Vital and Health Statistics (NCVHS) reported that preventable medical errors accounted for 12 – 15% of hospital costs, and that approximately 180,000 unnecessary deaths and 1.3million injuries occurred from medical treatment” (Fieschi 2002).

As previously stated, many adverse drug incidents are preventable. Bates et al. reviewed 4,031 adult admissions to medical and surgical units at two tertiary care hospitals and found 247 adverse drug events and an average of 1,900 per hospital per year. Twenty-eight percent were judged preventable (Bates DW 1995); (Institute of Medicine 2000).

In terms of resource utilisation, there is evidence indicating that adverse drug events account for a significant number of admissions to inpatient facilities. One study found that they resulted in between three and eleven percent of hospital admissions (Beard K 1992). They also account for an increased number of attendances to emergency departments (Institute of Medicine 2000).

In an analysis of 62,316 visits to an emergency department it 1.7 percent were related to medication non-compliance or inappropriate prescribing (Schneitman-McIntire O 1996); (Institute of Medicine 2000).

The elderly account for a significant proportion of bed utilisation in acute hospitals. Coupled with the affect of adverse drug events among the elderly we see a further impact on LOS. Some of these events are unpredictable but many others can be anticipated and prevented. A study of elderly hospitalised patients at a large metropolitan teaching hospital showed 20 percent received sedatives and hypnotics exceeding Health Care Financing Administration (HCFA) guidelines. These patients incurred approximately \$5200 more in costs and remained hospitalised 7.3 days longer than anticipated. In addition, serious patient falls occurring in the hospital were associated 12 days excess length of stay. These were often the consequence of incorrect medication therapy. (Heins JE 2002).

There have been many subsequent reports and research pieces, which confirm that the problem exists internationally and has a huge impact on patient outcomes. Adverse outcome for any hospitalised patient usually results in a lengthier period being spent in acute care. In addition numerous reports have confirmed that underreporting of adverse incidents exists. It has been said that reporting detects only about 1 in 20 adverse drug incidents (Bates DW 2000).

All of the above clearly indicates that adverse incidents have been and continue to be a major problem in healthcare, having a demonstrable impact on patient care and resource utilisation. While LOS is not specifically referred in all of the studies it is reasonable to assume that it is proportionately affected by this problem.

2.3 Surgery

Extended LOS in surgery occurs at both ends of the inpatient episode. Due to a lack of beds there is no guarantee that patients will be admitted on the day of surgery, therefore patients are sometimes admitted one or more days in advance of surgery, increasing LOS. A recent study by the HSE in one of Dublin's leading acute hospitals has shown that if all elective surgical patients were admitted on the day of surgery there would be a saving in bed days equivalent to 26 beds.

The other area in surgery where inpatient stay is extended is the area of surgical complications. The World Health Organisation estimates that globally, about 234 million major surgical operations are carried out each year. Studies have shown that complications following surgery result in disability or prolonged stay in 3-25% of hospitalised patients and this could potentially mean that at least 7 million patients annually may have post-operative complications. Rates of death following major surgery are reported to be between 0.4% and 10%, depending on the setting. Estimating the impact of these rates, at least 1 million patients would die every year during or after an operation (WHO 2008).

In the developed world, nearly half of all harmful events (such as miscommunication, wrong medication, and technical errors) affecting patients in hospitals are related to surgical care and services. The evidence suggests that at least half of these events are preventable if standards of care are adhered to and safety tools, such as checklists, are used (WHO 2008).

Procedural technology is constantly developing and less invasive procedures require a shorter recovery time. Continuing development of minimally and/or less invasive approaches to surgical procedures (lap chole, hip replacement, thoracic surgery, open-heart surgery) and diagnosis (FAST CT, PET) will support reductions in length of stay and the shift of care from inpatient to outpatient setting (HSE 2007)

2.4 Inefficiencies during Inpatient Care

Unnecessary increases in inpatient LOS can occur as a result of inefficiencies during care provision. Examples of delays which can occur include delays in receiving diagnostic tests, in accessing test results, in receiving clinical/specialist consultations, the need for repeat tests and delays in arranging follow-up care.

It is common, in hospitals where only basic information technology systems, are available, that the time taken from test ordering to test completion and reporting can be lengthy and variable. Thankfully there is technology available which can help to reduce these types of delays significantly. Picture Archiving and Communication Systems have shown that vast improvements can be achieved in the area of radiology area. Combined with Radiology Information System the improvements are even greater.

Inefficiency in the area of diagnostics can result in a reduction in availability of diagnostics for outpatients. The knock on effect is that patients are admitted to acute hospitals to access diagnostics sooner or in some cases they are kept in hospital in order to ensure they receive their diagnostics in a timely manner. As an outpatient they are likely to have to wait longer. These situations can be classed as inappropriate use of acute care beds.

The Health Service Executive (HSE) acknowledges that there are significant diagnostic backlogs within acute hospitals causing delays in inpatient stay. A discrete event simulation of an Irish hospital was developed to assess the impact of reducing this bottleneck and it showed that a 25% increase in diagnostic capacity resulted in 6% in total hospital discharges (HSE 2007).

Inappropriate hospital admissions have a knock on effect on internal bed occupancy. Delays can occur in bed availability in specialist areas. For example, patients often spend additional days in a specialised care area such as Intensive Care Unit (ICU) because there is no general bed available for them to move to. This causes an increase in ALOS for the ICU. Furthermore the patient who remains in ICU uses a costly resource without need. This results in delays for patients needing ICU. In addition, a patients in need of the ICU, perhaps due to have major surgery, which is now cancelled, leave expensive operating theatre staff idle further wasting valuable resources.

Hospital LOS can be affected by the availability of the consultant to progress the patient care plan. He/she may be unable to see all his/her patients in a timely manner. Delays in availability of tests and results can affect this, as well as being delayed at outpatient clinics, with consultations to other patients and with commitments to other institutions/hospitals. There is potential for some or all of these situations to be more streamlined and efficient with the utilisation of information technology.

Ireland has the fourth highest bed occupancy rate among OECD countries, it is particularly high for specific hospitals around Dublin and Cork as well as for medical, surgical and intensive care beds (where utilisation can be well over 98%) (HSE 2007).

2.5 Primary Care Deficits

Lack of services in primary care sometimes leads to inappropriate hospital admissions. For the elderly, in particular, this can have a detrimental effect. In some cases hospital admission can result in risk of functional, physical, and mental impairment, can lead to loss of autonomy and result in a burden to the family, the need for professional help or even death. Studies have shown a 16% greater length of stay, on average, for patients aged 75 and older than for those younger than 70 (Lang, Heitz et al. 2006).

A change of environment for an elderly person can lead to disorientation and fear resulting in diminished quality of life. This change is often irreversible resulting in the need for long term care as they quickly become institutionalised and can no longer live at home. The ability to monitor elderly patients at home would allow them to remain at home for longer. It would facilitate early detection of changes in the patients physical and mental health allowing early adjustments to be made to the patients home life thus continuing to extend their ability to live at home for as long as possible. While there will always be the need for human interaction to facilitate this, information technology could assist.

Patients referred from nursing homes represent an increasing number of acute hospital admissions. This upheaval to an unfamiliar environment can be quite traumatic for the patient. IT links for nursing homes to GP's and acute hospitals may reduce this type of admission.

The availability of IT within the community could provide for a better quality of life for patients as well as more patient participation in their own health management, particularly with proactive management of chronic diseases.

2.6 Inappropriate bed utilisation

In Ireland inappropriate admissions and discharge delays have an enormous impact on ALOS, particularly in large acute teaching hospitals. One of the main reasons for the delays is the lack of post acute facilities. This includes long-term care; step down

facilities as well as primary care needs. Some of our need for long-term care would be reduced if we had the ability to keep patients at home for longer. Many of those who are delayed suffer with chronic diseases, which if managed from home may result in patients having a lesser need for hospitalisation. Bed days used in Ireland due to delayed discharges in an acute teaching hospital can be up to 30,000 per annum, equivalent to 82 beds.

Patients with chronic diseases are regularly admitted to hospital for management of acute exacerbations of their conditions. Conditions such as diabetes, heart failure, and chronic obstructive pulmonary disease can be successfully managed within primary care if the proper services are available. At present patients with chronic conditions attend hospital when care is required. Proactive ongoing management in primary care would alleviate much of this and result in better patient outcomes.

It is evident that there are many ways in which acute hospital LOS can be reduced. IT can and does play a major part in this.

CHAPTER 3

INFORMATION TECHNOLOGY IN HEALTHCARE

The use of information and communications technology (ICT) in the organisational work environment in has completely changed how people work and how organisations operate. Its introduction into healthcare has revolutionised the provision of services to patients (Reichertz 2006). The impact of ICT, its ability to allow us to do things better and to provide treatments using new technology has far exceeded anyone's expectations.

Most of the early healthcare ICT developments started in universities, with the emphasis being on creating Hospital Information Systems (HIS) (Reichertz 2006). At the time, these systems focused largely on administrative and financial functions. They have been in existence for almost two decades now and have developed primarily as a means of communication. They still remain the main component of ICT to date. Some early installations of information technology in health care were for financial accounting of medical transactions (Detmer 2000). In this regard they provided some support to health care professionals as well as administrative staff (Haux 2006);(Reichertz 2006).

In the early 70s, from an ICT perspective, the need to provide best practice quality care came second to minimising costs and increasing efficiency. Gradually the focus moved in the direction of patient care. It was realised at this early stage that integration would be key to providing better patient care, but early attempts to achieve this failed due to insufficient hardware and software technology (Reichertz 2006).

Things developed further in the 80's. Healthcare learned, allowing better goals and objectives to emerge. While administrative functions and more specifically efficient running of the hospital, remained an important goal, it was recognised that there was a need to move towards the delivery of quality patient care and management. Administratively, functions included holding patient databases, which included admission and discharge functions and financial details. Human resource functions, and pharmacy and stock control were also prevalent. Patient care functions included medical records systems, order entry systems, and some pharmacy systems. In more established areas imaging systems were also being talked about at this time.

As the capability of HIS continued to be explored, the pace at which technology was changing and improving meant that healthcare was having difficulty keeping up in terms of implementation and integration. Simple things such as introduction of more powerful small computers completely changed environments. The impact of the Web, for example, was not predicted (Grimson 2002). What came subsequently was a move away from construction of individual systems towards systems which would facilitate better information exchange and integration (Reichertz 2006).

In the last 15 to 20 years there has been a significant shift in thinking. Hospital Information Technology (HIT) is being regarded as an essential investment for enhancing quality patient care and Hospital Information Systems are being replaced by Health Information Systems. Trials have shown that the quality of healthcare can be significantly improved through the use of health informatics (Detmer 2000) and it is now recognised that ICT has to directly support the patient and health consumers alike (Schug S 2007).

In today's healthcare environment integrating ICT into medical settings is considered essential to transforming hospitals into 21st century healthcare institutions (Weir, Hicken et al. 2006). It is considered to have the ability to facilitate information and communication within and among health care organisations, support diagnostic and therapeutic processes, allow the delivery of care to remote locations, increase the efficiency of delivery, and increases the quality of care provided to citizens (Schug S 2007).

Haux tells us that HIS development now has a different and broader focus. He outlines, in general, the current status of Health Information Systems and the way in which they should develop over future years. His beliefs include the continued shift from paper-based to computer-based storage and the move towards regional and global Health Information Systems as well as the inclusion of patients and health consumers as Health Information Systems users and the use of Health Information Systems data for healthcare planning. He anticipates an increase in new technology to include ubiquitous computing environments and sensor-based technologies for health monitoring. In addition, he recommends the need for national informatics strategies, new HIS architectures and education in health informatics, much of which is taking place today. He also identifies the need for further research around Health Information Systems (Haux 2006).

It is clear that information management is essential to healthcare delivery (**Chassin, W** et al. 1998) and it is more or less a certainty that future HIS will concentrate more on the quality of medicine. Systems will increase in the area of patient management,

but also in the area of direct problem management. Pictorial data and expert systems will be essential in this regard (Reichertz 2006). These systems will create that essential link between primary and secondary care, which is necessary to maintain continuity of patient care. (Chaudhry, Jerome et al. 2006).

There is no doubt that the world of IT in Healthcare has changed dramatically over the past forty years and continues to progress at a more rapid rate than anticipated at its inception. For it to continue in a structured way there is a need to develop in order to have well educated health care professionals and/or health/medical informatics specialists.

New health informatics systems make a valuable contribution to the progress of medicine and health sciences. Yet pace at which ICT has developed has led some in the recent past to believe that ICT has failed to deliver the promises of competitive advantage much propagated in the 1980s. This is sometimes traced to the lack of measured productivity improvement or benefit, the mismanagement of ICT systems and resources, the lack of integration and, perhaps most critically, the lack of alignment of ICT strategy to the missions and goals of our organisations (Feeney 2005). However we now recognise that health information systems are moving away from institution-centered systems towards trans-institutional information systems inclusive of diagnostic, therapeutic and telemedicine systems to facilitate integration and patient-centred shared care. Therefore, there is a need to ensure that there is sufficient education, knowledge and skills to create and manage systems going forward. Also that there is efficient development and strategic management of new health information systems in order to ensure that patient centred quality care can be provided. Research and exploration in this field must continue in order to enhance opportunities for global access to health services and medical knowledge. Ubiquitous technology will allow us to continuously consider new types of information systems for healthcare. Trans-institutional technology will allow for more efficient patient management and better use of patient data and therefore more medical informatics is required. (Haux 2006). We must bear in mind that the object of medical and health informatics is not to increase technology, but to provide a means to better care and more affordable care in our aging societies.

Despite our knowledge that HIS can and probably will make a major contribution to improving patient care, studies suggest that there is still a great deal to learn regarding the best methods for implementing and using information systems to achieve improved patient outcomes (Weir, Hicken et al. 2006). This kind of information reminds us of the need for continuous evaluation of our systems.

Moving forward, it is a common belief that over the next two decades e-health could deliver patient, provider and planner/manager interactions for all aspects of health care, that a positive impact on quality, access and cost effectiveness is likely and that this should lead to better evaluation of health status and outcomes (Detmer 2000). Many countries are striving ahead with national strategy policy documents and legislation. These documents need to take account those factors which will greatly influence the further development of information processing in healthcare in the future - population growth and development, medical advances and advances in informatics. In addition the changing demand of health consumers and performance standards will also have an impact (Haux, Elske et al. 2002). Both the UK and the USA have policy documents and legislation that favour the deployment of HIT for simplification of patient care and administration (Detmer 2000). Successful implementation of these policies and strategies in medical informatics requires a number of simple and central themes to be adhered to. Those are standards, terminology, usability and they must demonstrate value (Hersh 2002).

There is no doubt that Health Information Systems continue to be one of the most challenging and promising fields of research, education and practice for medical informatics, with significant benefits to medicine and healthcare in general (Haux 2006). But there is a cost factor. National strategy's and governments need to recognise this and allocate appropriate resources to this area. Currently about 10% of GDP of nations is allocated to healthcare and only about 5% of that to information and communication technology (ICT). It is likely, going forward that this will be insufficient to provide the necessary systems. The importance of HIS for the quality and efficiency of healthcare is clearly recognised. This may influence allocation of resources on the basis efficiency of care in the future may mean that care will remain affordable (Haux 2006)

CHAPTER 4

INFORMATION TECHNOLOGY IN PRACTICE

4.0 Introduction

Reducing inpatient LOS is primarily centred round improving the quality and safety of patient care. This is achieved by helping to ensuring that best practice knowledge is available to clinicians, which allows them to give appropriate treatment to patients in a timely manner and in the most appropriate environment and much of this is or can be facilitated by IT applications. Over time increasing amounts of these applications have become available which allow for better patient care. The use of IT coupled with the increased emphasis on quality and safety has the knock on effect of reducing LOS.

Reductions in LOS happen directly and indirectly - directly by reducing acute hospital inpatient stay and indirectly by reducing the need acute hospital admission i.e. admission avoidance. Various IT applications contribute to either one or both ways of reducing LOS. Some applications focus on process efficiencies, others focus on ensuring that best practice patient care is being provided. Both are primarily trying to enhance the patient experience by allowing point of care patient diagnosis and treatment and, in doing so, making the patient experience as pleasant and straight forward as possible.

The main goal in for IT in healthcare is to create a multi-organisational, multi-regional Electronic Health Record (EHR) for each individual patient. This consists IT applications dedicated to direct patient care. Each application is linked so as to ensure continuity, accessibility, efficiency and quality in healthcare provision. Applications such as:

- Computerised Physician Order Entry (CPOE)
- Decision Support Systems (DSS)
- Picture Archiving and Communications Systems (PACS)
- Radiology Information Systems (RIS)
- Pharmacy Automation
- Radio Frequency Identification (RFID)
- Telemedicine Systems
- E-health Systems

have been shown to have the ability to ensure best practice in healthcare. In particular, they have been shown to have an impact on patient LOS in acute hospitals.

One of the biggest resulting effects of this is that there is a reduction in the number of adverse incidents or potential adverse incidents thereby reducing LOS giving the impressions that the primary focus of having IT in healthcare is to address the problem of adverse incidents. This is not the case. Quality patient care and safety is paramount.

This chapter highlights the research in each of the named areas, which demonstrates that IT contributes to best practice care, thus reducing LOS.

4.1 Electronic Health Record (EHR)

An electronic health record (EHR) or electronic Patient Record (EPR) is an individual patient's medical record in digital format. Electronic health record systems co-ordinate the storage and retrieval of individual records with the aid of computers. It is usually accessed on a computer, often over a network. It may be made up of electronic medical records (EMRs) from many locations and/or sources. A variety of types of healthcare-related information may be stored and accessed in this way (Wikipedia 2008). Its primary uses are:

- Patient Care Delivery
- Patient Care Management
- Patient Care Support Processes
- Financial and other Administrative Processes
- Patient Self-Management (Safety 2003)

EHR's can be divided into hospital records, general practitioners, records and insurance records (Fieschi 2002). and consist of various applications tailored to the users needs. For acute care some of the most common applications in use are Computerised Physician Order Entry (CPOE), Decision Support Systems (DSS), Picture Archiving and Communication Systems/Radiology Information systems (PACS/RIS) and Pharmacy Automation. The interdependence of each of these systems provides efficiencies, safety and improved patient care.

A true EHR should allow physicians and nurses to practice in a paperless fashion. Internet technologies should allow trans-organisational sharing of patient data. Hence, the meaning of an EHR, as a representative of documents, should be transformed in to a collaborative environment that supports workflow, enables new care models and allows secure access to distributed health data (Safran and Goldberg 2000).

Most medical records are still stored on paper, which means that they cannot be used to coordinate care, routinely measure quality, or reduce medical errors (Hillestad, James et al. 2005).

4.1.1 Benefits of the EHR

In the US it has been demonstrated that the EHR has the potential to improve patient care and efficiency of throughput. In a study by the RAND Health Information Technology project team in 2003, significant potential inpatient and outpatient savings were shown. Hillestad et al analysed this study and estimate that with 90% adoption potential efficiency savings could average more that \$77billion per year. They estimate that one of the largest savings would come from reduced hospital stays (table 1) (Hillestad, James et al. 2005)

Potential Efficiency Savings with Adoption of Electronic Medical Record (EMR) Systems.

Savings Category	Mean Yearly Savings (\$billion)	Cumulative savings by year 15 (\$billion)	Annual Savings (\$ Billions)		
			Year 5	Year 10	Year 15 (90% adoption)
Outpatient					
Transcription	0.9	13.4	0.4	1.2	1.7
Chart Pulls	0.8	11.9	0.4	1.1	1.5
Lab Test	1.1	15.9	0.5	1.5	2.0
Drug usage	6.2	92.3	3.0	8.6	11.0
Radiology	1.7	25.6	0.8	2.4	3.3
Total Outpatient savings:	10.6	159.0	5.2	14.8	20.4
Inpatient					
Nursing time	7.1	106.4	3.4	10.0	13.7
Lab test	1.6	23.4	0.8	2.2	2.6
Drug usage	2.0	29.3	1.0	2.8	3.5
Length of stay	19.3	289.6	10.1	27.6	34.7
Medical records	1.3	19.9	0.7	1.9	2.4
Total Inpatient savings:	31.2	468.5	16.1	44.5	57.1
Total	41.8	627.5	21.3	59.2	77.4

Table 1: Potential Efficiency Savings with Adoption of Electronic Medical Record (EMR) Systems.

(Hillestad, James et al. 2005)

Some of the potential benefits relating to efficiency in bed days include:

Reducing adverse drug events in the inpatient setting – it is estimated that the use of CPOE as part of the EHR could eliminate 200,000 adverse drug events and save about \$1 billion per year if installed in all hospitals. Two thirds of the CPOE benefits are attributable to adverse drug events avoided for patients age sixty-five and older who accounts for a much larger fraction of hospital bed days and who are more susceptible than others to adverse drug events (Hillestad, James et al. 2005).

Reducing adverse drug events in the ambulatory setting - roughly eight million outpatient ADE's occur each year, of which one third to one half are preventable. About two thirds of these might be avoided through widespread use of ambulatory CPOE. Each avoided event saves \$1000 - \$2000 because of avoided office visits, hospitalisations, and other care. Scaling these numbers to the national level, it is estimated that two million such events could be avoided, generating annual savings of \$3.5 billion. Avoided adverse drug events in patients age sixty-five and older account for 40 percent of the savings (Hillestad, James et al. 2005). This is significant for bed utilisation, as studies have shown that many adverse drug events lead to hospitalisation particularly in patients of 65yrs and older

Disease prevention measures and chronic disease management - in the U.S. the burden of chronic disease is extremely high and growing. Disease prevention and chronic disease management programs aim to maintain healthier patient by facilitating on going patient care and treatment as opposed to sporadic outpatient attendances and ED admissions. In an example, Hillestad et al demonstrate a prevention program for pneumonia and influenza, which reminds patients to receive vaccines. This could potentially save 1.5 - 3 million bed days per year (assuming 100% compliance). They also looked at four chronic disease programs -Chronic Obstructive Pulmonary Disease, Asthma, Chronic Heart Failure and Diabetes - and found that potentially 245 million bed days could be saved annually (assuming 100% compliance). Most importantly, health outcomes for the patients were shown to improve (Hillestad, James et al. 2005).

On average, patients comply with medication regimens about half the time, it is therefore reasonable to assume that about half of the chronically ill would participate in disease management programs and therefore the health care system would reap about half of the estimated benefits assuming these programs were fully operational. (Hillestad, James et al. 2005).

4.1.2 The EHR and Length of Stay

In the US, a widely accepted measure of efficiency has been length of stay (LOS). Even fractional reductions in lengths of stay can be measured in dollars and cents and have a significant impact on an organisation's financial picture (Chaiken 2003). EMR systems with CPOE have existed for more than 30 years, yet in 2006 it was found that less than 10 percent of hospitals in the US have a fully integrated system. Despite this those who have EMR have demonstrated significant efficiencies which either directly or indirectly have had an impact on acute hospital admission and LOS:

At the University of Illinois at Chicago there was a 40 percent reduction in the number of patients seen without an accompanying medical record resulting in its physicians spending 30 percent less time looking for charts – leaving time for more timely patient care.

At RiverPoint Paediatrics in Chicago wait time decreased by 36 minutes in all encounters which was a 40 percent improvement. Its time to refill prescriptions went from between 24 and 48 hours down to approximately 15 minutes, a 9,600 percent decrease.

At Maimonides' Medical Centre in Brooklyn NY, in 2002, patient visits to the emergency department increased from 57,795 in 1996 to 77,118 yet at the same time ALOS plummeted from 7.26 days in 1995 to 5.05 days in 2001. This was a 30.4% reduction in ALOS, resulting from timeliness and completeness of clinical data, resulting in quicker diagnosis and treatment (Chaiken 2003). In addition, Maimonides' realised organisational efficiencies through the prevention of duplicate ancillary tests. In the laboratory, chemistry tests decreased by 48.9%, urinalysis by 41.6% and microbiology by 40.6%. Maimonides' also saw a 55% decrease in medication discrepancies and a 58% reduction in problem medication orders. (Nicholas E Davis 2002). That same year, the decision support feature identified 164,250 alerts, resulting in 82,125 prescription changes (Davies NE 2006).

Ohio State's University Health System data revealed a decline in LOS in a majority of its services, from transplant surgery to neurology (Davies 2004).

At Queens Health Network, NY, a 50 percent decrease in pharmacist interventions in medication orders in ambulatory care resulted because of improved legibility, systems alerts, and increased completeness of prescriptions. Availability of point-of-care, real-time patient information resulted in the hospital seeing a reduction in the numbers of admissions resulting from warfarin toxicity, a common problem when drug dosages are wrong (Davies NE 2006).

At Brigham and Women's Hospital in Boston after implementation of CPOE, application of its own design, serious medication errors decreased by 55%, and there was a 17% reduction in preventable adverse drug reactions (ADE's). Prior to this the average cost of an ADE's at this hospital was \$2,595. Hospital wide savings from preventable ADE's was projected to be \$480,000 a year (Bates DW 1998).

At Evanston Northwestern Healthcare, Chicago, following successful implementation of an EHR system turnaround time in obtaining test results has fallen significantly. Entire

categories of medication errors and potential errors have been eliminated and delayed administration of patient medications has decreased 70 percent, while omitted administration of medication dropped 20 percent across the organisation (Goldstein D 2006).

Christiana Care, a two-hospital, 900-bed health system in Delaware with an evolving EHR, redesigned its nursing admissions process to accelerate patient discharge. More than 25 % of the patients now have information imported from a previous encounter, eliminating duplicate documentation and improving patient satisfaction. A survey of ancillary department staff revealed that almost 90% believed that patients were being seen in a timelier manner and 44% believed that the decision support rules reduced the number of inappropriate referrals. In addition fewer duplicate referrals are now made. 50% of nurses believed that the new process took less time than its predecessor. One of the main aims of the redesign was to reduce LOS by accelerating ancillary referrals. While this could not be validated by the data, anecdotal evidence suggested the goal was achieved (Guite J).

From the above examples we can see that there is clear evidence of reductions in LOS. Indirect evidence is in the form of process efficiencies, which reduce time spent by clinicians at non-clinical duties as well as waiting times for patients to receive care. These efficiencies lead to a shorter hospitalisation period for patients indirectly demonstrating reduced LOS. The reduction in ADE's does the same.

4.1.3 the future for the EHR

Failings of the paper-based medical record such as:

- Illegible hand-written notes
- Frequently missing information
- Notes being unavailable at the time of a patient encounter. Perhaps because they are in use elsewhere and have not been returned
- Incomplete notes, sometimes due to clerical error
- Maintenance and storage costs.
- Security (Safran and Goldberg 2000) (Hersh 2002).

have driven the development of the EHR. In addition, the evidence indicates that the EHR is invaluable for its ability to improve patient care. However there are difficulties with its progression and while they will not halt its progress they may slow it down considerably.

Barriers to adoption include high costs, lack of certification and standardisation, concerns about privacy. Others are inherent in the design and sometimes related to organisational issues (Safran and Goldberg 2000). One of the main challenges lies in its ability to facilitate multi-centred integration going forward. Its ultimate success will lie in this area of development going forward.

4.2 Decision Support Systems (DSS)

To have safety in the clinical environment there must be structures in place that reduce the probability of harm, evidence that improves the chances of actions which increase favourable outcomes, and clear directions that lead to decisions to implement actions determined by the evidence. Computerised Decision Support systems provide this structure. (Morris 2002)

DSS uses reminders, prompts and alerts to assist physicians with diagnoses and treatments, while at the same time improving compliance with clinical best practices, periodic screenings such as mammograms, and other preventive practices (Charles MJ 2005).

Types of clinical decision support include:

- Proactive order sets
- Preventative health maintenance reminders
- Drug ordering alerts: drug-drug interactions, drug-allergy interactions, duplicate therapy
- Access to online reference materials
- Condition- or order-specific data displays
- Support for complex clinical guidelines, protocols, or pathways (Leonard KJ 2007)

DSS provide clinicians with clinical knowledge and patient-related information, intelligently filtered and/or presented at appropriate times to enhance patient care and have favourable impacts on patient outcome.(Morris 2002) Adherence with ordering preventative measures, the timely reminders and alerts etc all contribute to time efficiency, reduced patient adverse incidence and therefore reduced hospital stay (Hersh 2002)

Reviews have shown the effectiveness of decision support applications demonstrating their effectiveness in enhancing clinical performance for many aspects of health care.

Analyses of computer reminders and prompts were shown to significantly improve preventive practices (Hersh 2002; Safety 2003).

Bates et al noted that DSS is valuable for reducing the frequency of adverse drug events, even when not linked to computerisation of the ordering process. LDS hospital in Salt Lake City, Utah, showed large reductions in adverse drug events due to antibiotics (Bates DW 2000).

In one study, computerised order entry with relatively limited decision support resulted in a large decrease in near misses (84%) than in errors that actually resulted in injury (17%) – but in a later evaluation, after more decision support had been added, the rate of errors resulting in injury fell from 2.9 to 1.1 per 1000 patient days (Bates DW 2000).

A survey of antibiotic use in critical care by the American college of Physicians found that 47% of physicians use hand held DSS devices in their daily work resulting in the mean patient length of stay in ITU decreasing from 7.15 to 6.22 bed-days during its use, concluding that DSS may help to significantly reduce the length of stay and antibiotic prescribing in critical care. This reduction in-patient LOS in the ITU is very significant in terms of overall costs of ITU care. (Sintchenko, Iredell et al. 2005).

In a study by Tamblyn et al to determine whether inappropriate prescribing could be reduced when primary care physicians had computer-based access to information on all prescriptions dispensed and automated alerts for potential prescribing findings were that potentially inappropriate prescriptions per 1000 visits were significantly 18% lower (Tamblyn, Huang et al. 2003).

A study comparing clinical decisions made by physicians in the same practice using an EHR system and traditional paper records found that the former group made more appropriate clinical decisions as a result of all the tools available in an EHR system, including decision support (Tang PC 1999a).

Vanderbilt calculated that it saved more than \$7million on hospital-based operations during 2001 attributable to the availability of clinical decision intelligence which:

- Encouraged more cost effective drug substitutions
- Guided physicians to cheaper alternatives
- Sought patterns of resources over utilisation and made it harder for doctors to go ahead with orders out of habit.
- Saw a 30% drop volume of portable X-rays in the ICU (Alliance/IBM)

Banner Health documentation showed that clinical decision intelligence can change physician practice over time so much that alerts for particular problems decline. For example, an alert for overdoses of heparin incurred 15 times per 1,000 admissions at the beginning of 2001 but fell to five times per 1,000 by year-end. Doctors became aware that they had to lower the dose for impaired kidney function; guidance on prescribing was made available at the point of decision on the therapy. (Alliance/IBM).

Intermountain's LDS Hospital started feedback data on ADEs back to clinicians in 1990 in a high-risk trauma ICU. Incidence of moderate and severe ADEs plummeted from 40 in 1990 to 17 in 1992 and down to 1 by 1998. Incidence of ADEs caused by allergic or idiosyncratic patient reactions went from 56 in 1990 to 8 in 1991. These results are not from reducing errors but rather anticipating the conditions for possible harm (Alliance/IBM).

Multiple studies now demonstrate that computer based decision support can improve physicians performance and, in some instances, patient outcomes Information systems can assist in the flow of care in many important ways by making key patient information available. (Bates DW 2003).

4.3 Computerised Physician Order Entry Systems (CPOE)

CPOE is an application in which physicians write orders online. It can be linked to an order system and decision support system allowing presentation of the most appropriate orders to the physician based on diagnosis and can critique orders based in best practice (Bates DW 2000). The decision support in CPOE is intended to prevent adverse events while the order entry aspect creates its own database (Teich 2002). This system has probably had the largest impact of any automated intervention in reducing medication errors (Bates DW 2000).

CPOE fundamentally changes the ordering process, and can substantially decrease the overuse, under use and misuse of health care services. Studies have documented that CPOE can decrease costs, shorten length of stay, decrease medical errors, and improve compliance with several types of guidelines (Kuperman GJ 2003).

Different types of CPOE:

- Prevent adverse events through order checking and reminders;
- Promote optimal care through the use of order sets, templates, and disease management algorithms;

- Promote cost-effective care by sensing excess utilisation and suggesting alternatives
- Provide proactive workup guidance through disease-management algorithms (Teich 2002).

The National Roundtable on Health Care Quality recognised that problems in health care quality fall into three categories: the under use, overuse, and misuse of health care services. They noted that reducing the overuse and misuse of health services leads to an increase in health care quality while decreasing costs (Kuperman GJ 2003).

CPOE offers convenience and efficiency. Orders can be entered from any workstation in the hospital; the physician does not need to go to a patients' unit and find the chart before he/she can write orders. Because of this remote-access capability, physicians have less need to give verbal orders or telephone orders to the nurse, thus eliminating another potential source of communication breakdown or transcription error (Teich 2002).

There are good examples of the benefits of CPOE.

Following the implementations of CPOE at Ohio State University Hospitals and James Cancer Hospital a reduction of 64% was seen for medication turn around times, 43% for radiology completion times and 25% for laboratory result reporting times. Severity adjusted length of stay decreased in Ohio State by 0.2 days and in James by 0.07 days. (Hagop, Kumar et al. 2002).

Teich et al in a study to assess the impact of an inpatient computerized physician order entry system on prescribing practices, found that, 56% of preventable adverse drug events were primarily related to errors in prescribing (Teich, Merchia et al. 2000).

Evans and colleagues demonstrated reduced costs and length of stay in patients in an intensive care unit when the suggestions of a computerised antibiotic advisor incorporated into the ordering process were followed (Kuperman GJ 2003).

In another study, a randomised, controlled trial at one hospital indicated that inpatient costs were 12.7% lower and the length of stay was 0.89 day shorter for patients on general medicine wards that used CPOE with decision support (Kuperman GJ 2003).

In a time series design, Mekhjian and colleagues documented a decreased length of stay at one of two study hospitals from 3.91 days to 3.71 days (Kuperman GJ 2003).

Chaudhry et al. found that CPOE decreased rates of health services utilisation. The main services effected were laboratory and radiology services (Chaudhry, Jerome et al. 2006).

Children's Hospital of Pittsburg has eradicated handwritten transcription errors completely and cut harmful medication by 75 percent (Goldstein D 2006).

Another study of CPOE in prescribing practices found that the use of guidelines and dose selection menus resulted in significantly increased adherence to prescribing regimens known to optimise patient safety and reduce costs (Teich, Merchia et al. 2000).

A reduction of 55% from 10.7 events per 1000 patient days to 4.86 events per 1000 patient days and a potential saving to the hospital of \$480,000 was demonstrated in a study by Bates et al. analysing the effect of CPOE on prevention of serious medication errors. Bates concluded that the CPOE system reduced medication errors with potential for harm by more than half and that implementation even a modest CPOE system would result in error reduction. (Bates DW 1998).

An in early study from Indiana University Tierney et al found that implementation of a CPOE system on a medical service resulted in a reduction in the average length-of-stay days by 0.89 days.

McDonald et al found that the use of CPOE resulted in a 13% improvement in care efficiency but a zero difference in measures of patient outcomes either during or after the hospital stay. With 80% percent of all care costs initiated by a physician order McDonald et al. concluded that CPOE systems can induce more cost effective choices among physician users (McDonald 2004).

The Centre for Information Technology Leadership estimates that implementing advanced ambulatory CPOE systems would eliminate over 2 million drug events per year, avoid nearly 13 million physician visits, 190,000 admission over 130,000 life-threatening adverse drug events per year save \$44 billion per year.

The benefits of CPOE have been well documented (Bates DW 1998; Teich, Merchia et al. 2000; Mekhjian HS 2002; Bates DW 2003; Kuperman GJ 2003) Such systems can improve workflow processes by eliminating lost orders and ambiguities caused by illegible handwriting, generating related orders automatically, monitoring for duplicate orders, and reducing the time to fill orders (Mekhjian HS 2002). The use of computerised order entry, in conjunction with an electronic health record, is also

beginning to demonstrate a positive effect on clinician productivity (Overhage JM 2001).

CPOE can improve quality by standardising processes and providing physicians guidance as they care for patients. (Kuperman GJ 2003)The strongest evidence of the clinical effectiveness of CPOE is seen in medication order entry. Relatively simple systems have been shown to reduce the number of non-intercepted medication errors by up to 83 percent by using "forcing functions" for medication dose and frequency (Bates DW 2003).

4.4 Picture Archiving and Communication Systems / Radiology Information Systems (PACS / RIS)

The primary benefit of PACS/RIS systems in terms of reducing LOS is their ability to speed up the process of radiology procedures from the time of order right through to the time of receiving the full report. Other benefits include reduction in repeat radiographs and images available in many places simultaneously. It is one of the more established and accepted examples of the IT healthcare solutions available internationally.

In a case study of case study at a major public hospital in Melbourne, Australia which performs about 65,000 imaging exams per year, van der Wetering et al. found that there were improvements of between 5 and 10 min on average in waiting time for patients to receive their exams and results due to PACS. There was also increase in the total amount of examinations taken following implementation allowing for better patient throughput (van de Wetering, Batenburg et al. 2006). ✓

Key indicators such as radiology exam turnaround time, number of radiology procedures performed, inpatients length of stay before and after the PACS etc, were analysed at Reggio Emilia hospital. The study found that radiology department productivity increased by 12%, turn around time improved by more than 60%. Timelier patient care resulted in decreased lengths of stay. One service, neurology, experienced a 12% improvement in average inpatient stay. LOS for patients requiring radiology procedures decreased from 8.9 to 6.9 days resulting in a saving of 1,100 bed days. The cardio-thoracic service saved 578 bed days. Internal medicine saved 920 bed days and other areas saved 1500 bed days collectively. Outpatient examination reports times previously delivered in 5 days were available in 3 days post PACS. This resulted in decreased average waitlists for outpatients scans thereby enabling increased outpatient business. (Nitrosi, Borasi et al. 2007).

Mariana et al who also found improvements in service provision when RIS/PACS is used (between 35% to 57%), make particular reference to the contribution of speech recognition (Mariani, Tronchi et al. 2006). They note that one study showed that the mean turnaround time from report dictation to report transcription declined from 87.8 to 32.3 h with 24h report availability being 71.1% (Ramaswamy, Chaljub et al. 2000). Overall, Mariana et al found that the most important time differences are found in Execution and Reporting. In the execution phase, the complete digital handling of images eliminates the use of film and film development and bad images no longer require repeats procedures. In reporting the availability of IT tools speeds up and optimises the analysis of the image as performed by the radiologist. The use of PC speech recognition, fast access to image database in case of comparison with previous examinations of the same patient and the printing and signing of the report can be done almost simultaneously (Mariani, Tronchi et al. 2006).

Another study carried out in Christie Hospital NHS trust found that average patient examination time was reduced from 9.24 to 5.28 min. With chest examination, time reduced by 43% and the percentage of repeat examinations experienced with the digital system decreased to 8% compared to the level of 9.5% with the analogue system. Productivity at Christie Hospital was shown to increase as a result of the decreased time required for examinations (Wideman and Gallet 2006).

Numerous commentators have expressed the view that efficiencies can be had with the implementation of PACS/RIS Pilling et al. noted that there was improved medical staff efficiency because time not spent looking for films. In addition he found that Users judged PACS to be a major advance for the hospital, and an improvement in their working lives.(Pilling 2003).

Roche et al. found that early detection of diabetic retinopathy in primary care using digital retinograph identified 4000 cases in their early stages. Digital retinography is cheaper than conventional examination. Identified cases are managed with minimal need for acute care (Rocha 2007).

Arenson described that patient care could improve with faster access to images, leading to earlier actions on patients in acute situations such as in the intensive care units. The combination of computed radiology and softcopy interpretation often has resulted in a major decrease in the need to retake images, thereby improving the quality of service to the patient. (Kim, Park et al. 2002).

It appears that with efficient use of PACS and speech recognition, it is possible to moderately increase examination volumes while maintaining radiologist staff levels (Langer 2002).

Nitrosi et al concluded that a well-planned PACS deployment simplifies imaging workflow and improves patient care throughout the hospital while delivering substantial financial benefits. Staff buy-in was the key in this process and on-going training and process monitoring are a must (Nitrosi, Borasi et al. 2007).

4.5 Managing Adverse Incidents

The Institute of Medicine has helped to define quality by stating that healthcare should be safe, effective, patient-centered, timely, efficient, and equitable (Morgan Morris 2002) However, as we know, medicine will never be a risk free enterprise. We must, make the system as safe as possible for patients and staff. (DoHC Ireland 2008).

Studies of adverse events in numerous countries around the world demonstrate that between 4% and 16% of patients admitted to hospital experience one or more adverse events, of which up to half are preventable. Understanding why preventable errors occur is key to developing strategies by which they can be addressed and minimised.

Reports from the IMO have expressed concerns about medical errors and patient safety, and the quality of medical records. (Hersh 2002). They recommend that we identify errors, evaluate causes and take appropriate actions and concluded that mistakes can best be prevented by designing a health system that all levels is safer, making it harder for people to do something wrong and easier for them to do it right. This "systems" view of patient safety is now widely accepted internationally and mirrors the approach taken in many other major risk industries such as the aviation industry (Institute of Medicine 2000; DoHC Ireland 2008)

As many as 18% of preventable adverse drug events (ADEs) arise from the clinician having insufficient information about the patient (Michael Yang 2002). IT can ensure that more information is available to the clinician at the point of care and help to reduce ADE's

Computerised tools can also be used with electronic medical records to identify, intervene early in, and track the frequency of adverse events. Classen et al, pioneered an approach for combining clinical data bases to detect signals that suggest the

presence of an adverse drug event in hospitalised patients. This approach identified 81 times as many events as did spontaneous reporting, which is the standard technique used today (Bates DW 2003).

Electronic tools designed to identify a broad array of adverse events in a variety of settings seem promising. Often, these signals may permit earlier intervention; for examples, Raschke et al found that 44 percent of the alerts generated by a tool that they build had not been identified by the team of clinicians (Raschke R 1998) (Bates DW 2003).

Medication errors are among the most common adverse incidence in healthcare. And detecting them is one way of ensuring they are reduced Bates and colleagues found that preventable adverse drug events and potential ADE's occurred in 7.3 percent of admissions. Of these, 66 percent were not intercepted and 25 percent resulted in an ADE. For a hospital with 20,000 annual non-obstetrical admissions, this amounts to almost one ADE per day (Heins JE 2002).

Adverse drug events are frequently identified in the nursing home setting; in a recent study of two large long – term care (LTC) facilities, the rate of adverse drug events was nearly 10 per 100 resident – months. The same study indicated that a substantial proportion of the adverse drug events in these LTC facilities may have been preventable and that a majority of errors that were associated with adverse drug events occurred during the ordering and monitoring stages of pharmacotherapeutic management. If these findings are applied to the residents of all U.S. nursing homes, then approximately 1.9 million adverse drug events – more than 40% of which are preventable – may occur each year. Of all adverse drug events, 86,000 may be fatal or life-threatening (Subramanian, Hoover et al. 2007).

A system installed to detect opportunities to reduce Adverse Drug Events (ADE's) at Good Samaritan Regional Medical Centre in Arizona detected opportunities to reduce ADE related injury in 6.4% of admissions. In a similar study, Leape et al. combined preventable and potential ADEs to calculate the total number of preventable events. Opportunities to reduce ADE related injuries were detected in 6.9% of admissions in this study. (Raschke R 1998).

Dexter et al. conducted a randomised controlled trial to determine the effects of computerised reminders on the rates at which four preventive therapies were ordered for inpatients. 54% percent of patients were identified as eligible for preventive measures, but these measures were not ordered by the admitting physician. However the reminders did significantly increased the rate of delivery of the therapies. The

authors believe that this trial provided compelling evidence that computerised reminders can increase the delivery of preventive care in hospital patients (Dexter, Susan et al. 2001).

Kucher et al, in a study of prophylaxis against deep-vein thrombosis in hospitalised patients found that installation of a computer alert programme increased physicians' use of prophylaxis and markedly reduced the rates of deep-vein thrombosis and pulmonary embolism among hospitalised patients at risk (Kucher, Koo et al. 2005).

In a head to head comparison with chart review and spontaneous reporting, a computerised monitor was found to detect 45% of events detected by any method, compared with 64% for chart review and only 4% for voluntary reporting. The cost of computerised monitoring was only 20% of that for chart review (Bates DW 2000).

Medication errors are one of the highest adverse incidence categories One method shown to improve patient safety and health system efficiencies is reducing ADE's using electronic prescribing or ePrescribing. This refers to the use of computing devices to enter, modify, review, and output or communicate drug prescriptions. These systems can eliminate confusion due to illegible handwriting and prevent errors in dosage and drug combinations. According to The US Centre for Information Technology Leadership the use of ePrescribing would create about 2 billion dollars in savings in the United States for reduced hospital and doctors visits due to fewer prescribing errors. About 27 billion dollars saving per year are estimated due to fewer medication errors, the elimination of duplications and information on cheaper generic alternatives available to doctors while in the prescribing process (Schug S 2007). Given the above it is probable that hospital admissions related to illness resulting from prescribed medication could significantly resulting in savings in bed days and other resources.

Unfortunately, according to the American Society of Health – System Pharmacists, the adoption of computerised medication order entry technology is limited, even for some of the most advanced organisations in the United States. They estimate that 13 – 15 percent of hospitals today have some form of computerised medication order entry implemented, but physicians in these organisations enter less than 25 percent of the orders. The use of advanced clinical decision support capabilities (i.e. automated screening of laboratory data relevant to medication orders) within pharmacy systems has not been broadly evaluated, but experience suggests that this is a relatively small percentage of organisations (Heins JE 2002).

Automation is known to reduce errors in drug prescribing and dosing. To realise the full benefit of information technology, healthcare organisations must view information

technology strategically, spanning processes across the organisation (Morgan Morris 2002).

A two-pronged approach is required to address adverse incidents

1. To have systems in place to detect and prevent errors. Hospital computerised physician order entry (CPOD) systems are widely regarded as the technical solution to medication ordering errors, the largest identified source of preventable hospital medical error. Published studies report that CPOE reduces medication errors up to 81% (Koppel, Metlay et al. 2005)
2. To have a system in place, which requires reporting of medical errors so as information, can be used to prevent future errors. The IMO recommends that these reporting systems be both mandatory and voluntary – to complement the mandatory reporting (Institute of Medicine 2000).

Voluntary reporting systems rely on strong educational initiatives, institutional supports and professional codes of conduct to encourage promote and support healthcare professional codes of conduct to encourage promote and support healthcare professionals in reporting adverse events. Mandatory systems seek to make healthcare providers accountable for serious mistakes by requiring that the mistakes be reported, and by providing disincentives such as sanctions for the continuation of unsafe practices (DoHC Ireland 2008).

Reason dictates that we reduce errors. However, human limitations guarantee that clinical error will not disappear. Human error and injury are unavoidable. Bates states that self reporting, radically underestimates adverse drug events, detecting only about 1 in 20 whereas computerised data can be used to detect signals that are associated with an adverse reaction (Bates DW 2000). Morris writes that clinical error rates are common (1-50%) and that most human errors are not shocking in fact, adverse drug events are generally undetected. He concludes that traditional screening for in-hospital adverse drug events detects only 1% and voluntary reporting only 12% of the adverse drug events detected by automated computerised screening. (Morris 2002).

4.6 Radio Frequency Identification (RFID)

RFID, although not a new technology, is one of the most recently emerging technologies to arrive in healthcare. It is in its early stages of development in the industry and has many potential uses. To date it appears that the main aim of this technology is to increase patient safety. In 2005 a survey of over 300 healthcare

executives reported that 67% of respondents cited patient safety as a very important benefit of using RFID technology - 48% cited patient identification and 46% cited medication administration as their preferences for its use (BearingPoint 2006). At this stage it is difficult to find any RFID projects, which have had a major impact on LOS in acute hospitals, however its potential to do so exists and therefore the applications available are worth mentioning.

Real Time Location Systems (RTLS)

RTLS can be used to track patients, staff, laboratory specimens and expensive assets. Tracking through departments and procedures can optimise resources throughout an organisation. For example, the tracking of samples from collection through laboratory processes to achieve optimum turnaround times helps improve patient processing and efficiency. It also prevents the patient having unnecessary repeat procedures (Zebra Technologies 2006) .

RFID's unique identification allows for individual people to be located on a floor plan of an organisation, also potentially improving efficiency. Alexander Hospital and the National University Hospital in Singapore implemented RFID to control the flow of people during the SARS outbreak (Liao, Liu et al. 2006).

Medication Management

Misidentification of patients is a common problem that many hospitals face on daily basis. Patient misidentification is one of the leading causes of medical errors and medical malpractice in hospitals and it has been recognised as a serious risk to patient safety (Aguilar A). It is universally agreed that better patient identification is a fundamental starting point for improved patient safety and will reap rewards in transfusion, medication administration, radiology, laboratory medicine, and surgery (Dzik 2003).

Positive patient identification and ensuring the "Five Rights" of medication administration: right patient, right drug, right dose, right route and right time; using RFID technology can greatly reduce the volume of medication errors which are reported to cost £½ billion each year in the NHS in longer hospital stays (Audit Commission 2001). The technology can ensure the medication being administered is for the correct patient, the right dose, the right medication right time and right route.

Transfusion and Blood Products Management

Similarly with the transfusion of blood and blood products where stringent records must be maintained of the full process, RFID technology has a major roll to play in patient safety. There is an estimated one in 14,000 chance in the U.S. that a patient

will receive the wrong blood due to human error, with 10 to 15 reported deaths as a result each year (Lusky 2005). As with pharmaceutical production, RFID can be used to track a blood or blood product unit from blood bag manufacture, donation, production testing, storage, distribution and transfusion (Knels R 2006). As with other examples, safer transfusion process can reduce error and therefore LOS.

Patient Management in the Operating Theatre

The Use of RFID is also being explored in relation to Operating theatres where identification of the right patient for the right procedure is of paramount importance. (Sandberg et al (2005). Chang-Gung Memorial Hospital (CGMH) in Taiwan has introduced a solution which focuses on patient safety, verification, and identification in operation theatres, collection of data in real time, reduction of wrong-site and wrong-patient surgeries, automation of various manual functions, administration of the right medicine in the right dosage at the right time, and ensuring compliance with hospital policies for patient safety and operating procedures. Birmingham Heartlands Hospital in the UK is currently testing the use of RFID and photo identification to prevent surgical errors for ENT patients (BJHC 2005).

Other uses of the technology are also being explored in this area including the tagging of instruments and swabs to prevent these being accidentally left in body cavities. In the US, 1500 patients yearly have something erroneously left in them by operating staff (Institute of Medicine 2000).

Leaving foreign bodies in patients during procedures. In the United States during 2000 to 2002, 2,591 cases of foreign bodies left in patients during procedures were reported. The fiscal impact of such incidents is placed at \$17.25 million in excess costs (Nagy P 2006).

Diagnostic Imaging Management

The use of RFID technology in Diagnostic imaging has the potential to ensure that the correct patient is having the correct procedure. One of the best examples current use of RFID for patient care focusing particularly on the patient is in the CT suite of the Advocate Lutheran General Children's Hospital in Illinois where the technology has been developed in such a way as to provide a holistic "fun" experience of an otherwise scary event for any child. The technology is educational, interactive and completely child orientated and has the potential to reduce the child's LOS.

Everyone benefits, clinicians as well as patients. In a 'traditional' scanning situation, about one-third of children require sedation because they are unable to relax enough for a successful diagnostic exam. This can add six to eight hours of recovery time to a procedure that could be completed in 15 minutes. This means an extended LOS for the

child. 'Positive distraction' keeps young patients calm so they're more likely to lie still. It also cuts down on the amount of radiation they're exposed to by avoiding the need for a re-scan, again creating resource efficiencies.

Community Patient Care – Care of the Elderly

With elderly patients a number of uses for RFID technology and RTLS have been suggested, from using the technology to monitor people in their own homes (Donoghue A 2005) to implanting subcutaneous RFID devices to track and prevent patients with dementia from wandering. The potential with this is the ability to facilitate elderly patients remaining in their own environments for as long as possible. A family member or a healthcare provider can monitor an individual from a distance. Potentially, this may reduce the need for hospital admission as the patient is in a monitored and safer environment where care can be managed without acute hospital intervention. It also reduces the possibility of accidents happening at home, which may result in the need for hospitalisation.

Community Patient Care – Chronic Illness Management

Implementation of RFID with sensors will make a great opportunity for monitoring patients suffering chronic diseases such as diabetes. For example, the Digital Angel Corporation has patented a glucose-sensing RFID tag. These tags will monitor patient glucose level over a period of time and a future development could include the use of a subcutaneous slow release insulin which is also RFID controlled where the insulin is released in direct relation to the patients blood sugar thus ending the need for insulin pens and glucometers. Continuous monitoring and treatment of patients with chronic illnesses can reduce the need for repeated hospital admissions.

Community Patient Care – Haemophilia Management at Home

There are approximately 2000 patients in Ireland with Haemophilia 200 of which have severe haemophilia. 60% of the haemophilia patients in Ireland receive their required product at home. The National Centre for Hereditary Coagulation Disorders in St. James's Hospital are currently using an EPR and unique medication barcode and RFID to identify patients, testers, locations and medications. Positive results have shown documentation errors reduced from 12 in the year prior to implementation to 0 in the year post implementation (White, B, 2006).

While there is potential for RFID to have a positive impact on acute hospital LOS it also has some limitations. There is:

1. Insufficient quantifiable results of the technology
2. Lack of standardisation of protocols for RFID

3. Lack of integration
4. Issues with interference and reliability. Security and privacy issues
5. Cultural barriers (Nagy P 2006).

The application of RFID technology in hospitals has been modest, mainly due to the cost and early developmental stage of the technology (Aguilar A).

4.7 Tele -Medicine and Chronic Disease Management.

In the US more than 50% of people use the web regularly, and of those, more than 50% search for personal health information. Studies have shown that users were almost as likely to turn to the Internet for healthcare information, as they were to their physician. (Daniel Z. Sands 2004) As well as this 90% of physicians use the web on a regular basis (Hersh 2002). With the increase in technology these figures are constantly increasing and probably reflect the trend worldwide. Armed with this information it is reasonable that the application of eHealth is very conceivable. Reasons for applying eHealth include a growing population of the elderly, more of them chronically ill, and an increase demand for rehabilitation and telemedicine. The idea of moving the information not the patient is more meaningful than ever, especially since eHealth applications require less and less patient travel

One of the most common patient centred eHealth applications is telecare or telemedicine. This can be defined as "the delivery of healthcare to individuals within the home or wider community, with the support of devices enabled by ICT" (Tang P 2000). It includes access to information, physiological monitoring, and management of the environment (Clark 2006). For telecare to be complete it is essential that it has the ability to populate EHR systems, especially for those patients which chronic conditions. (Hummelink R 2007).

Common applications of telecare include

- Home monitoring of vital signs for patients with chronic disease, as well as replacing home visits by nurses in person with telemedicine videophone consultations.
- A Patient-managed Home Telecare System with integrated clinical signs monitoring, automated scheduling and medication reminders, as well as access to health education and daily logs, is presented as an example of ICT use for chronic disease self-management.

It has been demonstrated that early identification of adverse trends in clinical signs recorded in the home can either avoid hospital readmission or reduce the length of hospital stay. Typical applications include the management of chronic heart failure, asthma, diabetes and hypertension. These and other applications may be based around videophone systems which allow nurses or doctors to view and talk to the patient while collecting data from equipment that records vital signs (Celler BG 2003).

Expected outcomes of telecare services

- Reduce the need for residential / nursing care
- Unlock resources and redirect them elsewhere in the system
- Increase choice and independence for services users
- Reduce the burden placed on carers and provide them with more personal freedom
- Contribute to care and support for people with long term health conditions
- Reduce acute hospital admissions
- Reduce accident and falls in the home
- Support hospital discharge and intermediate care
- Contribute to the development of a range of preventative services
- Help those who wish to die at home to do so with dignity (DOH 2005)

One of the areas where telecare has potential to be most beneficial is Chronic Disease Management. Chronic diseases are the leading cause of illness, disability and death worldwide, and their prevalence is rising. The World Health Organisation has identified that chronic conditions become the most expensive problem for health care systems. Together they may account for nearly 70 percent of the health budget in some countries. Currently chronic conditions are responsible for 60 percent of all deaths worldwide (Rocha 2007).

There is growing evidence suggesting that patients with chronic conditions do better when they receive effective treatment within an integrated system with self-management support and regular follow-ups. In the analysis of one US chronic disease programme a reduction of emergency room visits and yearly inpatient days was noted. In the same way a health study in the U.K. – Castlefields – showed a reduction in admission for older people, a better control of hypertension in diabetic patients, and, more importantly, a significant reduction in cardiac diseases (Rocha 2007).

The Florida Program and the Creation of Veterans Affairs (VA) Office of Care Coordination (OCC) was established with the specific aim of using technology to

maintain patients who had chronic diseases in their homes. Technologies included videophones, tele-monitoring devices; in-home messaging devices, a PC Web-based interactive system, and specialised instamatic cameras for wound care follow-up (Spotswood 2004).

According to VA, in 2002, the outcomes analyses of the pilot programs showed a 40 percent reduction in emergency room visits, 63 percent reduction in hospital admissions. 60 Percent reduction in bed days of care, 63 percent reduction in VA nursing home admissions and an 88 percent reduction in nursing home bed days of care when care coordination was used to help treat the patients in the home environment. The most telling statistic of all was patient satisfaction rates, which topped 90 percent (Spotswood 2004).

In the United Kingdom people with chronic conditions account for over 60 percent of hospital bed days. Consequently, chronic diseases are associated with high health care expenditures and are a huge challenge for the health care systems (Rocha 2007)

In Australia it is estimated that improved knowledge sharing and care plan management for patients with chronic disease would generate direct savings to the healthcare system of \$1.5billion per annum. Savings to the community from associated non-healthcare costs are of the same order. And increased workforce participation and productivity could add a further \$4 billion pr annum to the economy (Georgeff 2007).

For the patients, home monitoring could reduce emergency room attendances by up to 40%, hospital admissions by 30 – 60% and hospital LOS by up to 60% (Georgeff 2007).

In a report for the Australian Centre for Health Research Michael Georgette found that no less than 25% of all Australians suffer from chronic illness and nearly every one of these would be better off if the medical practitioners who care for, and treat them were more in touch with each other. Costs of a health system in which providers of health care to chronically ill people operate in disconnected silos where one doctor often does not know what another has tested for and prescribed, are worrying.

For example:

- More than 50% of doctors do not follow best practice guidelines.
- 30 – 50 % pf patients with chronic disease are hospitalised because of inadequate care management
- Less than 14% of people with chronic disease are placed on care plans

- Less than 1% of patients are tracked to see if they adhere to care plans.

The evidence for better outcomes through more proactive patient interaction is persuasive – one study demonstrated that better disease management improved patient satisfaction by 71%; patient adherence to care plans by 47% and disease control by 45% (Georgeff 2007)

Georeff believes that getting healthcare providers and users connected and communicating is essential in managing chronic diseases and once the broad based connectivity is achieved there are many ways in which disease management can be facilitated.

Hospital admissions due to chronic obstructive pulmonary disease (COPD) exacerbations have a major impact on the disease evolution and costs. Casas et al. have demonstrated that low intensity integrated care intervention can be effective to prevent such hospitalisations. In a study of patients with chronic obstructive pulmonary disease (COPD) in two cities, Barcelona and Leuven it was shown that the use of an integrated care-plan using web based technology resulted in a lower number of re-hospitalisations. (Casas A, T et al. 2006).

Other trials involving COPD patients have been able to conclude that home-based schemes are associated with cost savings as well as decreased hospitalisation (Seemungal and Wedzicha 2006).

Osman et al. found that an asthma education programme based on computerised booklets can reduce hospital admissions and improve morbidity among hospital outpatients (Osman, Abdalla et al. 1994).

Progression of chronic heart failure (CHF) can lead to increasing hospital attendances and admissions. Early detection of any alteration in condition using ambulatory tele-monitoring of multiple vital parameters may avoid hospital admission. In a study of patients with CHF Downes found that before tele-monitoring 96 cases of hospitalisation accounting for 1374 days were required. With tele-monitoring the number of admissions to hospital could be reduced by 78 percent, the number of days actually spent in hospital by 85 percent (Downes R 2007).

The benefits of home Telecare for managing CHF, however, have been extensively reported and studies have found significant cost savings. One found an 83% decrease in the admission rate for those with CHF in the third quarter of the year after the intervention, compared with the third quarter of the year before the intervention.

Another reported that when a Telecare group of patients with CHF was compared with patients receiving usual care, mean CHF – related readmission charges were 86% lower, with fewer CHF related emergency department visits (Celler BG 2003).

A recent systematic review showed that programmes for the management of chronic heart failure that include remote monitoring have a positive effect on clinical outcome, reducing the rate of admission to hospital and mortality by 20 percent (Rocha 2007).

Because patients battle their chronic illnesses mostly on their own, away from clinicians or medical centres, it is imperative that they become active participants in their care (Spaeder 2004).

Improving the health of people with chronic illness requires transforming a health care system that is mainly reactive to one that is proactive and focuses on maintaining healthy patient rather than waiting to treat a sick one (Rocha 2007). As evidence accumulates that telemedicine in combination with disease management reduces morbidity and medical cost, telemedicine will become a routine component of outpatient management (Spaeder 2004).

There are areas other than disease management where telecare can benefit LOS and patient outcomes. Studies in the UK have shown that the economic benefits of telecare are considerable. A study of the elderly with dementia in Northamptonshire found that over 21 months evaluation period, people without telecare were four times more likely to leave the community for hospital or residential care. The equivalent cost saving over 21 months was £1.5million (DOH 2005).

Stroke morbidity and mortality can considerably be reduced by early treatment. Recently in Berlin, the use of Telestroke as the application of telemedicine for acute stroke has demonstrated that teleneurological examination and treatment is feasible and reliable. The aim of StrokeNet is to improve pre – and early intra – hospital stroke care with telemetric examination prior to hospital arrival. (Von Reden A 2007). Patients who receive timely treatment for strokes can have a considerably shorter LOS than those who do not.

In an evaluation of nurse telephone consultation using decision support software in comparison with usual general practice care provided by a general practice cooperative Lattimer et al. concluded that nurse telephone consultation in out of hours primary care may reduce NHS costs in the long term by reducing demand for emergency admission to hospital. The service produces benefits in terms of service quality (Lattimer, Sassi et al. 2000)

Remote monitoring can reduce the amount of recurring admissions to hospital, facilitate more efficient clinical visits with objective results, and may reduce the length of a hospital stay for individuals who are living at home. Tele-monitoring can also be applied on a long-term basis to elderly persons to detect gradual deterioration in their health status, which may imply a reduction in their ability to live independently. Mobility is a good indicator of health status and thus by monitoring mobility, clinicians may assess the health status of elderly persons (NiScannail C 2006).

Long-term, sensor-based measurements taken in a person's natural home environment provided a clearer picture of the person's mobility than a short period of monitoring in an unnatural clinical setting. By monitoring and recording a patients' health over long periods, tele monitoring has the potential to allow an elderly person to live independently in their own home (NiScannail C 2006). An estimated 90% of older people want to live in their own home (DOH 2005)

Objective mobility data can be used to monitor health, to assess the relevance of certain medical treatments and to determine the quality of life of a patient. The need for expensive residential care (estimated at €100 per patient per day), home visits (estimated at €74 per patient per day), or prolonged stays in hospital (estimated at €820 per patient per day) could be decreased if monitoring techniques, such as home tele-medicine (estimated at €30 per patient per day), were employed by the health services (NiScannail C 2006).

The evidence exists to show that telecare has a major role to play in changing the way we manage patient care for the better.

CHAPTER 5

BARRIERS TO IMPLEMENTATION OF IT IN HEALTHCARE

Bates reports that despite the substantial opportunities for improvement in patient safety, the development, testing, and adoption of information technology remain limited. Numerous barriers exist, although some approaches to overcoming them are at hand (Bates DW 2003). Barriers are not new although the nature of them has change. Haux et al states that between the 1960s and 1990s barriers were primarily technical in nature whereas today there has been a significant shift towards organisational problems and change management (Haux 2006).

One of the main broad reasons that barriers still exist is that IT's rapid progression means that it is still seen as a new development in healthcare. New trends and changes are often not readily accepted and not given priority by users in particular if the benefits are not fully understood by primary clinical users Hersh 2002.

Reports from the Institute of Medicine have expressed concerns about medical errors and patient safety, the quality of medical records and the protection of privacy and patient confidentiality (Hersh 2002).

The Main Barriers that exist today are as follows:

1. Financial Barriers
2. Technological Barriers
3. Attitudinal and Behavioural Barriers.
4. Organisational Change Barriers (IMS HIT Initiative 2005)

Financial Barriers

The high up front financial costs of implementing EMRs with uncertain financial benefits is a primary barrier to their adoption (Miller and Sim 2004)The high initial costs (EHR installation training, and motivation of staff etc) of development and implementation of IT as well on going change are substantial. Providers find it hard to commit to ongoing funding when the benefits are not seen at the cold face of care provision immediately. They need certainty that there will be a significant return on investment. Ultimately it is society who will determine who pays the cost of IT because even if they save money, the upfront costs will be substantial (Hersh 2002).

Technological Barriers

The IMS report that issues such as inadequate technical support, inadequate data exchange and fragmentation, lack of adequate electronic data exchange between EHR and clinical data systems such as lab, radiology, pharmacy, and referral systems can prevent seamless implementation of IT systems. In addition poor Internet connectivity, customising and lack of standards also contribute to the technical barriers (IMS HIT Initiative 2005). Another major technological challenge is the protection of privacy and confidentiality (Hersh 2002) The result has been that most applications do not communicate well, even within organisations, and the cost of interfaces are high (Bates DW 2003).

Interoperability is an ongoing challenge. Technical and organisational barriers preclude a uniform infrastructure for exchanging medical records on an Intranet. To exchange patient identified information among hospitals, even apparently simple tasks, such as identifying the correct patient, can be a challenge (Safran and Goldberg 2000).

Most experts conclude that the public Internet does not offer adequate protection for transmission of medical records. Newer technologies, such as virtual private networking, which creates secure connections within the public Internet, and wide-scale deployment of public key infrastructures, may provide a means of exchanging confidential information on public networks (Safran and Goldberg 2000).

Advances in health care informatics should help develop solutions that will overcome those technical barriers slowing down the massive use of ICT in health care (Fieschi 2002).

Attitudinal and Behavioural Barriers.

Healthcare workers show concerns about how IT systems will change the healthcare delivery and the relationship between and among providers, patients, and healthcare organisations. Many physicians are still uncomfortable with computers and fear that electronically inputting information may take more time than writing and dictating.

There is a lack of leadership mainly out of fear. Staff may fear job losses, may resist change. Physicians may see certain systems such as DSS as being told how to do things and a threat to their clinical ability and individuality. In addition there is a whole physical change of environment, which may involve disruption.

Many health care professionals as users accept the necessity of computer based health information systems and see their benefits, but they are not really content. They know that computer-based information processing tools are still improvable, especially with

respect to the ease of use and the ease of data input and have concerns about the increasing amounts of data in medicine and health care. (Haux 2006). There is also a tendency for clinicians and policy makers to see information technology as relatively unimportant (Bates DW 2003).

The introduction of IT into nursing and healthcare is a social, not just a technical task. It's not about IT as such, it's about change management. In the UK it has been described as "the biggest computer programme in the world ever". The importance of consultation, communication, leadership, decision making education and training, and change management cannot be emphasised enough. (Clark 2006).

Organisational Change Barriers

Physicians have often expressed the fear that IT systems will slow them down, force them to function as clerical staff, or dictate the practice of medicine (Heins JE 2002). Heathfield et al states that clinicians are becoming increasingly involved in the development and procurement of information technology in health care, yet evaluation studies have provided little useful information to assist them. Perhaps this is why the lack of clinical input to date has been cited as a major factor in the failure of information technology in health services (Heathfield H 1998). Clinicians who are to use the systems must be involved from the beginning in their design and development (Clark 2006). They will have to accept some impact on their practices, particularly as the individual physician becomes more accountable to document increasingly expensive care and demonstrate avoidance of error. (Hersh 2002). Grimson et al noted that technology change and organisational change cannot be considered in isolation from each other (Grimson 2002).

The move from paper to paperless may be a big upheaval, which may take time to get used to. Essentially what this all means is that there is a complete change to workflow design. Resource allocation may change, responsibilities may change and process issues are exposed which can cause hard feelings with staff. The resulting and necessary staff training will cause temporary reductions in productivity. There may initially be Uncertainty about the types of training and skills needed to adopt IT systems for healthcare quality (IMS HIT Initiative 2005)

At organisational level the key challenges have been managing complex informatics applications and the computer networks upon which they run. Although individual computers are relatively inexpensive, maintaining large networks of them and training the myriad of healthcare workers who use them are not. Berg has noted that the interpersonal challenges to large organisations in implementing EPR's is much more daunting than managing the technology itself (Berg 2001).

Most authors agree that IT is essential to the provision of quality, safe, best practice patient care. It is now essential that clinicians, in their practices and relationships with colleagues and health care facilities, as well as government recognise that investment in and adoption of new forms of information technology must be considered as being as vital to good patient care as the adoption of new technological tools for diagnosis and treatment (Bates DW 2003).

CHAPTER 6

INFORMATION TECHNOLOGY IN HEALTHCARE IN IRELAND

In Ireland, The Health Service Executive (HSE) is currently actively engaging in transforming the Irish Health Service. It has produced a number of documents in recent years, which outline how they intend to implement this transformation.

One of the primary aims is to significantly reduce the dependence on acute hospital care by providing much of the care currently provided in acute hospitals within the primary care setting. It has set targets for improvement in Acute Hospital ALOS going forward.(HSE 2007). This is reflected in the HSE's *Acute Hospital Bed Capacity Review – a Preferred Health System in Ireland by 2020* and in *Transformation Programme 2007 – 2010*.

The success of this massive change sits on the implementation of “The Preferred Health System”. This system seeks to deliver

- Better Service to Patients. More accessible health services configured locally around the patient, rather than centrally around hospitals, e.g. increasing the diagnostics available from your GP, expanding community nurse services to enable more patients to be treated at home.
- Better Patient outcomes. A shift towards prevention and better self-care to reduce acute episodes as well as less invasive surgery, e.g. day case as standard for cataracts. Patients also spend fewer days in hospital, which reduces the risk of infection.
- More efficient service for taxpayers. Bring the performance statistics for Irish Hospitals more in line with international comparisons. Installing a performance improvement culture across the health system, e.g. hospital inpatient discharge planning as standard (HSE 2007).

At present and based on existing practice, Ireland requires 12,778 public patient beds to meet existing demand. – a short-fall of 1,118 beds. If the Preferred Health System was in place today in Ireland would require 5,202 fewer hospital beds than currently in place to meet existing demand (HSE 2007).

Changes in demographics and increases in rates of conditions such as cancer, diabetes and cardiovascular disease, mean that there is likely to be a 60% increase in the demand for acute hospital services from 2007 to 2020. Based on this it is hard to see

how this transformation can take place without complete change in service provision. IT has to play a significant role if successful transformation is to take place. (HSE 2007).

The HSE predict that with successful implementation of the Preferred Health System, the number of public patient hospital beds Ireland is going to require in 2020 will be 8,834. Reduction of 2,826 fewer acute hospital beds being required than are in place today (HSE 2007).

Implementation not only requires hospitals to do things differently, it also requires services and capacity to be in place in primary and community care that are not currently sufficiently developed. It requires integration of care that enables patients to move easily between hospitals and the community. It presupposes the availability of new technology and infrastructure to facilitate local services better configured around the patient and community care (HSE 2007).

Factors, which negatively affect LOS and inappropriate admissions, have been addressed in chapter 3. Eliminating most or all of these factors is what is required to move to The Preferred Health System". The presumed availability of new technology will hopefully address these and other issues.

The HSE recognise the need and potential of IT. They welcome telecare recognising that there is a need to address our increasing levels of chronic disease. 20% of Irelands population currently have chronic disease (Smith 2007). The projected increases in population anticipated will no doubt mean that this figure is set to rise in the future.

Developments in information technology now mean that monitoring patients at home is now a practical alternative to keeping people in hospitals. Remote consultation and monitoring, combined with the emergence of the expert patient could reduce dependence on acute care (HSE 2007)

HSE also recognise that less invasive procedures require a shorter recovery time. Continuing development of minimally and/or less invasive approaches to surgical procedures (lap chole, hip replacement, thoracic surgery, open-heart surgery) and diagnosis (FAST CT, PET) will support reductions in length of stay and the shift of care from inpatient to outpatient setting.

They are aware that access to diagnostics is a key issue in the Irish health system noting that the principal alternatives to acute admission identified for patients at the point of admission are (HSE 2007).

- Access to assessment / diagnostics without acute admission
- Home – based patient care including GP support, therapy, specialist nursing, community nursing and home care packages.
- Access to non –acute bed with therapy support e.g. physiotherapy (HSE 2007).

There is increasing health technology innovation. Much of its impact over the last twenty years has been a move towards less intensive and invasive care often completed as outpatients. It is likely that this general trend will continue to 2020 with changes in diagnostic and treatment technologies, rather than policy interventions, allowing conditions to be managed in settings other than inpatient beds (HSE 2007).

HSE Transformation Programme Priorities are to:

- Develop integrated services across all stages of the care journey
- Configure hospital services to deliver optimal and cost effective results
- Implement model for prevention and management of chronic illness(HSE 2006)

All these priorities recognise the need for increased IT in healthcare.

The Information Society Commission points out that the Irish health service has a significant and ambitious change agenda planned. Many of the reforms envisaged are heavily dependant on technology and in recognition of this, the Government doubled the Health Service ICT spend for 2004 to €18million (Information Society Commission 2004). This is a very significant development and underlines a commitment to make the necessary decisions to prioritise information as the very foundation of a high quality and responsive healthcare system (DoHC Ireland 2004)

The Information Society Commission Report – *An e-Healthy State* notes that spending in ICT in the Irish healthcare system has languished behind investment levels internationally, and accepted ICT investment levels in other sectors. Other countries that have shown similar levels of historic under-investment, such as the UK, have recognised this and instigated significant programmes of investment. They state that Much of the concern expressed about the health reform programme relates to the fear of services being centralised and being more difficult to access for citizens living away from these locations. They also point out that as an island economy, Ireland could,

and should, set a target of being seen as a leader in eHealth research and adoption within the EU (Information Society Commission 2004).

The Commission makes a number of recommendations in this regard:

- 1 - That a significant ring-fenced be created to finance eHealth projects
- 2 - That HIQA develop a framework to measure and evaluate the totality of benefits that should be delivered and need to be delivered to justify the investment required in eHealth systems
- 3 - That current examples of best practise in eHealth are used as a basis for further development
- 4 - That eHealth applications be designed and developed on a "shared alliance" basis that facilitates patient care. There is little benefit in developing, as an example, GP systems that do not integrate with hospital or community systems. If patient interaction is placed at the centre of system design, then the resulting systems will deliver maximum patient benefit.
- 5 - That Irish health agencies proactively seek to benefit from the funding and expertise available (Information Society Commission 2004)

In an Irish context, an analysis of the benefits that should be realised from the implementation of a national hospital information system predicted realisable efficiencies of €345 – 550 million over the first 10 years of the system. Even the conservative level of benefits estimated would cover the cost of the investment required to develop and maintain the system (Information Society Commission 2004).

In the past, IT has been under funded the Deloitte and Touché report, *Audit of the Irish health System for Value for Money (2001)*, pointed out that the outcome of under-investment in information and communications technology (ICT) in the past is an inadequate infrastructure to meet the complex information needs of a modern health service including performance management and demonstrating value for money (DoHC Ireland 2004).

In recent years, there has been some progress made in implementation of IT in healthcare. According to Damien McCallion Head of ICT Directorate, HSE, the big step needed is to link primary and secondary care in this regard there has been some progress, for example "The National HealthLink Project" A project which has developed and implemented an electronic communication system between primary and secondary care and has greatly improved the efficiency of information exchange between GPs and hospitals in areas such as radiology, lab results and waiting times (Information Society Commission 2004)

On the other hand here are areas of primary care, which are devoid of IT systems. Some don't even have e-mail. McCallion says that "although there have been some good initiatives in individual places, there hasn't been any sort of cohesive approach". "Some of the problems with this have been down to individual areas themselves. Another problem is that our systems are quite old and significant investment is needed to replace them". Having said that McCallion points out that "IT investment on its own won't solve the problem".

He says that there is a strategy about to be published, which is a three-year plan for IT implementation. He recognises that different organisations are at different levels with IT - some still need basic pharmacy management systems and basic patient administration systems etc.

Some hospitals have good HIS as well as PACS, Order Entry etc, but this is mainly confined to the teaching hospitals. McCallion says the as part of the strategy there is a major plan to role out PACS nationally. He sees it as "one easiest of all the technologies to implement, in that from a clinicians perspective they don't really see it as IT, they see it as medical imaging, there's less resistance to it and everyone's up for it." He says that the advice from Canada and other countries is, if you want something that's going to probably fund the back wall of your EPR, PACS is it".

Another major action of the new strategy is to role out the national client index - which is a patient identifier establishing of a base index. This is currently at the public tender stage.

McCallion is mindful that the ICT has been under the spotlight for the wrong reasons in the past saying that there has been a need for confidence building after PPARS

In terms of funding McCallion believes that in the short term, "over the next 12 - 18 months maybe up to two years there's probably enough capital funds in the system. The issue is getting the projects through and structured in a rigorous enough way" He points out however, that we don't have a very high IT skill base here in terms of the types of people we need to make projects work.

Having said that some of our acute hospitals have a good foundation for building an EHR. Many of our teaching hospitals have good HIS, PACS, Order Entry, Internet and Web based technology. Pilot projects such as the Mater Hospitals "carelink" which allows patients with artificial defibrillators have them interrogated over the phone without having to attend the hospital are proving very successful. St James telemedicine and telesynergy service, which allows multidisciplinary conferencing in a

secure system, using multi-media imaging and Internet connections, is another example. The telehealth service in the Northwest is another good example.

The HSE are hopeful that as part of the *Transformation Programme* they can develop a unified national ICT infrastructure and support services as well as developing clinical and administrative systems. This will involve establishing national ICT governance structures, integration with shared services, ICT staff development and engagement with health professionals to drive ICT based transformation as follows:(HSE 2006)

The vision is to see patient and clinicians benefit from e-health in a variety of ways:

- Empowering citizens and patients
- Provide targeted information on specific health and personal topics
- Allow citizens to assess and manage their own health risks
- Inform citizens of the available health services in their areas
- Enable them make an informed decision on who should deliver these services and where
- Provide acces to these services
- Allow citizens to take an informed role in their interactions with healthcare professionals.
- Reduce the need to travel for health services by using tele-consultation
- Provide easier access to support groups and fora (Information Society Commission 2004)
- Better and more efficient health services

At the moment in Ireland if one wants to see a good example of the EHR in practice look no further than The Hermitage Medical Clinic. This is one of Irelands newest private hospitals which, from its outset set the goal of making the hospital's operation entirely paperless, investing more than €4.2 million in IT. All patients have an electronic record created on admission/attendance, which stored centrally and made available in real time to medical and administrative staff throughout the hospital from the patients bedside to the operating theatre. This results in the information being available at the point of care to both the caregiver and the recipient and decisions being made in real time with the patient.

The technology has added advantage for the patient in that he/she has access to the technology for TV, phone, wireless Internet access and general PC functions. Patients access the system using a swipe card. Doctors and Nurses have different cards, which allows them access to the Electronic Patent Record functions. This means that there is no need to seek or carry round paper charts.

The full record is available at the bedside (Smith 2007). Its ability to integrate and be interoperable with other systems which may form part of IT development in the future in Ireland has not yet been tested.

CHAPTER 7

CONCLUSION

Information technology and its contribution to reducing hospital admissions and LOS among other things can help to ensure that patients receive the best care.

It is clear that the ability to reduce LOS and acute hospital admissions using IT is significant. Much of the evidence focuses around the fact that the objective of IT is to provide better care. In doing this it brings new technology creating new procedures or new ways of doing things, which divert inpatient admission and /or shorten LOS. It also expedites processes and eliminates repetitive work, which shortens LOS. It helps clinicians to provide best practice in a more timely patient centred way, achieving better patient outcomes, reducing adverse events and shortening LOS. It brings the care to the patient instead of bringing the patient to the care – promoting safe hospital avoidance.

The obvious benefits can, and hopefully will, allow the provision of healthcare to continue to our citizens in a patient centred way. This will mean change. Much of the barriers to implementation of IT centre on organisational problems and change management and will need to be addressed.

Anything that saves time in the patient journey saves bed days. There are many healthcare IT applications which alone do not show significant savings, but collectively allow for better use of resources and more efficient use of time which contributes to faster processing and treatment of patients resulting in shorter length of stay in hospital and greater throughput within hospitals.

In researching the subject I found that there is very little research, which looks at a broad range of IT solutions and their impact on efficiency. Research seems to focus on stand alone IT systems or isolated projects. Yet the international objective for IT has moved from local IT to regional and national IT integration.

This change is expanding and being supported. Many studies say that it is beneficial in terms of enhancing quality of patient care and efficient running of acute hospitals. The focus is now clearly patient centred and not institution centred.

I also noted that not enough of the research on this topic specifically quantifies the impact on bed days saved or hospital admissions reduced. Further evaluation would be

required to identify this and since LOS is a well-established measure of efficiency I believe that there is a need to reflect its significance thus demonstrating the merits of funding IT in this regard. More specific research will yield robust data, which can reinforce the case for continuing substantial investment.

The two main areas of direct patient care, which are well researched, are adverse incidents and chronic disease management.

Tackling the problem of adverse incidents is of major significance in the pursuit of improved patient safety. The research shows that the key is to detect and prevent incidents. IT solutions (primarily DSS and COPE) play a significant role in preventing adverse incidents. There are also recommendations for mandatory and voluntary reporting of adverse incidents, which can also be facilitated using IT

In Ireland, it has been acknowledged that there has been significant investment in recent years in the improvement of services. Yet the Irish Health System, in common with many others across the world, has faced challenges dealing with unsafe practices, errors in diagnosis and treatment and non-compliance with standards (DoHC Ireland 2008) There are a number of different adverse event reporting systems in place throughout the Irish Health Service. However, there is no universal system (DoHC Ireland 2008).

The ability to manage chronic disease outside the acute care setting is an example of proactive healthcare management as opposed to reactive. For the most part patients present with chronic disease when their condition has worsened and they can no longer manage at home – at this point the reactive process has set in. If, on the other hand they are being continually managed at home their care is such that episodes of acute hospital care are minimised. IT allow us to provide more essential services in the acute setting so as to meet the healthcare needs of our chronic disease sufferers who subsequently have better health outcomes.

There is a noticeable difference in the levels at which countries are at in terms of IT implementation. Ireland appears to be well behind its counterparts in developed countries. Where as the US, Australia and Canada are making good progress. Having said that the American Veterans Affairs (VA) appear to be the only organisation with a well developed EHR with multi-centre interoperability.

The fact that there are so many isolated projects up and running certainly shows that there is a healthy interest in IT in healthcare. While the bigger picture is obviously seamless integrated healthcare delivery facilitated by ICT, the interest shown by

healthcare professionals and patients alike can be developed and built upon to encourage progress.

It is hard to predict how long it will take for ICT to be commonplace and fully integrated in our healthcare system internationally. I don't anticipate seeing it in my working lifetime. What we have had in the past twenty years is the development of ICT at a far more rapid pace than was anticipated. This has resulted in us now having the ability, the will and the knowledge to do far more than was anticipated in earlier years. As with the development of healthcare, different countries are at different stages of growth and what is lacking now is the long-term financial commitment to aid further progress.

The changes in healthcare technology have reduced some of the cost of care by allowing us to do more for more people. But benefits will have to be apparent to drive investment. The future of IT in healthcare lies in significant funding which should allow for interoperability, full implementation of EHRs, mandatory reporting of medical errors, nurse and physician documentation systems.

According to Hersh, considerable challenges remain in medical informatics, however its impact will continue to grow. This, in my view is certainly the case with regard to acute hospital care and in particular regarding attendances, admissions and length of stay. The focus is now on primary care and providing as much treatment and care away from the acute setting as is possible. The risks and the cost associated with acute inpatient care to date mean hospital admission is to be avoided unless absolutely essential for treatment. While it is difficult to directly quantify how information technology can contribute to reducing acute care, it is clear that it can and does have an impact. What are required are significant studies, audits and research to accurately demonstrate this.

Throughout this dissertation reference has been made to costs of healthcare and there are two main themes, which emerge in this regard. The first is that poor medical care costs lives and money. Patients sometimes die if they do not receive adequate care whether it be that they are the victim of a costly adverse incident or they do not receive timely treatment or they do not receive the best available treatment due to cost constraints. The other being that better care saves money and lives. Money saved by reducing patient LOS can be diverted into ensuring that the best care is available and on time.

In order to have the ability, going forward, to provide best practice healthcare to our growing and greying population there is a need to generate changes and efficiencies in

the way we do things. IT has a very significant role to play in achieving these objectives. By using IT to facilitate best practice we observe a reduction in adverse incidents, an increase in process efficiencies, a change from reactive inpatient care to proactive outpatient and/or home based care – particularly in the area of chronic disease management. But most importantly we observe a healthier more satisfied patient.

Exploring this topic in detail has proved interesting, but it is far more extensive than the confines of this dissertation allow. There has been plenty of literature in the general area of patient safety and its implications for quality patient care. Much of this literature states that savings can be made in terms of hospital admissions and LOS, but there is very less available which specifically quantifies savings in this area.

What is evident is that there has been significant progress made in the area of IT in healthcare, which contributes to improved patient care. However much of what is available is in isolation with regional and national integration still in its infancy.

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ABBREVIATIONS

ALOS	Average Length of Stay
CPOE	Computerised Physician Order Entry
CSO	Central Statistics Office
DoHC	Department of Health and Children
DRG	Diagnostic Related Group
ED	Emergency Department
EHR	Electronic Health Record
EPR	Electronic Patient Record
HCFA	Health Care Financing Administration
HIS	Hospital Information System
HIT	Hospital Information Technology
HSE	Health Service Executive
ICT	Information and Communications Technology
IMO	Institute of Medicine
IT	Information Technology
ITU	Intensive Care Unit
LOS	Length of Stay
OECD	Organisation for Economic Co-Operation and Development
PACS	Picture Archiving and Communications System
PPARS	Personnel Payroll and Related Systems
RFID	Radio-Frequency Identification
RIS	Radiology Information System
WHO	World Health Organisation