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Planned implementation of an integrated Cardiovascular Information System in an Acute Hospital Group

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Planned implementation of an integrated Cardiovascular Information System in an Acute Hospital Group

Paul G. Nolan

A Dissertation submitted in part fulfilment of the degree of MSc Leadership, Institute of Leadership, Royal College of Surgeons in Ireland

2015
Planned implementation of an integrated Cardiovascular Information System in an Acute Hospital Group

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Abstract

Computer based patient records have been highlighted as a requirement in modern healthcare. Evidence around their contribution to quality of care is mixed and is more reliant on how well they are implemented, with there being a bedding in period of up to one year before seeing benefits. Successful implementation leads to efficiencies, cost savings and a return on the significant financial outlay. The need for funding can be a major barrier, as are changes in work practices and people issues such as resistance. Sites with great implementation have high levels of clinician involvement, leadership with vision, resilience, flexibility and collaboration. This project outlines the plan to deliver a CVIS which will integrate across a hospital group. It has identified triggers for change and forces that might prevent it, has developed a communication plan based on a stakeholder analysis. It has created a collaborative working group, involving key stakeholders who have agreed the key priorities and essential features of the system. Important milestones are highlighted, such as addressing the funding, putting governance in place, selecting the correct vendor, having sufficient hardware, software and training in place. The project will be evaluated throughout its life cycle using a novel WHO-HOT-Fit framework. The project is an academically robust, strategic plan to implement a CVIS which will require leadership that is collaborative, honest and seeks out, and identifies people with talent and tacit knowledge who can contribute to the process.
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<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
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<tr>
<td>CIO</td>
<td>Chief Information Officer</td>
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<tr>
<td>CVIS</td>
<td>Cardiovascular Information System</td>
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<td>EHR</td>
<td>Electronic Health Record</td>
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<tr>
<td>HSE</td>
<td>Health Service Executive</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>NHS</td>
<td>National Health Service</td>
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<td>NIMIS</td>
<td>National Image Management Information System</td>
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<tr>
<td>PACS</td>
<td>Picture Archiving and Communication System</td>
</tr>
<tr>
<td>PESTLE</td>
<td>Political, Economic, Social, Technological, Legal, Environmental</td>
</tr>
<tr>
<td>pPCI</td>
<td>Primary Percutaneous Coronary Intervention</td>
</tr>
<tr>
<td>SMART</td>
<td>Specific, Measureable, Achievable, Realistic, Time-bound</td>
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<tr>
<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities, Threats</td>
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Chapter 1  

Introduction

1.1 Introduction

The Institute of Medicine in 1997 (Dick, Steen, & Detmer) highlighted the need for computer based patient records, especially where patients are receiving a continuum of care from multiple health care providers and organisations. Many authors in the area suggest that electronic health or medical records can reduce risk, increase the quality of patient care, increase efficiency and reduce costs (Pizziferri, Kittler, Volk, Honour, et al., 2005; Samaan, Klein, Mansour, & De Witt, 2009; Weber, Bloom, Pierdon, & Wood, 2008). In the Irish healthcare setting, the development of hospital groups (Higgins, 2013) will lead to increased formal collaboration between constituent hospitals with patients travelling smoothly between them and this will require efficient sharing of clinical information. Electronic health records, if implemented correctly, can be a vehicle which will facilitate this level of patient centred, shared care. A Cardiovascular Information System (CVIS) is an example of this type of innovation.

The aim of this organisational development project was to plan for the implementation of an integrated CVIS in an acute hospital, which would ultimately integrate across the hospital group. This system would integrate all cardiology requests, procedures, images and reports within one unified electronic record which will be accessible throughout the group.
1.2 Aims and Objectives

The key objectives, based on SMART characteristics (Meyer, 2003), of the project were

- 100% of requests for investigations would be requested on the CVIS, 4 weeks after the system goes live
- 100% of non-invasive investigations and reports would be available on the CVIS, 4 weeks after the system goes live
- >75% of invasive investigations and reports would be available on the CVIS, eight weeks after going live, increasing to 100% within three months
- audits of data entry, e.g. procedure logged against procedure carried out would achieve a >80% match eight weeks after going live, increasing to a maintained level of >95% within three months
- four months after the system goes live, >95% of Echocardiograms performed in the three hospitals connected to the National Image Management Information System, will be available at the implementing site
- one year after the system goes live, >95% of Echocardiograms performed in the implementing site will be available in the other hospitals within the group
1.3 Organisational Context and Project Rationale

The planned implementation site is the Cardiac Investigations Department in the largest centre of a newly formed hospital group. This department provides both invasive and non-invasive procedures, not only to Cardiology but also to all specialities from paediatric to geriatric. It operates within a larger Cardiology Unit which encompasses two Cardiac Catheterisation Labs, a Coronary Care Unit, a Chest Pain Clinic and services such as Cardiology Out-patients, Cardiac Rehabilitation and a Heart-Failure Service.

The hospital group comprises seven hospitals, with the implementation site as the only model four hospital within the group, comprising 705 beds. It is considered the supra-regional centre, taking referrals from primary care and also from other hospitals within the group, leading to 38336 inpatient admissions, 86285 day cases and 245134 out-patient attendances in 2014 (Anon University Healthcare Group, 2015). While this site is the supra-regional centre, all hospitals, except one, within the group have cardiology units of varying sizes and levels of activity.

Within the Cardiology Department of the supra-regional centre there is a need to implement a CVIS which ultimately works for the end user. A SWOT analysis (see appendix 3), which is recognised as being useful in a change process (Iles & Sutherland, 2001), highlights the fact that there is already a CVIS in place, however, whilst the current system delivers a scheduling and appointment system, there are a number of clinical
shortcomings which can be seen as improvement opportunities for this project.

![Figure 1.1 Map of Hospital Groups, established as a transition to independent hospital trusts (Higgins, 2013).](image)

The system fails to bring together results from multiple systems into one unified record, resulting in clinical data which is dispersed and incomplete. Policies, such as Money Follows the Patient (Department of Health, 2013), which will see hospital funding allocated based on reported activity, will
require robust procedure data, therefore this shortfall must be addressed.
There has been recognition that hospital groups will need modern
information technology (IT) systems to aid in the integration of
services (Higgins, 2013) and the selected CVIS must allow easy ordering of
investigations and accessing of reports and images across the whole
group. The hospital has been approved to tender for an Electronic Patient
Record and any CVIS must be able to integrate seamlessly with this when
it is implemented.

The current lack of an effective CVIS within the supra-regional centre leads
to significant inefficiencies. For example a recent lean-project highlighted
that in one day there were 80 enquiries, either by phone or in-person,
looking for results of tests or checking whether tests were booked. An
essentially paper based system results in people physically bringing
requests to the department, those requests being manually entered on the
appointment system, paper based reports of those investigations being
printed and manually filed in the hospital chart. There can also be wasted
attendances at clinics if results have not been filed or are not available.
Whilst results of some investigations are stored electronically and can be
viewed on the hospital intranet, they are incomplete and utilise multiple
programs.

There is already frequent transfer of patients between hospitals within the
group. However investigations maybe carried out in different hospitals and
none of the current CVIS systems allow these to be viewed in the
implementation site. This often results in investigations, particularly
echocardiography, being unnecessarily repeated. The need to access images of investigations performed elsewhere will become even more important with the continued development of a structural heart disease program in the implementing hospital.

The supra-regional status will make it easier to promote future implementation, although it is important that this is balanced by actively engaging with other hospitals in the group so as to fully understand the range of services provided by the cardiac departments across the group, their interactions and also how traditional linkages outside the group have been formed and how this might impact on the implementation. Projects such as the National Imaging Management Information System (NIMIS), a national radiology project with cardiology implications, and also local initiatives need to be considered to ensure that the planned CVIS implementation will be aligned to them.

1.4 Potential threats to implementation

Potential threats have been highlighted by utilising both a SWOT and a PESTLE analysis (Appendix 3). Politically a significant change has been that the group Chief Executive Officer (CEO), who was in place at the times and was supportive, has moved, leaving an acting CEO in place. While in theory he is supportive of the project but given his previous position of Chief Financial Officer he is conscious of cost and return on investment. This potential weakening of support has been addressed by
engaging with other key members of the executive team such as the Group Clinical Director and also by carrying out periodic risk assessments and a communication strategy that was updated periodically.

Economically, the ultimate implementation will require finance, potentially in the order of €200,000 in the supra-regional site alone. The lack of designated funding for the implementation could have resulted in a lack of engagement amongst members of a formed working group. This risk was mitigated by obtaining senior management sponsorship of the project, which gave the work the validity of potential implementation and by building a guiding coalition (Kotter & Schlesinger, 2008). This was done by utilising and developing networks within the group.

Socially, despite the fact that the Hospital Group has been formed, there are some strong cardiology links between other hospitals in the group and hospitals in Dublin. These historical links relate to transport and telemedicine links, as well as being relationship based. A weak relationship with colleagues in other departments within the group was a real threat to engagement and site visits, which were carried out with an ethos of open listening aimed to build relationships early in the process to ensure success.

Technologically and legally a significant threat to implementation is that three of the sites have already implemented NIMIS, to varying degrees, in their cardiology departments. NIMIS is essentially a national radiology project onto which some aspects of cardiology have been added, so if it emerges that this was not the best cardiology solution there may be
resistance to change in these sites. Alternatively if it is decided that the vendors of the NIMIS system are the preferred vendors then the fact that the radiology department in the supra-regional centre are tied into a contract with another vendor until 2018 could pose difficulties to implementation, even though the hospital group is committed to rolling out NIMIS in all sites (Anon University Healthcare Group, 2015). These are just some of the issues which had to, and will continue to, be considered during the process.

1.5 Method of Evaluation

Evaluation of any information system should take place throughout the life-cycle of the project from pre-implementation, through implementation, post-implementation and routine use (Ammenwerth, Gräber, Herrmann, Bürkle, & König, 2003). The project will be evaluated using a proposed novel, WHO-HOT-Fit, evaluation framework. This framework combines work by Yusof (2008), which is based on the classic Delone and McLean Model (1992), with an awareness of the fact that different evaluation indicators will have importance for various stakeholders (World Health Organisation & International Telecommunications Unit, 2012). Indicators have been selected to reflect the overall aims and objectives of the project. The vast majority of the data will be easily retrievable from the CVIS, making the indicators practical to measure. They will reflect system use, user satisfaction, data quality and integration of the system across the hospital
group. This data will be used to ensure that the overall objectives are met and allowing for ongoing optimisation of the system during routine use.
Chapter 2 Literature Review

2.1 Introduction

Healthcare, both nationally and internationally, is being delivered in a far more complex and fluid environment. Many patients now receive care not just in one institution but from a spectrum of healthcare professionals and organisations. Within the Irish healthcare system the vision of moving away from a model of care which is centred around acute hospitals to one where patients are treated so far as possible in primary care (Department of Health, 2012), the roll out of the Money Follows the Patient model of funding (Health Service Executive, 2014) and the creation of the hospital groups (Higgins, 2013) will mean that typical patient journeys will bring them into contact with multiple healthcare professionals in different settings.

Within cardiology, the development of national programmes, such as the National Acute Coronary Syndrome Program (Health Service Executive, 2012), has, clinically, substantially changed the traditional regional based care model. This program aims to deliver timely Primary Percutaneous Coronary Intervention (pPCI), placing stents to open up blocked coronary arteries, in patients suffering a heart attack by sending them to designated national centres. This often results in patients being sent urgently, out of hours, to a centre which they may not have attended previously. The need for rapid access to a patient’s previous cardiac history, in such a situation, is clear and the need for a clinical IT system has been identified as a critical factor in delivering a
pPCI programme (Health Service Executive, 2012). A Cardiovascular Information System (CVIS), a discipline specific Electronic Health Record, can potentially provide this access if implemented correctly.

The need for this type of solution is now more pressing than ever given specialist programs that rely heavily on diagnostic imaging, such as a structural heart programme, are developing in certain centres.

The Institute of Medicine, in the United States, highlighted as early as 1997 (Dick, Steen, & Detmer) that the central role of primary care and the need for integrated healthcare delivery will be key drivers for the development of Electronic Health Records (EHRs). This report highlighted key characteristics of a successful EHR, these including an integrated view of patient data, clinician order and data entry, for example investigation requests and clinical notes, and a communications infrastructure that operates across organisational boundaries (Dick et al., 1997, pp.30). A fully functional electronic patient record should allow sharing of patient information at an institutional level, between clinical departments in the one institution and between individual clinicians, as well as at regional or national levels. It has been hypothesised that such a system would increase quality of care, reduce harm to patients, increase efficiencies and reduce cost.
2.2 Search strategy

Utilising Cooper's Taxonomy, (Cooper, 1988) a literature review was carried out using recognised databases such as Dynamed, Up to Date, BMJ Clinical Evidence, Web of Science, Cinahl and Heath Business Elite. The focus of the review was around theories and outcomes around implementation, with the aim of identifying central issues. The literature was reviewed from a neutral position and has been organised thematically for those working in healthcare and healthcare management. Searches were carried out initially using key terms such as Cardiology, Cardiac or Cardiovascular Information System, Patient Record or Picture Archiving System (PACS). Due to the scarcity of literature under these subject headings the search was expanded to include the terms Electronic Health or Medical Record Implementation and the literature was searched from the date of the Institute of Medicine’s landmark report on computerised patient records (Dick et al., 1997) until December 2014. Grey literature, such as Lenus was also searched. Literature was excluded if it was not applicable. For example some papers discussed personal electronic health records, which were outside the scope of this dissertation, others were simply a promotional piece outlining adoption of a particular vendors system by a particular institution or were documenting the protocol for a planned trial or study.
2.3 Impact of Electronic Health Records on Quality of Care

There is an intuitive perception amongst healthcare providers that Electronic Health Records (EHRs) will improve the quality of care given to patients and reduce risk. Unfortunately the literature around this area is far from clear and provides conflicting evidence. A number of studies have shown that the use of EHRs show no improvement in a number of quality care indicators. For example, a study undertaken in an ambulatory care environment (Linder, Ma, Bates, & Middleton, 2007), showed that in 14 of 17 indicators there was no significant difference between practices that used EHR’s and ones that did not. A potential criticism of these types of studies is that they often take place soon after implementation. However, it has been shown in a similar setting where EHR’s had been in place for a mean of 4.8 years, that neither the presence of an EHR, or the length of time which it was in place, was linked to improved quality of care indicators (Zhou et al., 2009). It would also appear that in the ambulatory care setting that a system that has features such as clinical notes, computerised prescribing and test ordering, is also no more associated with the delivery of appropriate therapy, for blood pressure and other chronic conditions, compared to a basic EHR or no EHR at all (Keyhani, 2008). In a hospital setting, a comparison of publicly reported quality indicators in heart failure and acute myocardial infarction against self reported EHR implementation demonstrated that in hospitals that had adopted a basic EHR, there was a significant improvement in the quality of heart failure care delivered but, that with an advanced system, care indicators for both conditions
dropped significantly (Jones, Adams, Schneider, Ringel, & Mcglynn, 2010). The fact that the quality indicators were taken for the year following EHR implementation may mean that this data reflects the complexity of early implementation and also potential difficulties faced by pioneers of the technology given that only 2% of hospitals had an advanced system in 2003.

Whilst some of this data, which is often derived from databases, may appear discouraging there is a growing body of evidence as to the positive effect that EHR’s can have of patient care. Again within ambulatory care, the presence of clinical reminders within an EHR increased vaccination rates and also resulted in fewer late vaccinations in children under two, when compared to a historic cohort (Fiks, Grundmeier, Biggs, Localio, & Alessandrini, 2007). The same group conducted a randomised trial of EHR based alerts and found a modest improvement in influenza vaccinations in children between 5 and 19 years of age (Fiks et al., 2009) and the clinical decision support functions of EHRs increase adherence to guidelines, such as prescribing controller medications in asthma (Bell et al., 2010) or increasing appropriate rates of screening mammography in a single centre site (Baron, 2007). Amongst Swedish nurses, EHRs have been shown to increase the number of charts in which notes of pressure ulcers were recorded and an increase in the quality of that data compared to a historical cohort of paper based notes (L Gunningberg, Fogelberg-Dahm, & Ehrenberg, 2009). Another study also noted that the electronic based records recorded clinical data more accurately
than traditional charts (L Gunningberg, Dahm, & Ehrenberg, 2008). It is worth noting that there was a four year gap between the electronic and paper systems studied and therefore other factors, such as staff education, may have been a factor, especially when one considers that the previously worst performing unit showed the largest improvements.

Amongst diabetics, EHR’s have been proven to improve delivery of optimal care. A study of over 14,000 primary care patients in the US demonstrated that where EHRs were used patients were significantly more likely to receive a defined optimal care package, although this did not improve overall glucose control (Herrin et al., 2012). In type II diabetics, data derived from an EHR, led to significant increases in all measures of diabetes care including blood pressure and glucose control (Weber et al., 2008). It should be noted however, that in this study the data was used to develop a multifaceted approach including audit and feedback to physicians and financial reimbursement for achieving outcome goals. A similar approach of using EHR derived data to provide monthly feedback to physicians, in a large US practice, and by fine-tuning reminder aspects of the EHR, resulted in high levels of compliance with drug prescribing measures (Persell, Kaiser, & Dolan, 2011). The concept of refining an EHR to aid quality improvement programs is supported by another study which demonstrated that prescription errors were significantly lower two years post implementation compared to baseline, 12 weeks and one year (Abramson et al., 2013). These studies perhaps gives credence to the conclusion that EHR’s and the data derived from them can be the
launch pad for quality improvement programs (Deutscher, Hart, Dickstein, Horn, & Gutvirtz, 2008).

Of course any data derived from an EHR is only as good as the data that is inputted and a lack of trust in data that is derived from EHRs can be one of the barriers to implementation (Saleem et al., 2009). For EHRs to support quality improvement the data must be robust and there is good evidence that high quality data can be derived from them. For example an implemented Cardiac Catheterisation Electronic Record demonstrated 98.5% validity in data entry when compared to the medical notes and the reports produced from the electronic record were more complete than those prior to implementation (Byrd et al., 2013). There was also the added benefit of a more efficient turnaround time with 75% of reports being available one day after the procedure compared to the previous four day wait. A more traditional way to collect the type of data which would aid quality improvement is to manually enter audit data into a database. A study which compared accuracy of cardiothoracic surgical data in a traditional database to that derived from an EHR showed that EHR data was as accurate and had the same number of missing data as the traditional database (Salati et al., 2014). An important element of the implementation of this EHR was intensive physician involvement and agreement about a standardised set of data to be collected. In spite of this, for the first 35 procedures the amount of missing data was higher in the EHR but for the next 65, data more closely correlated, suggesting a learning curve in the implementation of aspects of EHR workflow.
2.4 Other benefits of Electronic Health Records

Another proposed benefit of computer based health records is the efficiencies that will be brought about by having clinical information readily available. In a paediatric environment, the implementation of an EHR, resulted in reduced levels of incomplete documentation, increased number of presenting complaints lists completed and reduced time taken to complete repeat prescriptions (Samaan et al., 2009). There was also a halving in the level of support required from medical records, likely driven by the reduction in charts being pulled to 5.2% of visits. This study does sound a note of caution, implementation of EHRs is not without its drawbacks, for example the volume of patients seen in the clinic was still significantly reduced three months after the go-live and whilst this did return to normal soon after, the time spent with each patient increased by over 50% at three months and was still increased by 11% at two years. Contrary results were found in a network of out-patient oncology clinics where the time taken for each patient consultation was shown to reduce from 39 minutes to 26.8 minutes. However this reduction was not at the cost of direct patient contact time which was only shown to decrease by a statistically insignificant 4.5 minutes. There was a trend towards reduction in indirect time, such as reading, potentially implying that the EHR allowed easier collation of data by the physician (Pizziferri, Kittler, Volk, Shulman, et al., 2005).
Even amongst physicians who had reservations about the impact of computers and potential negative effect on patient interaction, they reported that the electronic health record allowed them to better educate patients about their condition and build a collaborative treatment plan (Doyle et al., 2012). Physicians in the out-patient setting have highlighted the ability to collect and rapidly access data as well as supporting improved communication between care providers as advantageous (Chao, Hu, Ung, & Cai, 2013). The use of a fully functional EHR may also allow delivery of more patient centric care based more around phone consultation and self reporting of symptoms rather than in-office visits (Chen, Garrido, Chock, Okawa, & Liang, 2009).

2.5 Keys to successful implementation of an Electronic Health Record

What is clear from the literature is that there is mixed evidence surrounding the potential benefits of EHRs. This may well reflect the binary approach, to some of the studies, which simply recorded the presence of an EHR and its relationship with quality rather than an assessment of its implementation and perhaps the implementation of the system is what is key. This hypothesis is supported by a study which showed there was no relationship between the mere presence of an EHR and nationally reported quality of care indicators. However they did find that where presenting complaints were updated, clinical notes
were used and radiology and laboratory results were integrated, then the EHR was associated with better care concluding that simply deploying an EHR would not improve quality (Poon et al., 2010).

The importance of planning and implementation is highlighted by an article which proposes key elements of safely integrating an electronic health record into clinical practice (Sittig & Singh, 2009), which include matching the specification of any system to the workflow requirements, optimising workflows and communication processes, including follow-up processes for clinical alerts for example, as well as suitable organisational characteristics such as a culture of innovation. Semi-structured interviews of organisational leaders in two sites who successfully implemented an EHR revealed six key themes supporting implementation success (Yoon-Flannery et al., 2008),

- a sustainable business plan;
- effective communication;
- successful migration and integration of the EHR technology;
- specialist support;
- training of users; and
- overcoming concerns around privacy safeguards.

Effective communication not only relates to the project plan but also around managing expectations of end users (Wood III & Aceves, 2005). It has been shown that perceptions of EHR projects can be varied, with nurses attitudes towards EHR becoming less positive at 6 and 18 months after implementation where system limitations led to frustration.
compared to baseline where they were apprehensive but hopeful (Laramee, Bosek, Shaner-McRae, & Powers-Phaneuf, 2012).

However, a study of physicians in a primary care practice showed that the number believing that the EHR made a positive contribution towards quality of patient care increased from the first to the twelfth month post implementation and the number that felt the EHR had a negative effect on their interaction with patients decreased (El-Kareh et al., 2009).

Support and training have been highlighted as particularly important in the immediate period post going-live with an EHR (Fullerton, Aponte, Bragg, & Ballard, 2006) and, in a group wide community based health system, the lack of resources and constraints around training have been highlighted as challenges to implementation. In a single centre study which utilised focus groups amongst staff in dialysis and emergency departments who had already implemented departmental clinical systems to ascertain what lessons could be learned for future group wide implementation of an EHR, the commonly held assumption about the importance of training was debunked (Laramee, Bosek, Kasprisin, & Powers-Phaneuf, 2011). What this perhaps highlights more is the need to embrace and harness tacit and implicit knowledge and skills already in place in an organisation. Low IT literacy levels and the poor quality of training were some of the cited reasons in the case study of the poor implementation of a national, centrally driven EHR program in England (Takian, Sheikh, & Barber, 2012).

Studies based on this NHS EHR program give us evidence about the most appropriate leadership style for this type of project (Cresswell,
Morrison, Crowe, Robertson, & Sheikh, 2011; Cresswell, Worth, & Sheikh, 2012; Takian, 2012). The program is most often described as a top down approach and structured interviews and observation periods with 66 key participants across three sites showed that this implementation style resulted in little opportunity to tweak the system to suit local requirements which negatively impacted on the usability of the system (Cresswell et al., 2012). This ultimately resulted in people utilising workarounds, sometimes to bypass EHR functions which had negative effects, such as incomplete documentation and the potential for increased risk. This top down approach showed that the lack of consultation around implementation led ultimately to frustrations and the feeling that the system, which did not deliver, was imposed. Despite the fact that people had positive attitudes towards an EHR, the implementation style led to a real lack of true engagement in the implementation sites (Cresswell et al., 2011). In a mental health institution this approach led to the process being described as cumbersome and challenging, bureaucratic and ultimately delivering a system that was perceived as not being fit for purpose (Takian et al., 2012). Whilst centrally, the EHR program had a top down approach, the leadership in individual sites had an important effect and in one studied site, local leadership saw implementation ultimately as a change management project (Takian, 2012). Recognised as a successful site, a design authority was created which involved representatives of users from every area. This collaborative approach allowed local configuration and created a sense of ownership. In other
countries such as the US, the issue of the importance of user involvement in the decision making process (Fullerton et al., 2006), including designing and implementing any EHR (Chao et al., 2013) has been highlighted.

Other literature has highlighted the importance of a well defined implementation plan (Cherry, Carter, Owen, & Lockhart, 2008) and it is believed by some authors that a significant part of this is not only workflow mapping but also using the implementation period to redesign the care process including embracing and promoting these changes (Brokel & Harrison, 2009; Wood III & Aceves, 2005). These process changes should be designed around promoting evidence based practice, identifying and addressing safety issues and enabling improved communication between multiple healthcare providers.

2.6 Barriers to Electronic Health Record implementation

One of the keys to successful implementation will be to overcome potential barriers, whether real or perceived. A real barrier to implementation is the substantial financial investment required at the start of any program and any ongoing costs (Simon et al., 2007), therefore many are interested in new efficiencies, savings they may produce and any potential return on investment. Across five out-patient sites of a US university medical centre it has been demonstrated that, by comparing key financial indicators such as chart pulls and creation, transcription and salary costs in the three months prior to
implementation and the final three months of the year after implementation, the initial capital cost of implementing a EHR was recouped within 16 months (Grieger, Cohen, & Krusch, 2007). Furthermore the authors estimated there were ongoing annual savings of close to $10,000. In another study based in a 325 bed US hospital the authors studied both quality of care, using metrics such as length of stay and readmission rates, and cost of care, one year pre and post EHR implementation. They found a significant decrease in the number of radiology and laboratory investigations ordered per hospitalisation, a 74.6% decrease in transcription costs and a 26% reduction in the amount of paper ordered, amounting to 5.2 million sheets with total savings estimated at over $600,000 (Zlabek, Wickus, & Mathiason, 2009). Whilst literature such as this is encouraging there is always a question about whether these savings are simply desktop financial exercises and whether they are reflected in real life, something that does not appear to be answered in the literature.

Another potential reason for resistance is the potential loss in productivity which might be experienced during implementation (Simon et al., 2007), however one should be aware that during an implementation stage, a new EHR can be blamed for difficulties in a wider system. For example there was no significant increase in either length of stay or triage to provider time in a large US emergency department in the 5th to 11th month period post EHR implementation when studied retrospectively (Mathison & Chamberlain, 2011). However practitioner hours increased in this period due to increased
attentions and also due to a perception that the EHR was slowing processes, a perception that was not subsequently supported by the data. A study which looked at the effect of similar measures across twenty three emergency departments demonstrated that whilst there was an initial worsening of these measures immediately post implementation, these returned to baseline at 12 months (Ward et al., 2014). An interesting element of this study was that sites implemented systems from different vendors, even though they were under the one management group and whilst the presented data, being an average of measures from 23 different sites is robust, unfortunately not shown was the performance of individual sites. A potential criticism of measures such as length of stay is that, whilst easy to measure, they may not be able to give clues as to the reasons for differences. Huerta et al (2013) studied the effect of different types of EHR implementation on total hospital productivity by comparing survey data from the American Hospital Association between 2006 and 2008. They concluded that hospitals which were implementing an EHR showed reductions in productivity with the biggest reduction in sites that attempt a big-bang approach and their data suggest that a more staged approach has a less negative effect on productivity. Whilst this study, which also demonstrated that a site not implementing an EHR shows no reduction in productivity may appear disconcerting to EHR advocates, it does highlight the potential rocky road of the implementation phase.

Further proof of the significant change process involved is highlighted by evidence of the persistence of paper in the setting of a fully
implemented computerised patient record system used by a wide range of staff in a large American hospital (Saleem et al., 2009). Semi-structured interviews with 20 staff from a number of professions revealed that reasons for continued use of paper included, efficiencies, both real and perceived, familiarity with using paper as opposed to electronic systems, a preference to use paper in the presence of patients, ease in assimilating data and trends and trust issues around electronic systems. Some of these paper solutions were to circumvent perceived shortcomings in the computerised system. The perception that paper based systems are faster was studies amongst physicians on an ophthalmology specialist training scheme in the New York area (Chan, Thyparampil, & Chiang, 2013). Trainees were asked to document five cases using a paper based system and an electronic system using a keyboard based program and a mouse based program. The authors concluded that paper was significantly faster than the electronic system taking an average of 0.5 seconds to document each finding. While this figure is statistically significant it amounted to a maximum of 37 seconds for a case with 53 clinical findings, one might argue whether this could be considered significant in real life. Another significant weakness of the study was the fact that participants were given only a five minute tutorial in each documentation system, however they all currently used paper documentation in their workplace, thus they would have an innate familiarity with this type of documentation prior to the study. An unwillingness to change work practices has been highlighted as one of the factors which caused resistance to
implementation of electronic processes amongst physiotherapists (Deutscher et al., 2008) but one must be conscious that this may be based on real concerns about new work patterns. For example it has been shown in a network of ambulatory clinics, attached to a large US hospital that these can include a loss of eye contact with patients, a perception that use of computers in front of the patient is rude, preference for freestyle notes, and issues of speed, whether due to IT or an issue with computer and keyboard skills (Linder, Schnipper, & Tsurikova, 2006).

2.7 Summary

The evidence of the impact of EHRs on quality of care is mixed and there is certainly more to it than simply whether the institution has an EHR in place or not. There is certainly evidence that benefits are time dependent and there is a clear learning curve with these systems which are in the order of a year post implementation. The literature would suggest that EHR’s can provide a platform for improvements in the quality of care delivered, particularly when it forms part of a wider QI system, including feedback to physicians. The more successful implementations also appear to have significant input from physicians in the ongoing refinement of the system. A well implemented EHR can improve efficiencies, in terms of patient care but there is also significant evidence of the cost savings and potential return on investment that can be achieved. Such evidence can be used to support a business case.
which will need to overcome the most significant barrier to implementation, the initial financial outlay and ongoing costs. However other barriers that must be overcome are more related to people. These include loss of productivity, whether perceived or real, and there is evidence that this is a real phenomenon during the learning phase, resistance to changing work practices or processes and it must be acknowledged that this fear of change may be based on real concerns.

The mixed evidence around quality improvement, the need to overcome barriers and the importance of refining processes highlight the importance of the implementation of the EHR, having it is not enough. The series of papers outlining the markedly varying degrees of success in implementing the same NHS EHR in different sites emphasises the crucial importance of the methodology for EHR implementation used. The evidence would suggest that successful implementation requires leadership which has vision, resilience and flexibility to manage the rockier patches of implementation, whilst maximising user involvement to encourage changes in work processes which will maximise use of the EHR to improve the quality of patient care, whilst also refining the EHR itself.
Chapter 3       Methods and Methodology

3.1 Introduction

This project will involve significant change amongst different stakeholders within the organisation. The evidence for the approach taken to achieve the change will be laid out along with the key drivers, strengths and threats to success of the project. Using a recognised change model, each stage of the process will be discussed. Activities already undertaken will be described with important key milestones yet to be carried out highlighted.

3.2 Review of Organisational Development approaches and rationale for chosen model

The approach to change within organisations can essentially be classified into a linear step-wise approach or a more organic organisational development approach. One of the most cited linear models is Kotter’s (1995) 8-step model (Figure 3.1). A significant advantage of the model is that it enables people to focus on the individual steps rather than overly focussing on the end objectives, which can lead to failure (Gill, 2003). The model emphasises the importance of creating an urgency for change (Kotter, 1995) which needs to be recognised, real and shared (Kotter, 2008; Ven & Sun, 2009). Senior sponsorship gives change legitimacy (Mento, Jones, & Dirndorfer, 2002) but one must be careful not to make
the mistake of imposing change rather than encouraging active participation (Balogun & Jenkins, 2003).

It is important to recognise the importance of actively listening to frontline staff (Kotter & Schlesinger, 2008) and the ability to build relationships has been cited as important during change (Karp & Helgo, 2008). This is certainly true in healthcare where the strong sense of professional identity and autonomy can be a barrier to change (Golden, 2006). One successful change involved all who would be affected by any decision in the process (Graetz, 2000) while Kotter (1995) describes a coalition of up to fifty,
however this would go against the theory that smaller teams are more cohesive (Mickan & Rodger, 2000). Whatever the detail, a leader of change must realise that even in information technology projects, 80% of the issues are social and political (Lorenzi & Riley, 2000).

Much of the change literature talks about creating a vision which is meaningful and inspiring (Gill, 2003) while also realistic, as people look at the resources that are available before committing fully to a change (Weiner, 2009). The vision should be aligned to organisational goals and also individual goals, meaning people are more likely to be supportive (Gill, 2003). Kotter’s model highlights the importance of communicating the vision and employees see lack of communication as one of the key leadership failures (Woodward & Hendry, 2004), whereas consistent leadership messages are one of the contributors to organisational readiness for change (Weiner, 2009).

Kotter’s model highlights empowering others to act on the vision by changing structures and removing obstacles to change. Gill (2003) argues that people dislike imposed change and that in general people look at change in terms of what they will lose or gain (Woodward & Hendry, 2004), therefore, one could argue that most of the obstacles to change will be around people. The model also looks to create short term wins, and while this can help sustain change (Sirkin, Keenan, & Jackson, 2005), care must be taken to ensure that change is not perceived as a quick fix (Gill, 2003), or of declaring the change complete before it has been culturally embedded (Kotter, 1995).
A major criticism of the step models is that change is rarely a linear process (Cameron, Cranfield, Iles, & Stone, 2001) and that, particularly in healthcare, change is more challenging (Golden, 2006), more fluid and requires a more iterative model (Redfern & Christian, 2003). They do not allow for emergent change, and planned change is often affected by external factors and can have emergent phases (Iles & Sutherland, 2001). Organisational Development change models such as that of Senior and Swailes (2010) or the Health Service Executive (2008) (Figure 3.2) reflects this complexity and highlight the need to potentially revisit earlier stages in the process and the cyclical, learning nature of the change process. The concept of organisational learning was key to the work of Lewin and while some criticise his unfreeze-move-refreeze model of change as being too simplistic (Woodward & Hendry, 2004), his model was embedded alongside field theory, group behaviour and action research (Burnes, 2004). Lewin’s field theory espouses that to change the status quo you must understand the complexity of forces maintaining it and there is a belief that people will accept change when the forces driving it are strong (Karp & Helgo, 2008). Analysing the current situation is important as a lack of evidence of the need for change can create resistance (Gill, 2003; Ven & Sun, 2009). Action research is an important element of organisational development models and is explicitly stated as part of the mainstreaming section of the HSE change model. Action research is participative and internal to the organisation (Coghlan & Casey, 2001; Coughlan & Coghlan, 2002), bringing the advantage of tacit knowledge. This can bring important understanding of what people do (Morieux, 2011),
which is important in the public service where people want to maximise their potential (Karp & Helgo, 2008). This participative approach can also help overcome resistance (Kotter & Schlesinger, 2008). A potential weakness of some organisational development models is that learning comes at the end of a cycle of change or as a discrete point in the cycle, however organisational learning particularly occur when there is a breakdown in the process (Ven & Sun, 2009), Even in information technology (IT) projects, the change is more about how people adapt to the system and how the system is adapted to users (Lorenzi & Riley, 2000). Balogun (2003) argues that change is a process of knowledge generation and that tacit knowledge is at the root of organisational culture and to effect change one needs an understanding of this.

Figure 3.2 – The HSE Change Model (Health Service Executive, 2008)
Preparation is important as some of the levers for successful change include, comprehensive knowledge of the organisation, a good analysis of resource issues and relationships between key stakeholders (Redfern & Christian, 2003).

This project will use the HSE Change Model as it is well recognised within the organisation and is aligned its overall vision. It brings the benefits of an OD model; however, one should not forget some of the lessons of other approaches, such as Lewin’s emphasis on organisational learning.

3.3 Approach to the change using the HSE Change Model

3.3.1 Initiation

The drivers for change and issues which would inhibit full implementation were investigated using a force field analysis (Lewin, 1951) (Appendix 1). This highlighted a number of factors supporting an integrated Cardiovascular Information System (CVIS), which included staff frustration at the lack of such a system, test reports not being available in a timely manner and the support of the Cardiologists for such a system. Supporting change from a risk management and quality viewpoint is a coroner’s recommendation that the processes around test requesting be improved, particularly around timeline documentation. There are also forces resisting such an ambitious change, strongest amongst those being the difficulty in accessing financial resources and staff resistance to changes in workflow.
To lead change, one must be able to identify key stakeholders, their roles and perspectives. As part of the initiation a stakeholder analysis was carried out (Appendix 2) and this highlighted the fact the soon to be acting CEO, who had taken up his post recently, while having high responsibility, had low interest in the project due to a lack of awareness. The secretarial staff in the department would have a huge impact on successful implementation and failure to get their buy-in would be catastrophic. Reflecting the importance of communication (Health Service Executive, 2008) the stakeholder analysis included a tailored communication plan which was updated periodically.

To examine the readiness for change of both the student and the organisation, to understand the important political and social aspects of the change (Lorenzi & Riley, 2000) and to highlight leverage points a PESTLE analysis was carried out which incorporated a mapped on SWOT analysis (Appendix 3). Politically, strengths include that the hospital group was one of the first to be announced, which means that it has developed some degree of autonomy. There is also a recognition that for the group structure to work there must be in investment in ICT (Higgins, 2013) which is demonstrated by the recent e-Health Strategy which aims to increase spending in this area from 0.85% of the health budget to 2-3% (Health Service Executive & Department of Health, 2013). This is led by the newly appointed Chief Information Officer (CIO) for the HSE, who was recently placed 5th top 100 CIO list (“CIO 100 2015,” 2015). Despite these optimistic developments, obtaining, in the order of €200,000, will be difficult and represents the biggest significant threat to the project. A potential
opportunity on the economic, legal and political fronts is the “Money Follows the Patient Model” (Department of Health, 2013) which requires robust patient level costing. A recent audit of coding in the hospital highlighted potential lost revenue of €70,000 for cardiology procedures.

A significant strength socially is that the student and the project have good support within his own centre and they are respected both within the hospital and across the group, however the lack of a deep relationship between the student and his colleagues in other centres was identified as an area of improvement. An opportunity arises from the replacement of the Cardiac Angiography labs in the implementing site, with a plan to increase the number to three and commission a fourth in another site within the group. This could be procured under a service level agreement and a CVIS could be purchased as part of this. On the technological front another potential source of resistance might come from the three sites which have already implemented the limited Cardiology solution from the National Image Management Information System (NIMIS) program as these sites might reject a proposal to implement another system. The radiology department within the implementation site utilises another vendor and while it is a group priority to implement NIMIS (Anon University Healthcare Group, 2015) this remains a highly contentious issue. Technologically, it is an opportunity that the hospital has been approved to tender for an electronic chart, however this also is a threat as the acting CEO was unsure as to whether a CVIS was required also, and therefore he may be unwilling to invest until the electronic chart is implemented. Legally, a development to monitor is that one of the Dublin Academic
Teaching Hospitals is going to tender on a CVIS, a fact that demonstrates the concept is on the national agenda but the result of any tender may be rolled out nationally, preventing local selection.

This period of preparation for the change built an evidence base for and highlighted the potential benefits of the change. It helped identify key leverage points and drivers for change as well as the potential risks to change which was important to consider as the project moved into the planning phase.

### 3.3.2 Planning

The initial stage of planning was building commitment for the change and communicating the vision of an integrated CVIS, and the benefits to key stakeholders, such as the secretarial staff. During this key people were identified and invited to join a working group. Decisions on who to include on the working group were based on the fact that they were representative of a key stakeholder group and more importantly that they had the key skills and expertise to help the group achieve the objectives (Brower, 1995), while also considering that the optimal size of a team is eight to twelve people (West & Lyubovnikova, 2013). In order to avoid the trap of groupthink (Garvin & Roberto, 2001) an effort was made to invite people who were confident enough to express a different opinion to the leader (Morley, Moore, Heraty, Linehan, & MacCurtain, 2004). This group involved personnel from
• the secretarial staff;
• nursing;
• the Consultant staff;
• the Non-Consultant Hospital Doctor staff;
• the cardiac technicians;
• the Biomedical Engineering department; and
• the Information Technology department.

The group was convened in the context of the initial work contributing to an MSc but continuing to develop and outline a business case.

As part of the planning process it was felt that it would be important to find out the key desirable features for a CVIS, amongst end-users. This was done using an emailed survey as it was felt to be most practical although some authors believe that personally delivered surveys have a higher response rate (Anseel, Lievens, Schollaert, & Choragwicka, 2010). To increase response rate, recommended techniques such as a pre-notification email, sending out the survey mid-week, using incentives, question length and structure, were all adopted (Dillman, 2011). The survey (appendix 4) was sent to 290 users and had a response rate of 23.1%. The literature would suggest that expected rates would be in the order of 50% for physicians (Sinkowitz-Cochran, 2013), however a HSE survey had response rates of 38 to 39% amongst clinical staff (Health Service Executive, 2009), therefore the rate obtained was reasonable. A number of key features were seen from the results (appendix 5) including
- the ability to order and review the results of all cardiac procedures online, through a CVIS;
- individual secure passwords;
- easy to use appointment and scheduling system; and
- intuitive, easy to use screen processes

and amongst Cardiology staff they also ranked these additional features as important,

- level of training and support they would receive;
- ability to extract departmental and research statistics; and
- ability to customise letters, forms and reports.

As part of the process, visits of the seven cardiology departments in the group were carried out by the student. These visits had two aims, firstly to process map all cardiac investigations from request, to performance, to report, using recognised tools (NHS Improving Quality, 2014). These visits were done in a spirit of participative problem solving (Borrill et al., 2001), with organisational learning at its core. Secondly to investigate staff perceptions of their current situation and what they felt could be improved. For those that had already implemented the NIMIS system, the aim was to understand the human aspects of the change process as these are vital to successful implementation (Fleurant et al., 2012). Semi-structured interviews, a recognised qualitative research technique, were carried out with different professions and grades in each of the sites. This technique is useful for exploring issues related to feelings, behaviour, experiences
and personal interpretations (Parahoo, 2014). Interviews concentrated
around

- What was good about their current set-up?
- What could be improved about their current set-up?
- For those who had recently implement any element of a CVIS
  - how did they find the change process/implementation?
  - how positive are they now compared to the beginning?

Some common themes were evident from people working in departments
without an integrated CVIS, frustration at the number of interruptions to
workflow due to queries, inefficiencies of paper-based systems and lack of
availability of reports. In centres with an implemented CVIS, the
centralised accessibility of information at all times was of huge benefit to
both the patient and the staff with a significant reduction in enquiries and
inefficiencies. Problems still existed with integration of some equipment
with some processes requiring multiple steps and one site also noted a
significant amount of time, equivalent to 0.4 of a working week around
administration of the system. With regards to the change process people
in one centre felt it went smoother than they thought it would but there was
a significant problem getting physicians to request investigations via the
new system. One site highlighted the poor support which they received
from the vendor of the supplied product, whereas this was not an issue in
another site. The site visits have identified people with experience and
tacit knowledge who could contribute towards a successful implementation.
The working group firstly agreed features of the system which were essential and then which features could be considered desirable. A consensus was obtained that efforts should concentrate on centralising all requests and reports from the Catheterisation Labs and Cardiac Investigations and that clinical modules, such as heart failure would come as a second phase. Members of the working group will meet with vendors and using the process map for our centre, ask them for their integrated CVIS solution, highlighting any upgrade issues etc that would be needed and also offer their solution for group wide integration. It will be vital at this stage to feedback this analysis to key stakeholders, particularly those in senior management to give a clear and informed vision of the desired future state (Young, 2006). At this stage we would hope that authority would be give to the group to develop a detailed implementation plan which would create a detailed tender document. The detailed implementation plan will be vital because while vision and leadership are required good management, monitoring, planning and control are essential (Gill, 2003). A recently released toolkit highlights the importance of selecting the correct vendor (Grevendonk, Taliesin, & Brigden, 2013) and there will be a significant evaluation period, including a prolonged on-site trial with various users as well as visits to reference sites (Holbrook, Keshavjee, Troyan, Pray, & Ford, 2003). The selection criteria will also have to include features which the literature have proven to be key to success such as sufficient hardware, training and support, successful system migration and ease of use. A key to successful implementation will be obtaining financial resources, therefore the project will require to be
costed, not only for purchase but also for ongoing operations which can account for up to 15% of the budget (Grevendonk et al., 2013).

3.3.3 Implementation

The implementation period will require that milestones are set and risk is managed. These issues will include

- Agreement of governance structures

The importance of robust governance arrangement is recognised (Office of Government Commerce, 2005) and should include clinical and managerial leaders (Murphy, 2011) who must clearly understand their role in the decision making process (Gocsik & Barton, 2014). Many quality improvement projects fail as senior management are not willing to defer to those lower down in the organisational hierarchy (Brown, Waterhouse, & Flynn, 2003), buy in from the executive team will be vital. The implementation will need to be closely project managed and while IT professionals may have skills in this area, clinicians can also take on this role (Murphy, 2011), however what is vital to success is that they have the skills to do this (Office of Government Commerce, 2005). The governance structure will be put in place at the time of development of the detailed business case and reflect that of the organisation (Appendix 6). The group will report via the Group Clinical Lead for
Cardiology, through the Medical Directorate to the CEO and executive team.

- Ensuring there is sufficient hardware within the Catheterisation Laboratory and Cardiac Investigations

This has been highlighted as a key enabler for implementation (Yoon-Flannery et al., 2008) and delays in putting hardware in place can significantly delay implementation (Ancker et al., 2013). Consideration of hardware requirements will be important when evaluating potential solutions as software which can run on existing computer systems is often the best choice (Wood III & Aceves, 2005). Whatever the choice, inadequate hardware, which presents difficulties for users or where processing speeds are poor can lead to inefficiencies and user frustration (Aggelidis & Chatzoglou, 2012; McAlearney, Robbins, Hirsch, Jorina, & Harrop, 2010). Ensuring that hardware specifications and availability are met will be led by IT staff and the vendor in consultation, with clinical end-users and will be completed 4 weeks before the go live date.

- Ensuring that sufficient licenses are available to meet demand for end-users across group

When existing IT infrastructure is used for such projects, licences are installed which are often concurrent, that is only a limited number of users can be logged on at one time. If insufficient licences are purchased then users will be unable to log on, a key
frustration for users (Moody, Slocumb, Berg, & Jackson, 2004). Ideally full usage requirements would be simulated but this is rarely done (Fullerton et al., 2006). We do however have data for the amount of licences required for the hospital's patient administration system (PAS) and concurrent use of the CVIS could be projected from this. This would need to be done as part of the full specification requirements and would be the responsibility of the project team.

- Ensuring migration of appointments and schedules and historical reports from existing system onto selected system

This is a real concern for implementation (Yoon-Flannery et al., 2008) as the challenge of legacy systems has been identified as a potential threat in the Irish health system (PA Consulting & Department of Health, 2012) and the cost of transition will have to be borne in mind (Bassi & Lau, 2013). The working group, with specific input from IT, Biomedical Engineering and potential vendors will have responsibility for ensuring solutions in place at least two months before the new system going live.

- Ensuring adequate training prior to go live date

Training is recognised as being pivotal for success (Ammenwerth et al., 2003; Yoon-Flannery et al., 2008) as lack of training can contribute to resistance (Takian et al., 2012). It is also important for safe implementation (Sittig & Classen, 2010) as lack of training can
lead to increased error rates in physician ordering systems (Menachemi & Collum, 2011). This training, which will be overseen by the project team, but delivered by the vendors, will involve the training of super-users, a key enabler (Adler, 2007; Holbrook et al., 2003), in each of the clinical user groups. For other users a training needs analysis will be carried out in consultation with each user group (Paidi, Voutsinas, Zoulias, & Natahanail, 2006) in order to develop a customised training plan (Adler, 2007). For example there is evidence that physicians are unwilling to give up the time required for training (Dick et al., 1997). Some authors suggest “just in time” training for physicians (Haughom, 2011), however most recommend training a couple of weeks before going live so that learned skills are fresh (Adler, 2007) but that it should be ongoing (Fiks et al., 2009; McAlearney, Robbins, et al., 2010) and this approach has been proven to improve data quality in a cardiology setting (Byrd et al., 2013).

- Designing new processes, work-flows and procedures to support implementation

This vital aspect will be led by the project team, in consultation with clinical users, as examination of workflows will ensure that sufficient hardware is in place to maximise efficiencies (Cresswell et al., 2012). It has also been proven that the most successful implementation is where there has been an emphasis on workflow
redesign, performed in collaboration with end-users (Takian, 2012).

This will occur early in the pre-implementation period.

The approach to this may depend on the selected vendor and will certainly be guided by those in the working group, as they represent key end-users and stakeholders and a key to successful implementation of electronic health records is the involvement of users in the decision making process (Fullerton et al., 2006).

During the implementation phase communication will have to increased significantly, as this will be the period of most significant change for people, with some believing that organisations underestimate the requirement for communication by a factor of ten (Kotter, 1995). In spite of the preparation that will go into the change and the fact that all users will have been represented in the working group, it is during this phase that we will be most likely to see resistance. It is important during implementation to recognise that people will be worried about what they are losing (Woodward & Hendry, 2004), they may be afraid that they will not have the requisite skills to cope (Kotter & Schlesinger, 2008), therefore it is important to provide support, the absence of which is seen as a barrier to successful EHR implementation (Yoon-Flannery et al., 2008). It is therefore important to continue to communicate the benefits that will be obtained and the what, how and why of the change (Graetz, 2000). While it may not be possible in this change project to plan for short term wins (Kotter, 1995) it will be important to celebrate when milestones are reached. This is especially true in this project as the literature would
suggest that there can be a period of up to six months before real improvement is seen (Chao et al., 2013). Implementing the change will require that old ways of working are phased out and it will be important to address one of the barriers to implementation, those who refuse to change their work patterns (Deutscher et al., 2008). As a leader, one needs to be careful not to ignore the opportunity in resistance, which indicate key learning, originating from good motives (Ven & Sun, 2009). Indeed action research and the integration of learned lessons is an important part of implementation (Mento et al., 2002).

3.3.4 Mainstreaming

Mainstreaming will involve celebrating the achievement of successful implementation; this can be recognised by achievement of key deliverables and objectives. The evaluation will demonstrate this is a tangible way. The leaders of the change must walk the walk (Kavanagh, 2006) make sure that there is an alignment between the organisational culture and the new processes (Mento et al., 2002) indeed it is important not to declare the change over until it has been culturally embedded (Kotter, 1995).

Evaluation not only will define the initial level of success of the implementation but will also provide an ongoing measure of its effectiveness. Sites which have great success with EHR implementation, continuously optimise and improve their system over time to, for example, collect more robust data with which to improve patient care (McAlearney,
Song, et al., 2010) or develop improved clinical processes (McAlearney, Robbins, et al., 2010). This will help embed the CVIS into the fabric of the organisation.

3.4 Summary

The project used and will continue to use the HSE change model, indentifying key drivers for the process, while also recognising the value of other models, such as effective communication, particularly to the identified stakeholders. The activities already undertaken were outlined, such as the survey of end-users, thus identifying the key system features required and site visits which helped build relationships and develop organisational learning. Important milestones were identified, such as having governance structures, hardware and software and user training in place. Evaluation at various stages of the project will play a key role in demonstrating success and identifying opportunities for improvement and optimisation.
Chapter 4 Evaluation

4.1 Introduction

In any change process it is important to ensure that it is succeeding and improving delivery of services. A vital part of this is evaluation which can prove the benefit of the change, thus giving the evidence to facilitate further change or align processes with the new paradigm (Kotter, 1995). Within the area of Health Information Systems, evaluation can contribute towards patient safety (Sittig & Classen, 2010), guide decision making (Currie, 2005) and lead to learning which allows the organisation to optimise their information system and processes (McAlearney, Song, et al., 2010). This chapter will discuss some issues around HIS evaluation, discuss frameworks and propose one to evaluate this project.

4.2 Evaluation in Health Information System projects

Evaluation of Information System projects and particularly those in healthcare is complicated, unclear and confusing, prompting many different questions (Aggelidis & Chatzoglou, 2012; Yusof, Papazaifeiropoulou, Paul, & Stergioulas, 2008). Even in large companies there has been little success in evaluating implemented Information Systems (Costello, Sloane, & Moreton, 2007) with some organisations reluctant to invest resources in evaluation processes as it can detract energy from new or creative
projects. A workshop which was aimed at improving research into the evaluation of Hospital Information Systems (HIS) defined evaluation as

“The act of measuring or exploring properties of a health information system (in planning, development, implementation, or operation), the result of which informs a decision to be made concerning that system in a specific context” (Ammenwerth et al., 2004)

They also noted that the system also included the humans who interact with it. This definition certainly supports the concept that evaluation should take place during the whole life cycle of the system (Ammenwerth et al., 2003). The four classic stages of a system’s life cycle are pre-implementation, during implementation, post-implementation and routine use (Currie, 2005). Proponents feel this approach gives an opportunity for problem solving at each stage of the project (Yusof, Papazafeiropoulou, et al., 2008). There is a clear distinction between evaluation activities and those of program management (World Health Organisation & International Telecommunications Unit, 2012), which will be vital during the implementation. Kazanjian and Green (2002) believe that any evaluation framework should answer three key questions, who is making decisions and who will it affect, what will be the benefit and how much will the benefit be. They also state that any evaluation should take into account population, economic, technological, social, political and legal contexts, however they fail to explicitly state how one would go about this in a structured way. What is clear is that consideration must extend beyond just a technological based evaluation as failure in one project in South
Africa was due to poor infrastructure, usability, poor implementation, poor training and slow response to system malfunctions (Littlejohns, Wyatt, & Garvican, 2003).

Within healthcare evaluation and particularly in the area of IS, there is a divide between researchers who believe in quantitative and qualitative evaluation (Costello et al., 2007). Quantitative is often perceived as being scientifically more robust, whereas qualitative data can be seen as softer and inferior (Currie, 2005), however factors which are best measured qualitatively are some of those recognised as critical to project success (Paidi et al., 2006). A vital element to the potential success of an HIS implementation is the interaction between the technology and the user (Ammenwerth et al., 2003). Whilst a quantitative evaluation may highlight that data on a system is 80% complete, a qualitative evaluation involving users could uncover options to improve system usability to increase the level of completeness. Quantitative evaluation also often happens at the end of the process (Currie, 2005), thus limiting the learning that can be obtained about the process and the opportunities for improvement (Yusof, Papazafeiropoulou, et al., 2008).

4.3 Evaluation Frameworks for Health Information Systems

The DeLone and McLean (D&M) Model of IS success (1992) provides a multi-contextual framework in which to evaluate IS projects. It is quoted as being the most cited models in IS literature (Urbach & Müller, 2012) and
was updated (Figure 4.1) just over ten years ago (DeLone & McLean, 2003).

![Figure 4.1 The Updated DeLone and McLean Model of Information System Success](DeLone & McLean, 2003)

Potential indicators of system quality would include accessibility of the system – is it available in all clinical areas, ease of learning – as assessed by users. Markers of information quality include accuracy of clinical data entered, completeness of data entered versus a standardised data set, and timeliness indicators – turnaround time for procedure reports. Service quality was not in the original 1992 model but its inclusion in this setting is important as technical support is a key factor in implementation success (Cherry et al., 2008). One could argue that although the net benefits in this model incorporate benefits to the organisation, there is no reference to how the organisation would support and enable success. In the setting of implementing Electronic Health Records there is evidence that vision,
leadership and appropriate change management are vital (Takian, 2012). It has also been highlighted that the feedback loops within the D&M Model can have both negative and positive effects. For example, poor user experience could lead to decreased use and therefore reduced benefits and the organisation plays a key role in controlling and supporting these types of issues (Yusof, Kuljis, et al., 2008).

In the same paper the authors provide a new evaluation framework (Figure 4.2) which incorporates human, organisational and technology-fit factors (HOT-fit), based on the D&M Model. They comment that the net benefits should be more clinically orientated, around task performance, productivity, error reduction, clinical outcomes and communication.

![Figure 4.2 The Human-Organisational-Technology Fit (HOT-Fit) evaluation framework (Yusof, Kuljis, et al., 2008)](image)
The inclusion of the organisational paradigm is appropriate reflecting the fact that factors such as a sustainable business plan (Yoon-Flannery et al., 2008), financial and organisational support (Cherry et al., 2008) and alignment with the organisational goals and strategies (Paidi et al., 2006) are vital to success. End user satisfaction is vital in health, perhaps more than any industry, due to the high level of professional identity and autonomy. This satisfaction will be based on their attitudes, the quality of the information and also their knowledge of, and training on, the system (Aggelidis & Chatzoglou, 2012). Clinicians see information systems as tools (Yusof, Papazafeiropoulou, et al., 2008) and system workflows should match and aid clinical ones as closely as possible (Ammenwerth et al., 2003). Early work on the D&M Model highlighted the fact that different stakeholder will have differing opinions on measures of evaluation (Seddon, 1997). For example, taking a simple measure such as user satisfaction, a clinician will score this highly if the system is easy to use, however an administration person will score this low if entered data is incomplete. The World Health Organisation’s (WHO) e-Health Strategy Toolkit (2012) highlights that evaluation indicators should be meaningful from the point of view of multiple stakeholders, however one must be conscious of restricting evaluation indicators to what is both practical to measure and important (Ammenwerth et al., 2003). Therefore the chosen evaluation framework will combine the HOT-Fit model with the WHO’s highlighted importance of stakeholders, in an innovative framework which will be referred to as the WHO-HOT-Fit Evaluation Framework (Figure 4.3). Reflecting the Innsbruck declaration (Ammenwerth et al., 2004) around
health information system evaluation, this framework will anchor evaluations which will take place during the life cycle of the project.

![Figure 4.3 The proposed WHO-HOT-Fit Evaluation Framework](image)

### 4.4 Evaluation indicators to be used

The net benefits of a fully integrated Cardiovascular Information System (CVIS) will reflect the overall objectives as outlined in Chapter 1. The following indicators will demonstrate system use, for both the invasive and non-invasive procedures, from request to report. Collection of this data will be the responsibility of the appointed CVIS administrator and it will be easily extracted from the system. This would initially be monitored weekly, post implementation but would increase to quarterly once targets had been
achieved. Shortfalls in reaching these indicators will highlight areas for improvement, for example, training of junior doctors on use of the system.

- four weeks after the system goes live, 100% of requests for non-invasive cardiac investigations, in the implementing site, will be requested on the CVIS
- four weeks after the system goes live, 100% of reports of non-invasive cardiac investigations, carried out in the implementing site, will be available on the CVIS
- four weeks after the system goes live, turnaround time from non-invasive test performance to the report being available on the CVIS will be less than 6 hours in >95% of cases
- eight weeks after the system goes live, >75% of reports of invasive cardiac procedures will be available on the CVIS, rising to 100% at 3 months
- eight weeks after the system goes live, turnaround time from invasive procedure performance to the report being available on the CVIS will be <48 hours. This will decrease to <24 hours at 3 months

The measure below will demonstrate the quality and reliability of the procedural information being entered into the CVIS. Again this will be the responsibility of the CVIS administrator and CVIS data can be extracted easily and compared to an alternative data source, such as patient charts. This would be assessed by monthly audit and would be fed back to clinical staff to improve and maintain data quality.
• eight weeks after the system goes live, the accuracy of the procedure logged on CVIS versus the procedure carried out will be >80%. This will rise to >95% at three months.

User satisfaction will be measured by both quantitative and qualitative measures, using both surveys and semi-structured interviews, to ensure that both system features and any required support is optimised. This will be performed monthly in the first year and will subsequently be performed bi-annually and will be the responsibility of the project lead initially, before handover to the CVIS administrator.

• three months after the system goes live, >75% of staff will be satisfied or very satisfied with the CVIS. This will rise to >90% at three months.

The indicators below, the responsibility of the project lead, will measure the group wide integration of the CVIS. This data will be easily collated from the CVIS and through liaison with key staff in the other sites. Reaching these targets will be a tangible sign of system integration.

• four months after the system goes live, >95% of Echocardiograms performed in the three hospitals connected to the National Image Management Information System, will be available at the implementing site. This target will be reached for the remaining outlying hospitals one year after going live.
• one year after the system goes live, >95% of Echocardiograms performed in the implementing site will be available in the other hospitals within the group

These net benefit indicators have been chosen as they will be feasible to measure in a reproducible fashion, reflect the evidence of successful implementations, while also aligning to both group and national strategies. For example, electronic ordering has been demonstrated to increase efficiencies, reduce duplicate requests and ambiguity around handwritten requests (Tang, 2003). The accuracy of procedural data will aid the hospital in the clinical area, such as returning data to the National Acute Coronary Syndrome Program (Health Service Executive, 2012), and funding programs such as Money Follows the Patient, a priority for the group (Anon University Healthcare Group, 2015). The timelines for these indicators have deliberately been staggered as there is evidence that attempting a “big-bang” approach can negatively impact productivity in a greater way than a more phased approach (Huerta et al., 2013). These net benefits also will benefit a wide range of stakeholders, whereas others, such as complete data returns for Money Follows the Patient will directly show a return on investment to senior management and CEO.

These net benefit indicators will be measured during the post-implementation stage and will continue to be measured during routine use. To attain these benefits, we must ensure that elements to the left of the WHO-HOT-Fit framework are monitored during other stages. System quality will need to be assessed during the pre-implementation phase, as
vendors offerings are being evaluated, but also throughout the rest of the life cycle. Items will include database quality; does the data meet agreed European standards (Flynn et al., 2005) but will it also be capable of dealing with the proposed Unique Health Identifier (Health Information and Quality Authority, 2015). Under system reliability, monitoring of system downtime would be vital as this is a significant concern of users, as is rapid technical support in the event of a system issue (Laramee et al., 2011). This would be one of the issues to be evaluated under the service quality heading. Also under this heading would be customer support and training, reported as being crucial, particularly post going live (Fullerton et al., 2006). For example a key facilitator of implementation would be to ensure that >90% of staff received relevant training on the CVIS and that this is repeated at times of staff change.

The survey of end-users, referred to in chapter 3, highlighted the importance of user satisfaction and the ability of the system to deliver this should be evaluated by all user groups during the pre-implementation phase, as this will increase the chances of success (Holbrook et al., 2003). This should also be evaluated during the latter stages of the systems life-cycle and also for multiple user groups as it is important to evaluate how well the system works for different users but also the same users in different contexts, for example the Cardiac Catheterisation suite versus an out-patient clinic (Yusof, Papazafeiropoulou, et al., 2008). Organisationally an appropriate governance and communication structure around the system needs to be in place with reference to patient safety issues (Brokel & Harrison, 2009) so that, for example that there is zero tolerance for test
reports not assigned to the correct patient, or that 100% of critical findings are communicated verbally to the medical team immediately.

4.5 Summary

While evaluation of information systems in health can be challenging it is vital that it is carried out, not only at the end of implementation, but throughout the whole life-cycle of the system. This evaluation must take into account not only the technology and the system, but also how users interact with the system. Their use of that system will involve using and creating information, which also needs to be evaluated for issues such as completeness. These users must have high levels of user satisfaction to ensure long term viability of the system and the governance and organisational support for the project must be in place. The proposed evaluation indicators for this project are realistic to measure, reflect accepted success based on the literature and will be relevant to a wide range of stakeholders from frontline to executive management.
Chapter 5 Discussion and Conclusions

5.1 Introduction

The planned project outlined is ambitious but demonstrates significant strengths, such as the considerable evidence base supporting the initiative and its implementation. A significant amount of work has been carried out in the initiation stage including activities which have promoted organisational learning and relationship building. While the implementation plan is theoretical, it is evidence based and uses a recognised organisational development model to bring about the change. The successful implementation will positively impact the initial implementing site and the hospital group as a whole, by bringing about efficiencies, improving quality and safety and giving robust data. These efficiencies, will translate into a patient’s cardiac procedure history being instantly accessible to their treating physician. This project will need leadership which welcomes collaboration and input from all stakeholders, not only to maximise the benefit of their expertise and experience, but also to manage relationships so that all stakeholders are impacted in a positively.

5.2 Strengths and weaknesses of the implementation plan

The implementation plan utilises the HSE Change Model (Health Service Executive, 2008), which is both recognised and accepted within the
organisation, while also referring to other aspects of change theory such as Lewin’s Field Theory (Lewin, 1951). The extensive literature review highlighted that quality of care can be improved by systems such as a Cardiovascular Information System (CVIS), but this is dependent on how well it is implemented. It can also provide a platform for continuous quality improvement. There is also evidence that these systems can improve efficiencies and provide cost-savings for the organisation. This type of evidence base is important when one considers an obvious barrier is the substantial financial investment required. As leader of a project such as this, one has to be aware of the people issues, particularly around resistance to changes in work practices. The keys to successful implementation, from the literature, include a sustainable business plan, efficient communication, successful migration and integration of technology, support and training and vitally, from a leadership point of view, the importance of user involvement and shared approaches to decision making.

A strength of the project is that a robust force field analysis was carried out to identify driving and restraining forces. It could be argued that this analysis was centred on the student’s site and considering group wide integration is the ultimate aim, perhaps the needs of other sites could have been addressed more fully. This potential shortcoming is likely tempered by the visits to the other cardiology departments in the group, which gave opportunities for organisational learning, created an awareness of the ultimate vision and was conducted in a spirit of openness and learning. The approach of concentrating on implementation in one site first, rather
than trying a big-bang approach is supported by HSE strategy (Health Service Executive & Department of Health, 2013).

The PESTLE analysis carried out addressed some of the significant political issues, such as a potential for conflict around the National Image Management Information System (NIMIS), which applies to a number of sites in the group, as well as national issues such as Money Follows the Patient (Department of Health, 2013). This national policy, with its requirement for procedural data for individual patients for each episode of care, will be an important part of our business plan and is therefore a significant opportunity for the project to deliver to the wider hospital group. The SWOT analysis carried out, in conjunction with, and mapped onto the PESTLE analysis (Appendix 3), highlighted that a major threat to the project is the fact that there is no approved funding and this will need to be addressed soon, as change projects need to be realistic (Young, 2006).

The project has already been discussed with the acting CEO and there is currently a review of the delivery of invasive cardiology services across the group. This will involve the required replacement of both cardiac angiography labs at the implementing site, as well as building a third to meet capacity, and potentially a fourth at another site in the group. The CEO recognises that an integrated CVIS will be a key enabler to this and, as this will be likely delivered as a service level agreement, it presents an opportunity to include a CVIS as part of the equipping stage of this wider service upgrade. The fact that it might be a part of this larger project makes it even more important that the CVIS project is very clear in its
objectives, implementation plan and evaluation, hence continued work as outlined in chapter 3 and 4 is vital.

These discussions with the CEO highlight the strength of the stakeholder analysis which was carried out, which not only identified the key stakeholders but also led to the development of a tailored communication plan to increase awareness and support amongst them. This also led to the selection of people for the project working group which has been meeting regularly. This group was selected, not only to be representative of key stakeholders and their interest in the project, but also to ensure people were selected for their expertise, for example an NCHD with a degree in electronic engineering was selected. To avoid groupthink (Garvin & Roberto, 2001), people who would be confident enough to express their opinions were also chosen. Whilst this project working group has functioned well, attendance from some groups, for example the cardiac angiography lab nurses has been poor. This most likely reflects their busy departmental workload, however as the project moves from initiation, into the more detailed planning stage, this deficiency will need to be addressed as user involvement is vital (Fullerton et al., 2006). A key output of the group, taking into account the results of the end-user survey which was carried out, was to agree the essential required features of the system and the key priorities.

The implementation plan, like any plan is theoretical, however it is built on robust data from the literature. One of the important next steps will be in selecting the correct vendor and it will be important that potential vendors
are evaluated based on their ability to help the project deliver the objectives outlined in Chapter 1. The selection of the vendor is of particular importance if this project is delivered as part of a wider service level agreement, as the current information system, which has failed for all stakeholders, was delivered without any planning or specific selection process when the cardiac angiography labs were commissioned over ten years ago. This plan has taken full account of the literature evidence and will implement a clear governance structure. It will be important to have clear lines of responsibility as this project will require significant investment, will span multiple departments, such as cardiology, IT and Biomedical Engineering and will ultimately be answerable to the CEO and executive team. A potential criticism of the plan is that the governance structure will only be put in place at the development of the detailed business case, however there may be support for this approach (Grevendonk et al., 2013). The plan also recognises the key milestones and deliverables, such as ensuring there is sufficient hardware and software in place, that integration with legacy systems are in place. The plan also highlights the importance of developing a tailored training plan and recognises the importance of developing super-users, people trained at a higher level on the system, in each of the user groups. The current information system only had such individual, who has since left the cardiology department, and this lack of succession planning, a feature of high performing organisations (The King’s Fund, 2011), is one of the reasons that this system has failed.
The plan is clear in the statement that the implementation of the CVIS will require changes to workflow. These changes should be welcomed as an opportunity to optimise workflow but one needs to be cognisant of the fact that the system needs to fit in around the clinical workflows as much as the user fitting to the system. Changes to workflow are likely to lead to resistance. As leader there needs to be a recognition that in most cases resistance has a genuine motivation, often due to concern regarding the change and whether personnel have the necessary skills to cope with new and unfamiliar work practices. The implementation needs to manage resistance by continuing to communicate the benefits of the change and supporting staff throughout the process. Leadership needs to be authentic and honest regarding the downsides. For example, it needs to be clear that there will likely be a six-month period of increased difficulty, and to recognise failures and mistakes and ensure they lead to organisational learning which will improve the system further.

The project will be evaluated using a new, WHO-HOT-Fit, evaluation framework and while its novelty may cause concern it is based on the very well regarded DeLone and McLean Model (2003). This will allow evaluation at different stages of the system’s life-cycle in order to ensure that it delivers on the project’s overall SMART objectives as well as creating a framework for continued optimisation of the system which will maximise the impact for the organisation, end-users and patients.
5.3  Impact of the planned change project

5.3.1  Impact on the organisation

Successful implementation will lead to increased efficiencies within the department itself as the fact that all requests for, and reports of, investigations carried out will be accessible to all end-users on one system. It will substantially decrease the amount of interruptions to work due to enquiries, which during a recent lean project were logged at 80 per day. These efficiencies will benefit all end-users in the implementation site with easy access to reports, proven to reduce the need for chart pulls, and electronic ordering will save junior doctor time as they will no longer have to walk to the department to hand in a paper based form. Electronic ordering will also reduce the risk around ordering of tests and documentation around same, an issue highlighted by a recent coroner recommendation. A fully implemented system will give accurate data for both invasive and non-invasive procedures carried out in cardiology for all patients. This robust patient level data will support the hospital in maximising it’s funding under Money Follows the Patient and when integrated across the group will allow this benefit to be maximised across the group as a whole. It would also prevent duplication of tests between sites, as each site would have access to the reports and images of studies, for example echocardiography, carried out in other hospitals within the group. This robust data would also support the delivery the research programme in the cardiology department. This would extend from identifying patients, from the database, with certain findings who may be
candidates for clinical trials, to monitoring data during follow-up. A database which demonstrates high levels of data accuracy and completeness will allow the department to quickly perform clinical audit, for example on the number of complications related to pacemaker implantation, which will allow for organisational learning, improvement of clinical processes to improve patient care.

5.3.2 Impact on Stakeholders

Within the cardiology department there is widespread frustration at the limitations of the current information system, which only serves as an appointment and scheduling system. Therefore staff handle requests and reports, which for the most part are in paper form thus leading to multiple inefficiencies. Successful implementation will hugely increase staff satisfaction across all professions and will also demonstrate the significant achievements that the department can accomplish. A system that delivers for cardiology will also need to deliver the key desirable features identified by all users via the survey which was conducted. The aim of ensuring that the CVIS delivers for all end-users must be kept at the forefront of the implementation process and that, during the ongoing evaluation and optimisation of the system, their views continue to be sought and acted on as appropriate.

Outside the cardiology group and direct clinical end-users, the staff in the Biomedical Engineering and IT departments, will have played a key role in
the implementation of the CVIS and their expertise will have been valued at all stages. Obviously implementation of a CVIS has the potential to increase demands on their services, therefore it will be essential to ensure that there are supports put in place and that within the governance structures, there is a clear agreement on what are the responsibilities of the vendors technical and after sales support, versus those that fall under the remit of the hospitals own support. Once the system is integrated group wide, the governance structures and procedures will have to clearly reflect lines of responsibility across the group. For the CEO and executive management, this is a major project and successful implementation will reflect well on them and increase the organisations reputation, known to help attract and retain staff and improve patients’ expectations (Sofaer & Firminger, 2005; Van Bogaert, Clarke, Vermeyen, Meulemans, & Van de Heyning, 2009). It will also provide a significant morale boost to staff, as well as preparing the organisation for the larger approved project of an Electronic Health Record.

5.3.3 Impact on patients

Patients will benefit from the fact that their full cardiovascular procedure history would be contained on one system, immediately accessible group wide. This would mean that on admittance to the emergency department of any hospital in the group, previous investigations, for example an electrocardiogram would be immediately available, an important comparative aid in the diagnosis of a heart attack. Group wide integration
will also increase safety for patients, particularly those undergoing emergency stenting procedures following a heart attack under the National Acute Coronary Syndrome programme (Health Service Executive, 2012). An important part of this program is the rapid repatriation of patients to their local hospitals and an integrated CVIS would ensure that a legible report of their procedure is available at this site. It would also reduce the instances where the results of investigations are not available at the time of a patient’s out-patient review because they have not yet been filed in the hospital chart, which often necessitates a further out-patient visit. This will also benefit the organisation as a reduction in review appointments and an increase in new patients being seen in out-patients is a service target (Anon University Healthcare Group, 2015). A CVIS which is integrated across the group could facilitate patients having investigations carried in their local hospital, whilst the images and report could still be reviewed by their treating specialist and an opinion may even be proffered to their general practitioner without the patient having to make a long round trip to the main centre. An integrated CVIS should aim to improve the link between cardiology and primary care using the HSE’s dedicated primary care portal, Healthlinks (Health Service Executive & Department of Health, 2013).

5.3.4 Impact on Theory and Practice

The literature review carried out in preparation for this project highlighted that there is a paucity of data around the implementation of Cardiovascular
Information Systems and even when the search is increased to Electronic Health Record Implementation and related terms, many of the papers originate from the United States and from primary care physician offices (Krist et al., 2011; Simon et al., 2007). When implemented this project could produce learning that will contribute to the literature around implementation of such systems in an acute hospital setting and importantly in the Irish healthcare setting.

The proposal to use a novel, WHO-HOT-Fit, evaluation framework, combines Yusof et al’s (2008), health specific, modification of the highly respected Delone and McLean Model (2003) with the emphasis that the World Health Organisation place on tailoring the evaluation for different stakeholders (World Health Organisation & International Telecommunications Unit, 2012). Reporting on the relevance of this evaluation framework during the different stages of the life-cycle of the project, pre-implementation, during implementation, post-implementation and during routine use, will potentially give supporting evidence for the use of this framework for the evaluation of such projects.

5.3.5 Personal impact

In trying to put a context on the personal impact of this project I found it beneficial to return to an article we were introduced to last year which I used as a personal audit of my ability to, interpret developments in my working environment – sense making, build trusting relationships –
relating, create a compelling vision – visioning and developing new ways of working – inventing (Ancona, Malone, Orlikowski, & Senge, 2007). I believe I have developed an ability to see the bigger picture and rather than just looking within my own organisation have selected a project which will impact the whole hospital and ultimately the wider hospital group. During the course of this project I have gathered a wide evidence base, not only through peer-reviewed journals but also through traditional media and even social media, through which a connection with the HSE’s Chief Information Officer was made, leading to a planned meeting in June. I have also developed my networking ability, a key leadership skill (Goleman, 2004), which has led to me being informed of such projects as the proposed service level agreement to provide new cardiac angiography labs. While I feel I have very good relationships within my own team, I recognised that to lead a project such as this I needed to develop relationships within the hospital and also across the hospital group. For example the site visits, which I carried out, were performed in an ethos of active listening and learning by me which encouraged sharing of knowledge, particularly from sites that had implemented NIMIS. It was also clear to me that there was a significant amount of knowledge about NIMIS and its implementation in each of the sites. This recognition has led me to develop a Cardiology NIMIS Working Group within our professional body to create a forum for sharing of this knowledge amongst users nationwide. This expertise will certainly be tapped into during implementation, particularly if the same vendor is chosen. I also found as the project progressed I had more confidence in approaching senior
management in the organisation with proposals. This coupled with an increasing awareness of the needs of stakeholders, has allowed me to develop a significantly improved ability to try and view things from other peoples perspectives, recognise the value in resistance and opposing views and see that I do not always have the right answer. I am extremely conscious that an area for improvement will be around the area of inventing. The literature would suggest that optimal implementation of a CVIS requires new processes and previously I would have been cautious of such changes, particularly if they were not originally my idea. The implementation stage of the project will challenge an area that could be improved; however I am hopeful that better sense making and deeper relationships will enable me to listen to these suggestions with an open mind as well as contributing new ideas myself. This openness to information sharing which allows followers to contribute towards the decision making process are some of the hallmarks of the authentic leadership (Avolio, Walumbwa, & Weber, 2009) which I believe in and which is known to increase the likelihood of success in projects of this nature (Fullerton et al., 2006).

5.4 Recommendations and Conclusions

Success in this project will require that the financial and staffing resources required to implement the plan will have to be sourced, either through direct funding or as part of the equipping phase of a cardiac angiography lab development. An important next step will be the development of a
detailed tender which will incorporate and deliver the key desirable features, as defined by the end-user survey, and the SMART objectives outlines in Chapter 1. It will be important to select the correct vendor, who will provide the correct level of technical support and user training at different stages of the life-cycle of the project, who will be able to maximise the integration of equipment from different vendors and who will also provide a solution for dealing with legacy information and data storage systems.

This project will require leadership which is honest, welcomes and values contributions from multiple stakeholders, recognises expertise outside the implementing site and has the ability to defer to experts within the group at appropriate stages of the project. An appropriate governance structure will need to be put in place to ensure clear lines of responsibility during the planning, implementation and post-implementation phases.

The project thus far has allowed me to develop my ability to be more aware of developments within the organisation which may affect the project, both positively and negatively, to build relationships, particularly outside my direct team. I have also seen that personal areas that need improvement can be augmented by the strengths of others within the team and utilising these strengths is crucial in helping me lead the project to a successful implementation.
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7. Appendices

Appendix 1

Force field analysis carried out indicating drivers supporting change and factors restraining change from happening.
## Appendix 2

### Sample portion of stakeholder analysis with communication plan

<table>
<thead>
<tr>
<th>Stakeholder Category</th>
<th>Project Role</th>
<th>Impact/Desire</th>
<th>Why</th>
<th>Impact</th>
<th>Responsibility</th>
<th>Readiness</th>
<th>Capacity to Engage</th>
<th>Communication Strategy</th>
<th>Get Comment</th>
<th>Request and Next Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Clinical Director</td>
<td>Overall clinical governance of group</td>
<td>Low</td>
<td>Not aware</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>Send email, discuss with AB about having time to brief on a dedicated meeting, update monthly in person</td>
<td>Request sent</td>
<td>Ask business manager to raise</td>
</tr>
<tr>
<td>Medical Director Business Manager</td>
<td>Manager of clinical staff, coordinator to same, important influence within medical directorate and to other directorates</td>
<td>Low</td>
<td>Not aware</td>
<td>Medium Medium Low</td>
<td>Medium to high</td>
<td>Request sent</td>
<td>Meet with personally, update progress monthly via email</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
</tr>
<tr>
<td>Clinical Director of the Medical Director</td>
<td>Clinical governance of medical directorate</td>
<td>Low</td>
<td>Not aware</td>
<td>Medium Medium Low</td>
<td>Medium to high</td>
<td>Request sent</td>
<td>Meet with personally, update progress monthly</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
</tr>
<tr>
<td>Group Cardiology Lead</td>
<td>Group-wide influence in Cardiology</td>
<td>High</td>
<td>Not aware</td>
<td>Medium Medium Low</td>
<td>Medium to high</td>
<td>Email sent</td>
<td>Meet with personally, update progress monthly</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
</tr>
<tr>
<td>Local Cardiology lead</td>
<td>Strong, influential in local Cardiology</td>
<td>High</td>
<td>Aware of need, problem is involved in Cardiology</td>
<td>High Medium</td>
<td>High Medium to high</td>
<td>Update on progress</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead AMR/Physician</td>
<td>Strong, influential in AMR, expertise in non-cardiology perspective</td>
<td>High</td>
<td>Low to medium</td>
<td>Low to medium</td>
<td>Low to high</td>
<td>Update on progress</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-cardiology staff (UHG)</td>
<td>Low to medium</td>
<td>Low to medium</td>
<td>Aware of need</td>
<td>Low to medium</td>
<td>Low to medium</td>
<td>Update on progress</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical staff implementers</td>
<td>High</td>
<td>High</td>
<td>Aware of need</td>
<td>Low to medium</td>
<td>Low to medium</td>
<td>Update on progress</td>
<td>Email sent</td>
<td>Needs to be updated in person, meet with MD as necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-cardiology Consultants</td>
<td>Low</td>
<td>Low</td>
<td>Medium Low</td>
<td>Low</td>
<td>Low</td>
<td>Update opportunity</td>
<td>Pre-survey notification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCIDCs</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Key:**
- **Low** indicates low impact or desire.
- **Medium** indicates medium impact or desire.
- **High** indicates high impact or desire.
- **Low to medium** indicates a medium impact or desire, but possibly lower.
- **Medium to high** indicates a high impact or desire, but possibly lower.
- **Low to high** indicates a high impact or desire, but possibly lower.
- **Update on progress** indicates that the stakeholder will be updated on progress.
- **Email sent** indicates that an email will be sent to the stakeholder.
- **Request sent** indicates that a request will be sent to the stakeholder.
- **Ask business manager to raise** indicates that the business manager should be asked to raise the issue.
- **Needs to be updated in person, meet with MD as necessary** indicates that the stakeholder needs to be updated in person, and the MD should be met with as necessary.
- **Meet with personally, update progress monthly** indicates that the stakeholder should be met with personally and progress should be updated monthly.
- **Email sent** indicates that an email will be sent to the stakeholder.
- **Request sent** indicates that a request will be sent to the stakeholder.
- **Ask business manager to raise** indicates that the business manager should be asked to raise the issue.
- **Needs to be updated in person, meet with MD as necessary** indicates that the stakeholder needs to be updated in person, and the MD should be met with as necessary.
- **Meet with personally, update progress monthly** indicates that the stakeholder should be met with personally and progress should be updated monthly.
Appendix 3

Combined SWOT and PESTLE analysis – orange colour or explosion shape represent a weakness or a threat. Green colour or box shape represent a strength or an opportunity.
Appendix 4

Survey investigating key desirable features for a CVIS amongst end users

1. The aim of this survey is to assess YOUR thoughts about the desired features of a potential group wide Cardiovascular Information System (CVIS). A CVIS should - provide a history of patients contact with the groups Cardiology services - allow booking of both non-invasive Cardiac Investigations (eg Echo, ECG) and invasive investigations (eg Angio/Angioplasty) - allow results of both non-invasive and invasive investigations to be reviewed - support documentation in clinical and specialist areas eg CCU, Heart Failure Unit, Cardiac Rehab

We believe that any system should address the desired features of the widest group of end-users possible. Therefore we would be extremely grateful if you would take the time to respond.

The survey comprises of 25 questions and should take roughly 15 minutes to complete. All survey responses are anonymous, however if you would like to be included in a draw for a €50 One-4-All shopping voucher, please fill you email in at the end of the survey. Many thanks for your valuable time. (Select one option) Continue

2. The ability to order all cardiac diagnostic tests and procedures, online, through a Cardiovascular Information System is essential.

With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

3. The ability to review what cardiac diagnostic tests and procedures have already been performed, online, through a Cardiovascular Information System is essential.

With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

4. The ability to review what cardiac diagnostic tests and procedures have already ordered, online, through a Cardiovascular Information System is essential.

With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

5. The ability to review the results of all cardiac diagnostic tests and procedures, online, through a Cardiovascular Information System is essential.

With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

6. Alerts on the main patient screen of critical test findings is an essential feature.

With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

7. Notification of critical test findings, via email or text message, is an essential feature.

With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree
8. Notification of declined requests for cardiac investigations, via email or text message, is an essential feature.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

9. Online, evidence based guidance, when requesting cardiac investigations is an essential feature of a Cardiovascular Information System.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

10. Intuitive, easy, screen processes are an essential feature of a Cardiovascular Information System.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

11. Easy to use scheduling and appointment system is an essential feature of a Cardiovascular Information System.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

12. When you are requesting an investigation, the ability to book your patient into selected dates/times in a scheduler, is an essential feature of a Cardiovascular Information System.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

13. The ability to customise, letters, forms, produced reports etc, is an essential feature of a Cardiovascular Information System.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

14. The ability to accurately and easily chart clinical notes, is an essential feature of a Cardiovascular Information System.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

15. It is essential that any Cardiovascular Information System automatically pulls clinical data eg vital signs/test findings from other cardiology equipment.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

16. It is essential that any Cardiovascular Information System has individual log on/log off security.  
With regards to the above statement I (Select one option)  
Strongly agree  
Agree  
Neutral  
Disagree  
Strongly disagree  

17. It is essential that I can access the Cardiovascular Information System remotely from home or private off-site office.
With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

18. The ability to extract departmental statistics, is an essential feature of a Cardiovascular Information System.
With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

19. The ability to extract population/research data eg all patients with an EF<35%, is an essential feature of a Cardiovascular Information System.
With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

20. The training I receive on a new Cardiovascular Information System will be vital to its successful implementation.
With regards to the above statement I (Select one option)
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

21. What do you see as the advantages of a group wide Cardiovascular Information System.
____________________________________________________________________
____________________________________________________________________

22. What do you see as the potential barriers/frustrations around the implementation of a group wide Cardiovascular Information System.
____________________________________________________________________
____________________________________________________________________

23. And finally, a little about yourself. I am a (Select one option)
Cardiology Consultant
Non-cardiology Consultant
Cardiology Admin/Clerical Staff
Non-cardiology Admin/Clerical Staff
Cardiology NCHD
Non-cardiology NCHD
Cardiology Nurse
Cardiology Clinical Nurse Specialist
Non-cardiology Nurse
Non-cardiology Clinical Nurse Specialist
Cardiac Physiologist
Other (Please specify) __________

24. The location in the group, which I carry out most of my work is
____________________________________________________________________

25. Many thanks for completing the survey. If you would like to be included in a draw for a €50 One-4-All voucher, please fill in your email address here. Many thanks again
Appendix 6

Key desirable features as identified by end-users

CVIS feature preferences - all staff

- The ability to review the results of all cardiac diagnostic tests and procedures, online, through a Cardiovascular Information System is essential.
- The ability to review what cardiac diagnostic tests and procedures have already been performed, online, through a Cardiovascular Information System is essential.
- The ability to review what cardiac diagnostic tests and procedures have already ordered, online, through a Cardiovascular Information System is essential.
- It is essential that any Cardiovascular Information System has individual login and off-security.
- The ability to order all cardiac diagnostic tests and procedures, online, through a Cardiovascular Information System is essential.
- Easy-to-use scheduling and appointment system is an essential feature of a Cardiovascular Information System.
- Alerts on the main patient screen of critical test findings is an essential feature.
- Intuitive, easy, screen processes are an essential feature of a Cardiovascular Information System.
- The training received on a new Cardiovascular Information System will be vital to its successful implementation.
- The ability to accurately and easily chart clinical notes, is an essential feature of a Cardiovascular Information System.
- The ability to extract departmental statistics, is an essential feature of a Cardiovascular Information System.
- Notification of declined requests for cardiac investigations, via email or text message, is an essential feature.
- The ability to extract population/research data for patients with an EF < 33%, is an essential feature of a Cardiovascular Information System.
- When you are requesting an investigation, the ability to book your patient into selected dates/times in a scheduler, is an essential feature of a Cardiovascular Information System.
- It is essential that any Cardiovascular Information System automatically pulls clinical data, eg. vital signs, test findings from other cardiology equipment.
- Online, evidence-based guidance, when requesting cardiac investigations, is an essential feature of a Cardiovascular Information System.
- Notification of critical test findings, via email or text message, is an essential feature.
- The ability to customise, letters, forms, produced reports etc, is an essential feature of a Cardiovascular Information System.
- It is essential that I can access the Cardiovascular Information System remotely from home or private off-site office.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree
Appendix 6

**Governance Established**

**Hospital Group Governance Structure**
Appendix 7

Process map of workflow in one Cardiology Department with NIMIS. (A box represents an electronic process, curvy box represents paper process)