

*Evaluating an Electronic Database in an
Operating Theatre Situation*

*Can benefits be realised through the migration of paper
based medical data capture to electronic systems in an
Operating Theatre Situation?*

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in partial fulfilment of the requirements for the degree of
Master of Science in Health Informatics**

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Declaration

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

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Chapter One: Introduction

1.1 Abstract

This dissertation seeks to determine whether there is any value to be had from implementing an electronic database in an Operating Theatre Department where a paper-based register already exists.

The background to this project is that, despite what is known about the value of electronic data collection and storage, there is a reluctance to embrace this technology in certain areas of the health system.

The approach taken to answer this research question was multi faceted. Firstly an electronic database was designed and introduced into the work place. This occurred following interviews and discussions, with the main stakeholders, to determine their specific user requirements. Following implementation, the users were questioned about their satisfaction with the system. This also afforded an opportunity to test the opinions of the respondents about the advantages of electronic data. To validate any advantages expressed in relation to electronic data, it was also necessary to assess the paper-based method of data capture. A comprehensive review of the literature which revealed certain advantages to electronic data provided a framework of questions to investigate the opinions of the users of this electronic database. An audit was then carried out on the present method of data capture in a non-metropolitan hospital. The cost of these paper-based registers was established and an assessment of the time savings that can be made using an electronic database was also made. Finally, an evaluation of data capture practices in Irish hospitals was undertaken.

The main findings of the project were that, following input from stakeholders a paper based process could successfully be migrated to electronic format. Subsequent to this an electronic database was implemented concurrent to a paper-based register. Significant savings in the time that it takes to undertake certain register related task were demonstrated. The time taken to capture the data in both systems remained the same however, other tasks were studied and significant time savings were observed. The study also highlighted the current situation with regard to data capture practice in Operating Theatre Departments in Irish hospitals.

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1.3 Abbreviations

AARK : Automated Anaesthesia Record Keeping

AIMS: Anaesthesia Information Management Systems

C.S.S.D.: Central Sterile Services Department

ENT: Ear Nose and Throat

G.A.: General Anaesthetic

HI : Health Informatics

HIPE: Hospital In Patient Episodes

HIS: Hospital Information Systems

HSE : Health Service Executive

L.A.: Local Anaesthetic

IT: Information Technology

NCHD: Non Consultant Hospital Doctor

Obs\Gynae: Obstetric and Gynaecology

P.D.A.: Personal Digital Assistant

UKNMC : United Kingdom Nursing and Midwifery Council

Chapter Two: Background

2.1 Introduction

The research question that will be answered in this study is:

Can benefits be realised through the migration of paper based medical data capture to electronic systems in an Operating Theatre Situation?

Information that is accurate, accessible and shareable is a well accepted necessity of good healthcare (Murnane 2005) and electronic medical record systems can improve the quality of patient care and decrease errors (Wang et al 2003). However the replacement of hand written paper-based recording systems throughout Irish hospitals appears some what sluggish. This chapter will set out the context of the problem. Following this, the motivation for the project will be examined. In the last section the aims and objectives of the project will be identified and, finally, the plan of action is proposed.

2.2 Context

As declared in the introduction there appears to be reluctance in Irish hospitals to replace paper-based record keeping with electronic systems. This project seeks to explore this practice in one hospital in Ireland. The project will take place in the Operating Theatre Department. Within this study the term “theatre” refers to the room in which the surgeries or patient episodes occur and the Theatre Department refers to the collection of theatres within the project hospital. All patient visits to the Theatre are recorded. This information is both a legal requirement (which is subject to data protection law) and also essential for compiling hospital activity statistics. In the Theatre Department where this project takes place, there are three Theatres and one endoscopy unit.

In each Theatre there is a large, A2 size (when open) pre-labelled register for recording the details of each patient’s visit to the Operating Theatre (see copy of paper-based register). Each visit is referred to as an episode and requires an entry in the register. This register is manually filled out by the un-scrubbed nursing personnel, in the Operating room, during the visit to Theatre. The register has 11 pre ruled fields for each entry. These fields are, date, time in and out, patient demographics which include name, address, date of birth, age, surgeon’s name, anaesthetist’s name, and nurses’ names.

[illegible]

The nurses' names include scrub nurse, anaesthetic nurse and circulating nurse (labelled I, C and A in the register, appendix 1). There are also fields for the operation performed and any remarks. These details are taken from the notes and from observation and are written in by hand. This is done for the most part chronologically in real time, during the patient visit, into the appropriately labelled sections of the register. The books are kept in their respective Theatres and are only removed when they are full. It is the nurses' responsibility to ensure all data is entered for each episode. In the Theatre Department where this project is taking place, the pre labelled registers are procured through the hospital's stores department. There are 200 pages in each register and each page holds 12 entries.

Each register holds about 6 months' worth of entries. When the register is complete it is kept in the Theatre Department for a further 6 months (or until the next register is full) and after a year the register is removed to the off-site safe storage unit. If details of a particular surgery or a number of surgeries are required, the person wishing to ascertain these details must first locate the register in which the details were recorded. When the register is located and retrieved, the individual manually turns the pages and looks through the register to find the entry. If the person wishing to retrieve the data is not employed in the Theatre Department, for example a previously employed non consultant hospital doctor, this has to be done in the presence of a nurse. Similarly when activity data for a given period is required, a manual totalling up of the entries is carried out. This is carried out by nursing personnel, medical staff and the hospital's data information officer.

In 2006 a project was undertaken to produce a database that could be used in the Operating Theatre Department to record and store patient episodes. This database was built by a member of the ICT Department in an associated hospital in Tullamore. The database never made it to the relevant Theatre Department. The reasons for this are vague, and there are a number of suggestions as to why this happened. This database remains on a computer in the HIPE office. For about a year, patient Theatre episodes were retrospectively (when the register was full) copied onto the database by a member of the HIPE office until that member of staff went on maternity leave and was not replaced. Consequently the data was no longer transcribed and the database was not updated for about 2 years.

2.3 Motivation

The author works and has worked in the Theatre Department as a nurse for a number of years. Among the responsibilities of the nurses in the Theatre Department is the participation in both the recording and collating of the data. The recording of patient episodes is performed on a daily basis. Each visit to the Theatre by a patient is considered a patient episode and all the details of the episode are hand written by a nurse in a large register. This is performed during the patient's visit, usually by one of the un-scrubbed members of the Theatre team. The circulating and anaesthetic nurses are not required to scrub during a procedure, (only the instrument nurse and the surgeon(s) are required to scrub) which allows them the opportunity to complete the required paper work.

Occasionally it is the responsibility of the nurses to locate the details of a particular patient episode. This requires a manual exploration of the relevant register, which may or may not be in the Theatre Department at the time. The register is perused to find the appropriate entry and the details subsequently extrapolated. On an annual basis, the data detailing the quantity of each procedure and various sub-sections is collated for the HIPE (Hospital in patient episode) office. The numbers are usually collected on a monthly basis. This is performed by the identification of each entry in the register followed by the manual counting of the same. The monthly numbers are generally stored on a piece of paper in the back of the register. Most frustratingly, the author was recently involved in recompiling a year's worth of data, after the sheet of paper with the collected monthly data had been mislaid.

The author feels strongly that storing the patient Theatre episode data electronically has a number of benefits for both the patient and the personnel recording and gathering the information. The author believes that there is often missing and illegible data in the manual register and has personal experience of patient details that have been omitted. In the opinion of the author the cost of the paper record is not insignificant, both in financial and environmental terms, and in recent years electronic systems have become much more cost-effective. Consequently the acquisition of such a system has become much more attainable. Moreover, the author is very aware there is a high personnel and space requirement for the routing, storage, archiving and maintenance of all paper-based patient documents.

2.4 Aims and objectives

The aim of this study is:

- To explore the notion that there is value to be realized from implementing an electronic register into a Theatre Department to replace a paper-based register.

The Objectives of the study are:

- To design and build an electronic database;
- To examine the implementation process;
- To evaluate the users' opinion of electronic data and the success of the system;
- To analyse the current paper-based system;
- To examine the current practice of data keeping in Theatre Departments in Irish hospitals under the authority of the HSE; and
- To explore the possible value of such a system and make recommendations for other Theatre Departments within the HSE.

2.5 Methods

In order to achieve the objectives, a number of steps are required to be undertaken.

Due to the nature of the project some of the steps may be performed concurrently.

- 1 A survey of the data capture practices in Theatre Departments in Irish hospitals as identified on the HSE website.
- 2 An audit of the present paper-based recording system will be performed.
- 3 A selection of end users will be canvassed for their input on the implementation of an electronic system and participation in the design will be encouraged.
- 4 Subsequent to this an electronic database will be built and implemented for a three month period.
- 5 Following implementation a user satisfaction questionnaire will be undertaken.
- 6 An investigation will be carried out to establish the cost of the paper registers.
- 7 A time and motion study comparing the two systems will be performed to assess if time and money can be saved.

In order to achieve the above objectives key issues that affect or guide these steps will be explored. Chapter Three will review available literature relating to such a project. It is hoped that this will help identify the best possible method of undertaking a project of this nature. From the literature a plan for designing and implementing the register will be devised. The success of the system will then be assessed using a questionnaire for the staff. Finally a small scale time and motion study of the paper versus the electronic data collection and collation will be carried out. Prior to commencement ethical approval was sought and obtained from the Director of Nursing (Ms Anne Kelly) and the Hospital Director (Dr Ron Charles).

Chapter Three: Literature review

3.1 Introduction

There is an old saying if it's not broken don't fix it. The present data-collection method in the Theatre Department is certainly not broken so does it need fixing?

This literature review will look at the different issues that surround the implementation of an electronic data collection system where a paper-based one exists. Available literature on health professionals' conceptions of paper versus electronic documentation will be reviewed and considered. Data capture practices in Theatre Departments both nationally and internationally will be explored. Available literature considering the cost benefit of implementing electronic health systems will be examined to establish the concerns surrounding this. As the electronic register's successful implementation will be paramount to establishing costs and benefits, issues that effect successful implementation will also be explored; this will include nurses as a specific cohort of end users. It will establish a method to evaluate if there is any value to be gained from investing in such a system. The conclusion of each subsection will be included at the end of that section.

3.2 Paper versus Electronic data

3.2.1 Introduction

A review of the literature on "paper versus electronic data" in the main indicates that electronic data collection has more advantages. There are however some articles which still advocate the use of paper-based data collection methods. For the purpose of this literature review paper-based records are considered as both ones that are hand written and electronically printed records; electronic data refers to any health information that is collected and stored electronically.

3.2.2 Paper versus Electronic data

As long ago as 1989 The Academy of Medicine in the United States charged a Committee to examine the problems with the existing medical record systems and to propose actions and research for improvement (Dick and Steen 1991). The committee found that computer-based patient records could positively affect healthcare from three perspectives. Their report suggested a number of weaknesses in a paper record which included missing, illegible or inaccurate data. In reference to the format of the record their findings suggest that a paper record often had poor organisation, leading to ineffective and time-consuming use. They also found that retrieval of information from the record can be difficult and the availability of the patient record is location bound. In conclusion, the committee proposed that real integration of information cannot be achieved when a paper record is used.

They also made some recommendations on advantages of electronic data capture.

Firstly, the quality of patient care could be improved in four ways:

- improved quality and access to data;
- integrated information between different settings;
- simultaneous access to medical knowledge and hospital protocols;
- the ability to incorporate decision support systems.

Secondly, research and audit could benefit in two ways by improved access to data and dissemination of results.

Finally, healthcare costs could be moderated by:

- reducing duplication of tests and the performance of redundant tasks;
- administration costs could be reduced by the automatic generation of routine reports and charges;
- practitioner productivity could increase due to reducing time spent locating missing records, or time wasted waiting for records to be found;
- a reduction of duplicate data entries; and
- improved time scale for data review.

In 1995 Tange's study disputed these claims and tested 60 clinicians' opinions against the findings of the Committee. They specifically tested clinicians' views on the weakness of paper-based records (Tange 1995). The testimony received found that the majority of clinicians tested did not agree with the inefficiencies of the paper record. Whilst they agreed that the paper-based record was cumbersome when used for extrapolation of data for research, the most striking result was the clinicians' confidence in the accuracy of the record. In fact a comfortable majority (73%) of the clinicians did not agree that patient data were often inaccurate, and the respondents were far more positive about the quality of the paper record. Overwhelmingly the clinicians supported the notion that a paper record is easy to carry to the bedside, and is flexible enough to allow freedom of expression concerning what and to which level to record information.

This notion that paper is not inferior is supported in an ethnographic study by Harper et al (Harper et al 1997). This study explored the advantages and disadvantages of changing from a paper-based anaesthetic assessment form to an electronic version. Their report suggests that whilst paper forms are often incomplete because there is no consequence for leaving information out, paper is much more suitable for this particular job because it allows free text annotation, it is flexible during an interview, it is unobtrusive (which allows the conversation to flow), it is a memory aid both during assessment and later during the operation and it is highly portable. Whilst these findings are valid, their significance may have preceded the ability to add free text in an electronic system. The use of tablets, P.D.A.s and "voice to text" programmes may well solve many of these issues.

More recently, Saleem et al (2007) undertook a qualitative study using semi-structured interviews to explore the persistence of paper-based records where an electronic health record exists. Their report investigated the issues and suggested that paper-based processes are not always inferior or inefficient. They also noted cognitive reasons why clinicians prefer paper to electronic records: handwriting can often stimulate memories that a computer record can not. They further proposed that, despite advances in technology, technology can not afford the same level of convenience as paper and pen. The respondents did however concede that paper records can be lost, there is an inability to integrate paper with other records and that

concurrent use of paper and electronic data introduces potential gaps in documentation which could generate possible paths to medical error.

A study by Meijden et al looked at attitudes of users towards electronic record keeping and their satisfaction with paper-based records (Meijden et al 2001). They found that some of the difficulties with paper records included poor availability, illegibility, poor organisation of the record and incompleteness. They also suggested electronic systems are well organised, legible and available simultaneously at different sites. Their study found however that “except for more concise reporting, no beneficial effects of electronic record keeping were expected”.

Gineken carried out a review of the literature surrounding the implementation of computerised patient records to explore why it is taking so long (Gineken 2002). The benefits of computerised records he lists include accessibility, readability, and ease of reporting, completeness where active prompts guide data entry, ability to include decision support, access to external knowledge and more efficient data analysis. His review does find that data entry by clinicians is the most challenging part. Specific data entry is often considered to be more time consuming than entering prose. Navigation through various fields and selection of applicable items is also perceived to be difficult.

Uslu and Stausberg reviewed 20 studies on the implementation of an EPR (Uslu and Stausberg 2008). Their critical analysis of these studies found that the benefits of collecting data electronically included improvements in data quality, data presentation, and data availability, ease of production of data reports, data handling, legibility, and patient satisfaction. They also found there is a high personnel and space requirement for the routing, archiving and maintenance of the paper-based patient documents.



Many studies refer to, and anecdotal evidence suggests that, space for storage of paper records is a problem. An article in IT reseller magazine (IT reseller magazine 2007) documents a project undertaken by Hull Royal Infirmary Hospital. The article reports how it took 5 years to scan and store 40 years of medical documents and images. All this information, 1.8 million medical images, has been stored on 350 Gb of Storage. Another paper from as far back as 1971 acknowledges the limitation of space for storage of records in the health service. The paper suggests the culling of all records over 7 years old to allow storage of new records (Lennox and White 1971).

As an adjunct to the above literature, it is fair to say that the visibility of electronic records could have further far-reaching consequences. Between 1974 and 1998 Dr Michael Neary performed 129 peri-partum hysterectomies at Our Lady of Lourdes Hospital in Drogheda, when most obstetricians would carry out less than 10 in their whole career (Hunter 2008). This obviously had serious implications for the patients concerned, some of whom were in their early 20s. As a result of his actions there is also a serious financial implication for the country. Recent estimates suggest that settlement of lawsuits could cost the country 45 million Euro (Reid 2006). Electronic data collection of his surgical procedures wouldn't necessarily have changed his

practice. However it may, if we accept that electronic information is more readily accessible, have allowed a timely review of his procedures when the first queries were raised. This review may have provided the information to allow an immediate identification of the affected patients and consequently the safe salvage of their notes. There has been a suggestion that the 40 sets of notes that could not be found, were “maliciously removed” (Reid 2006). Whilst it is fair to say that other measures have been put in place to reduce the likelihood of this ever happening again, it is also reasonable to suggest that the visibility and availability of electronic data collection has potential to improve patient safety in the Theatre Department.

Following this review of the literature a table has been compiled to highlight the main advantages and disadvantages of paper-based record keeping versus electronic record keeping (see Table 1).

Table 1: Advantages and disadvantages of paper and electronic data capture

Advantages of paper	Disadvantages of paper	Advantages of electronic data	Disadvantages of electronic data
Data entry easy	Data retrieval very time consuming	Ease of data retrieval	Requires training
Flexibility of paper	Poor availability at times of need	Easily available	Electronic forms often inflexible
Paper is non-intrusive	Incompleteness	Easier and quicker to search	Initially expensive
Allows patient assessment to flow	Illegibility	Legibility, readability	Can be obtrusive
Portability of paper	Poor organisation of paper findings	Well organised data	Most systems not portable
Cognitive stimuli of paper	Inability to integrate with other sources	Integration with other sources collected data	Acceptance subject to attitudes and abilities
Not always inefficient	Easier to lose	Easy to store large volumes	Possible loss of data with inefficient systems
More qualitative information	Degradation of paper records	No degradation of data	Security concerns
Requires no training	Storage costs	Cheap storage	Lack of consumer confidence
Trust	Physical space requirement for storage	Multi site availability	
Familiarity	Unavailable simultaneously	Encourages completeness	
	Data collation is difficult	Easier and quicker to collate data	
	Storage space	Continuous data processing	
	Reproduction of data is limited	Flexible data layout	
		Tailored paper output	
		Visibility	
		Easy to incorporate decision support	

(Ref: Dick and Steen 1991, Tange 1995, Harper et al 1997, Powsner et al 1998, Meijden et al 2001, Ginneken 2002, Uslu and Stausberg 2008 and Saleem et al 2009)

3.2.3 Conclusion

Following this review the pertinence of the findings set out in the available literature has been analysed in relation to this particular project. As this project is pertaining to the implementation of an electronic register in the Theatre Department, table 1 has been appraised for relevance to this particular project. Consequently, the following advantages and disadvantages have been highlighted as significant to the present system.

The advantages to keeping the paper-based system are:

- data entry is easy, if you can write you can fill it in;
- personnel are familiar with the data entry process;
- personnel don't require any new training to fulfil their role;
- personnel trust the paper record; and
- personnel have confidence in the system.

The advantages of the electronic register are:

- data entries will be complete;
- data entries will be more legible;
- data entries will be more accurate;
- data compilation is easier and quicker;
- data entries will be easier to search;
- data entries be easier to retrieve;
- data can be stored for longer and will not be subject to degradation;
- in the present environment where space is a premium, electronic data storage is cheap and requires very little space;
- if extra data is needed, it is easy to adjust the data collection system to reflect this requirement;
- it will be possible to view the record simultaneously in more than one place;
- information will be more visible;
- it will be easy to adapt the database to collect more information; and
- reproduction of data is easier as paper output can be tailored to specific personnel needs.

In conclusion it is fair to suggest that the list of advantages of the electronic register outweigh the advantages of a paper-based register. This project intends to support this claim by providing some evidence to substantiate this theory.

3.3 Theatre Data Capture

3.3.1 The Irish Position

A review of the literature available on data capture in Operating Theatres was undertaken. However no literature on how data is collected in Operating Theatres in Irish hospitals could be found. Emails to the HSE did not provide the answers either. So, in order to ascertain how Operating Theatres in Irish hospital capture Theatre episode information, a telephone poll of the hospitals listed on the HSE website was carried out. Of the 49 hospitals that were listed, the Galway University hospitals were contacted separately as University Hospital Galway and Merlin Park University Hospital. Each of the hospitals listed was contacted and a member of the data collection personnel (a Theatre nurse from each hospital) asked the following questions:

- How many Theatres are there in use in the hospital?
- Do you use a paper-based or electronic register?
- If paper-based how many registers are there in the Department?
- If an electronic system is in use, which system do you use?
- Any comments, problems?

The findings from this investigation are available in the results section of this report. See section 6.5

3.3.2. International position on Theatre data capture

Data from Operating Theatres is often used as an indicator of performance of a hospital (Faiz 2008). However the literature search of demographic data capture in Operating Theatres revealed very little about current practice. There was limited reference to Operating Theatres in the literature about Hospital Information Systems (Delpierre et al 2004 and Lo et al 2007). This amounted to a reference to the fact that Theatre data was often captured in a Health Information system. In fact, one paper alleges that despite the reality that the Theatre Department is considered a technology

friendly environment, less than 5% of Operating Theatres in the United States of America are computerised (Epstein et al 2007).

There is, however, a lot of literature available on Operating Theatre Department systems that are used for the problem of Theatre timetable scheduling. As far back as 1978, Magerlein and Martin reviewed a number of papers on Theatre scheduling. They reviewed surgical demand scheduling and divided the literature between allocation scheduling and advanced scheduling. Allocation scheduling is the identification of the specific Operating room, the start time and the specific day of surgery, whereas advance scheduling is the process of just fixing a surgery date for a patient (Magerlein and Martin 1978). More recently, a paper by Cardoen et al reviewed 124 articles on Theatre scheduling (Cardoen et al 2009). Their review revealed that, to date, there is no one system available that can adequately deal with the complex nature of Theatre scheduling.

The other area of computerised data that is produced in Operating Theatres is automated anaesthesia record keeping or AARK. AARK is a name for the systems which perform electronic anaesthesia recording. The record usually includes all the data that an anaesthetist would record on a paper record with physiological data being automatically added from various monitors. These monitors include electrocardiography, blood pressure and ventilator settings (de Lisle Dear et al 1999). In more recent times however, the literature refers to the advent of anaesthesia information management systems (AIMS) which go beyond the routine task of automating anaesthesia recordkeeping. Amongst their functionality they can improve compliance with regulatory agency requirements and provide accurate billing data (Egger Halbeis et al 2008).

From this review it is evident that certain stakeholders within the Theatre Department have an interest in using electronic systems. However, literature specifically related to the recording of patient episodes does not seem to warrant the production of a large amount of literature. Consequently the survey of the Irish hospitals that will be performed as part of this project seeks to provide more information on the data keeping practices of Theatre Departments in Ireland. The next section of this chapter will examine the broader literature surrounding the cost benefits of implementing an electronic health system.

3.4 Implementing an Information Technology system in a healthcare setting.

3.4.1 Introduction

The aim of this project is to ascertain if there is any benefit in implementing a computerised system where a paper-based record already exists. Peppard asked the question of how we can measure the benefits (of an IT system). Can they be quantified and can a financial value be attributed to it? He suggests that all IT projects have outcomes but not all outcomes are benefits (Peppard 2007). It has also been suggested that implementing an information system will not show an immediate financial benefit (Meyfroidt 2009). Grieger (2006) alleges that cost is a frequently cited obstacle to implementing electronic medical systems. They claim that positive return on investment is largely anecdotal and infrequently published in peer-reviewed journals. This is in contrast to the claims made by Heeks (2006) who stresses that the nature of peer reviewed publication tends to lend itself to academics purely writing about successful implementation of health information systems. This, in turn, is supported by the statement by Meyfroidt (2009) who claims that *“luckily reports of successful – but rarely uneventful- implementation experiences are more frequent than reports of major failures”*. So does this suggest that whilst failures of health information systems are widely publicised in popular media, for example the PPARS problems, (Hunter 2005) actual reporting of failures or successes appear merely as assertions or generalizations from personal or limited experience? This literature review will attempt to uncover which of these claims is supported in the literature. Due to the limit of information analysing the specific type of system in this project, this review has embraced the literature surrounding the implementation of any IT (Information Technology) system implemented into a healthcare setting.

3.4.2 Cost benefit analysis

A number of systematic reviews have been carried out on the benefits of implementing electronic health systems.

A review of 867 pieces of literature on health information technologies was carried out by Chaudry et al, to ascertain the impact of health information technology on quality, efficiency and costs of medical care. (Chaudry et al 2006). Three types of systems were part of the analysis. 63% of these were decision support systems aimed

at providers, 37% were electronic health records and 13% were computerised order entry systems. As the studies examined were for different systems and suitable for different health environments, they developed a Web-hosted database as part of the project. Of the papers reviewed, only 257 were suitable for inclusion in their database. From this database, 52 papers showed quantifiable benefits. The study found that despite the number of articles reviewed, only three major benefits on quality of care delivered were demonstrated. These were: adherence to guideline-based care; enhanced surveillance and monitoring of diseases; and decreased medication errors due to decision support systems. From their review of the literature Chaudry et al found that the sole quantifiable benefit that was identified from all the systems reviewed was reduced use of redundant or unnecessary tests. Basic cost data needed to determine the total cost of implementing a system or return on investment could not be extracted from the literature, and results on time utilization were mixed, limited, and consequently could not be generalized.

Shekelle et al (2006) reviewed 855 pieces of literature and included only 256 items in their final study. From the critique they identified that despite the diversity of the studies analysed, in general the authors predicted substantial savings from health information technology implementation. It was projected that investment costs would be outweighed by the benefits of the systems. However, the time predicted to even demonstrate that the systems costs would “break even” varied from three to as many as 13 years. The review also identified that some of the organisations published realisation of major gains already through the implementation of multiple functions. Consequently, Shekelle et al’s analysis of the literature found that, overall, health information technology can potentially alter the delivery of health care by making it safer, more effective, and more efficient. All their findings, however, are subject to the limitation that, of the available literature, no study or collection of studies would allow a reader to generalize the reported benefit.

Uslu and Stausberg (2008) reviewed available literature with the specific aim of clarifying the issue of whether and to what extent the use of an EPR is worthwhile. Their review of all the literature identified 19 articles which contained 20 studies concerned with the economic aspects that were deemed appropriate. Nineteen of these studies indicate an economically positive impact, while only one claims a monetary

disadvantage of EPR. However concerning the influence of EPRs on quality of care, the studies do not provide a clear answer to the question of benefits.

Poissant et al undertook a systematic review of the literature surrounding the impact of implementing electronic health records on documentation times (Poissant et al 2005). From their review they found 23 of 63 studies were usable for their analyses. The methods examined were time and motion studies and work sampling. Their review of the literature suggests that if the goal of implementing electronic health records is to reduce time spent on documentation then this goal is unlikely to be realised. However their study did find that point of care computer stations did reduce nurses' documentation time by up to 24.5 %. Doctors' time, however, was increased by as much as 328% if the use of a centralised or point of care workstation was required. This study examined a computerised order entry system which required the doctor to visit each patient to order tests and medication for them. However this increase in doctors' documentation time could be explained by the fact that, traditionally, whilst doctors are responsible for ordering tests in most healthcare settings, order forms including drug charts and radiology forms are gathered up by the nurses and left in a pile for the doctor to sign at a time that is convenient for them. The obvious conclusion that follows, therefore, is that it is a change of work practice that has increased the time rather than a comparison of one documentation process to another.

Berg (2001) suggests that implementing an information system in a health setting is a difficult task. His analysis of the literature surrounding the myths and challenges of implementing an information system found that technology and organisations transform each other in a two way process. He also found that future users as well as management support was essential to the success of any implementation. This is supported by Ginneken (2002) who analysed the literature and found that it was "crucial" to involve end-users in the selection of priorities for a system and the implementation and goal determination for a plan. He also found that clinicians' acceptance and commitment to implementation are vital for success.

3.4.3 Conclusion

The many previous reviews set out in the literature reflect the author's opinion that implementing an electronic health system can improve the quality of patient care by making it safer, more effective, and more efficient. The literature on the monetary impact of implementing a system suggests that it is also favourable. However, the overwhelming result from all the studies reviewed, is that due to the nature of health care and the diversity of health care needs, no one study can be generalised to prove that implementing an electronic system provides benefit, and no formula exists yet to quantify any benefit. However from this review, a time and motion study has been identified as a suitable method for identifying if any time can be saved from implementing the electronic register. Another issue that has been raised is the encouragement of end user involvement in the design of a health care system, so for this reason end user involvement will be investigated next.

3.4 End-user involvement

3.4.1 Introduction

In the previous section it was suggested that end user involvement increased the likelihood of successful implementation of a health information system. A review of the literature surrounding end user involvement was undertaken as follows.

3.4.2 General review of end user involvement

A paper by Lapointe and Rivard (2006) suggests that the measure of success of any system is the end users' satisfaction and ultimate utilisation thereof. In a study by Harrison and Kelly Rainer (1996), they propose that user satisfaction is probably the most widely used single measure of information system success. User participation and involvement have long been associated with system success (Klobas and McGill 2008), especially during the early stages and prior to implementing a system (Lee 2007). Another paper suggests users' involvement also fosters a sense of ownership among users and this is a necessary condition for successful development of information systems (Kim and Michelman, 1990).

Meijden et al (2001) contend that end user involvement in the whole process of development and installation of a system is vital. Their research into the development and implementation of an EPR, which explored how to encourage the end-user,

actually found that despite encouraging end user involvement through the use of questionnaires that related to electronic record keeping and subsequent changes in their daily work, they didn't achieve the anticipated increased interest in the system. Their findings indicated that this method was insufficient and that they needed to involve future users in the whole development process so they could gain an insight into all of the potential of electronic record keeping. This would also help the end users develop a sense of ownership of their system (Meijden et al 2001).

In a paper evaluating clinical information systems, Kirkley and Rewick (2003) describe various computerised health systems and their implementation. They describe one particular computerised provider order entry system, (which would ultimately be used by doctors), and how, from the beginning, the system developers made a commitment to involve nursing staff members (Kirkley and Rewick, 2003). They acknowledged that nurses serve as the patients' gatekeepers; if the patient's condition changes, the patient's nurse is best positioned to detect and take appropriate action. Consequently a number of nurses were asked to participate alongside physicians and executives in the design, selection, implementation, and training phases of the project. They confirmed that the system should complement current workflow practices, and this can be determined through user participation and observation. It also had the added benefit that by allowing nurses to be involved in the design they determined that if a physician encountered a problem with system the nearest nurse is likely to be a useful resource obviating the need to call technical support. They suggest the decision of utilising nurses' unique insight was a major factor in the organisation's success. The significance of this success can be measured against a paper from 2001 which claims that, in a survey of 1,000 hospitals, 66% of the hospitals do not have any computer order entry system available. From the 33% that have such systems implemented, more than half reported that less than 10% of orders are entered into the system and less than 10 % of physicians use the systems (Jech, 2001).

In order to reduce some of the resistance expected from the users of the system, as witnessed with other systems in the Department, the literature suggests involving the personnel involved in data entry in the design of the system. As the ultimate end users of this system, nurses will be key stakeholders in the electronic register. To best prepare for undertaking the project an exploration of the literature surrounding nurses and computers was undertaken.

3.4.2 Nurses as end-users.

Given that end user involvement has been highlighted as one of the key factors of successful implementation of a system, an exploration of the specific end users of the proposed system was undertaken. The most significant end-users of this system will be the nurses. All the data entry in the Theatre Department is carried out by the nurses. The system will require approval and uptake by them hence “*their (the nurses) perceptions of computer use are a key determinant in the successful implementation of a computer system*” (Hilz, L.M., 2000) This is supported in another paper which suggests that the method for evaluating the successful implementation of computer systems that is most frequently used in health care organisations has been the assessment of nurses’ attitudes toward computer use (Dennis et al 1993). Indeed, another report suggests that a negative attitude from nurses on a large enough scale will cause a system to fail. For this reason it is important to look at the literature surrounding nurses’ attitudes to computers (Jaques 2002).

3.4.2.1 Nurses attitudes to computers

From the author’s own experience, there is a lot of negativity towards computers. Within the Theatre there are 2 electronic systems that, if used, can reduce potential error and personnel time wasted. One is the ability to access blood results from a computer programme and the other is the ability to print off patient labels from another computer programme. The alternative to accessing the blood results from the computer is to “bleep” the on-call lab person, wait for them to reply, and then they look up the results and advise the caller of the results. This is subject to time wasting because one has to wait for the lab to call back, and also it is subject to error because often results are taken down in a busy corridor where noise interference is definitely a factor. With the label printing system the alternative is to ring the admissions office and ask the personnel there to send up the stickers in the “chute” system. Whilst this is easy to do this service is only available during office hours and not at weekends. This means that during out of office hours labels for specimens are hand written and this is again time consuming and subject to error. From a staff of 26 nurses there are only four nurses within the Theatre Department who regularly use either of these systems, suggesting that there is a reluctance to embrace current technology by nurses.

There has been some suggestion in the literature that age plays a part in this reluctance to embrace computers (Frantz 2001, Timmons 2003, and Chan et al 2004). The majority of nurses in the Theatre Department are mature and have a number of years experience in their present position. Only 2 of the 27 nurses working in the Theatre Department are under 35 less than 10 years' experience. All the others are over 35 with the majority over 40 with at least 15 years' post qualification experience. Many studies (Brodt and Stronge 1985, Sultana 1990, Negron 1995, Simpson and Kendrick 1997 and Eley et al 2009) have analysed these issues and their impact on their attitudes to computer usage and uptake.

Brodt and Stronge's study did not find significant differences between age and length of employment in attitudes towards computers (Brodt and Stronge 1985). This is correlated by Sultana's study (1990) which looked at how a nurse's age, years spent in nursing and previous computer experience impacted on their attitude to computers. The results of her study showed that despite the claims made by computer advocates, her respondents felt nurses' jobs are not made easier by computers, paper work is not reduced, efficiency is not increased and time is not saved. Age and computer experience did not make a significant impact on these results. These results have recently been reproduced (19 years later) in a study by Eley et al (2009) which concluded that demands from the working environment, computer access and lack of support were the principal barriers faced by nurses to their adoption of the technology in the workplace. Again they concluded that factors that were considered to present fewer barriers included age and lack of interest. While this is not disproven in a study by Simpson and Kendrick, which used Brodt and Stronge's questionnaire to test nurses' attitudes to computers, they did however find that younger nurses had more positive attitudes to computers and the more years experience a nurse had the more negative their attitude (Simpson and Kendrick 1997).

From the literature there is little written about Irish nurses' attitudes to computers. Murnane's study, which took place in 2002, included an attitude assessment scale. This study revealed that nurses' attitudes were generally positive towards the introduction of computerised nursing records within a Dublin hospital (Murnane 2005). Cowman's (1995) study of student nurses' preference for learning, however, revealed that computer assisted learning was their least favourite method. This is an

old study however and a subsequent analysis may reveal a different outcome. This author suggests that computers have become more ubiquitous in our every day lives especially among the student population. Also since the 1994 report, nurse training has become more academic and all nurses are now educated to degree level. Consequently computer use is required for production of course work, both in the review of literature to support their work and in the production of their assignments. A more recent study which explored the experiences and attitudes of Irish nursing students to computers (Curtis et al 2002) supports this suggestion. In the research paper, the authors report that almost one hundred percent of respondents felt that learning about computers was essential for nurses. This finding supports the proposal that nursing students are very aware of the prevalence of computers and their usefulness in healthcare. The authors did however acknowledge the lack of options to generalize the findings from their study due to the limitations and small size of their sample, (n= 74 or 61.7%) and as they only tested one cohort of students, from one educational establishment. This result is similar to the findings of a research study by authors Sinclair and Gardner who used a questionnaire to assess Northern Irish student nurses' "perceived career-related importance of computers". The results demonstrate that students gave an unequivocal and positive endorsement to the perceived career-related importance of computers (Sinclair and Gardner 1999).

From an international perspective an opinion article by Saba explored Nursing Informatics historically, contemporarily and prospectively. She investigated the history of informatics and described how Florence Nightingale compiled and processed data to justify the need for specific reforms as far back as 1857 (Saba 2001). Saba went on to suggest that it was another hundred years before computers started to appear in the nurses' workplace, by citing an example of nurses' involvement in computer use in the 1960s, when a nurse in America developed a computer-assisted instruction nursing simulation exercise to teach obstetrical nursing. Again in the 1970s she gave an example of five nursing papers on informatics that were presented at a medical informatics conference in Sweden in 1974. The first international nursing conference to be held on the impact of computers on nursing was not held until 1982 (Scholes et al 2000). Saba's article went on to describe how the need for standardisation of forms for re-imbursement of health care services was a

catalyst for the development of computerised financial systems and consequently to the provision of several workshops on how to use a computer for nurses (Saba 2001). With improvements in hardware technology and software usability, computer use became more widespread. Saba contends that at the beginning of the 21st century the “majority of nurses are computer literate and computers are found in all areas where nurses function”. However in discussing minimum informatics competencies for the profession, the 2001 ANA (American Nurse Association) Scope and Standards of Nursing Informatics Practice suggests that the nurse should have basic information management and computer literacy skills. This would suggest that the policy is for all American nurses to have a basic ability to use computers. This statement is not substantiated by Ball’s 2005 opinion article in which she claims that nurses have inadequate knowledge to undertake their many new roles in relation to nursing informatics and she suggests, “computer literacy and informatics should be made an important component of the nursing curriculum” (Ball 2005 p3.)

Padgett in her article “Are you computer-competent?” in 2003 supports this argument when she notes that some nurses just “put their head in the sand” when it comes to computer use and claim to have no knowledge or ability (Padgett 2003 p20) It must be conceded that Ball’s role as a professor at Johns Hopkins School of Nursing and the Padgett’s position as a nurse informaticist give both opinions some credibility, thus suggesting that, despite ANA policy, there may be areas in nursing in the United States of America where nurses are not computer literate. This reflects this author’s experience from her own workplace.

3.4.2.2 Nurses education and training

A review of the literature on computer usage suggests that training and education are required prior to implementation of computer systems. Consequently, this review will explore the education policies of nursing students, as this is the fundamentally most opportune time for nurses to acquire the skills required for computer use. In Ireland, An Bord Altranais’ Requirements and Standards for Nurse Registration Education Programmes (An Bord Altranais 2000a) includes “Information/ communication systems and technology” as a topic in their syllabus/indicative content under the domain of communication and interpersonal skills. The list of the standards for approval of educational programmes leading to registration that are relevant to information technology are included in table 2

Table 2: Standards for Educational Programme

- | |
|---|
| <ul style="list-style-type: none">• The curriculum is based on a range of teaching-learning strategies to assist the development of a knowledgeable practitioner and to equip students with the life-long skills for problem-solving and self-directed learning.• The curriculum design reflects various methods of teaching/ learning and provides a balance between lectures, tutorials, workshops, small group interactions, demonstrations, practical work and self-directed study.• The curriculum equips the student with a level of knowledge, research awareness and critical analysis. (An Bord Altranais 2000b) |
|---|

These standards imply a need to incorporate computer use into the curriculum. However there is no specific recommendation that insists IT skills are a taught component of the syllabus or a pre-requisite of qualification.

A piece of research undertaken by Sinclair and Gordon (1997) examined Northern Irish nurse teachers' perceptions of information technology. The study used semi-structured interviews to develop a questionnaire that was then distributed to all nurse teachers (n=236) employed by the National Board in Northern Ireland. A response rate of 63% suggests the results are very representative of the sampled population and the issues raised as important by respondents (such as lack of formal IT training for tutors and lack of appropriate technology) can be accepted as valid. However the age of the study (accepted for publication 1996) and the fact that it was carried out prior to the integration of colleges of nursing into higher education, would suggest that a similar study carried out today may identify different issues.

This is, however, not the case as demonstrated by a more recent study by Murphy et al (2004) into what is holding up progress in health informatics education in the UK. Their study also identified staff training as an issue affecting the implementation of IT training. The study concluded that there were insufficient personnel with the knowledge and the skills to lead nursing into developing strong health informatics education training and development. Of the colleges surveyed only 11% had a nurse tutor with specialised Health Informatics (HI) training. The paper suggests that because of uncertainty as to who is responsible for overseeing IT and HI education, employers and educators both presume responsibility lies with the other.

This dichotomy is being addressed by United Kingdom Nursing and Midwifery Council (UKNMC) Standards of Proficiency for Pre-registration Nursing Education, which identifies the ability to demonstrate literacy, numeracy, and computer skills needed to record, enter, store and organize data essential for care delivery, as a key skill in care management (UKNMC 2004 p33). Likewise in America, one of the organisation that accredits nurse education, the National League for Nursing Accrediting Commission (NLNAC), insists each programme type demonstrates how graduates have been educated in “communications, computation, and technological literacy that enable the gaining and applying of new knowledge and skills as needed” (NLNAC 2004 p84). Similarly from an Australian perspective, the Commonwealth Government’s report into health information management as far back as 1997 directed that all Australian universities take a leading role in integrating information technology into nursing curricula (Commonwealth of Australia 1997)

3.4.2.3. Policies that guide computer use by nurses in Ireland

A number of policies that influence the profession of nursing in this country are those that are published by The National Nursing Board (An Bord Altranais). Nurses have responsibilities in line with the code of conduct “the aim of the nursing profession is to give the highest standard of care possible to patients” (An Bord Altranais 2000b).

This would suggest that, as a major stakeholder, nurses have a responsibility to embrace computers and information technology in order to carry out our professional, ethical and legal responsibilities in the workplace. However the code also suggests “it is appropriate to highlight the potential dangers to confidentiality of computers and electronic processing in the field of health services administration” (An Bord Altranais 2000b). In contrast the scope of practice encourages nurses to embrace technology by suggesting that it “is particularly important in the context of a changing health care environment, changing patient/client needs and increases in new technology resulting in demands for nurses and midwives to expand their range of responsibilities” (An Bord Altranais 2002b p28). This dichotomy from the nursing board may contribute to the attitudes of Irish nurses and consequently may result in the behaviour experienced by the author. It is hoped however that as all nurses’ training is now to degree level, and as a consequence requires the students to use computers both for preparation of course work and submission of assignments, more

recently qualified nurses will have a different attitude to computers and their use in the delivery of health care.

3.4.2.4 Conclusion

In conclusion it is fair to say that nurses have a complex relationship with computers. The value of some of the literature is questionable due to its age and the rapidly evolving environment in which we live. Much of the education and training issues identified may be superseded by the fact that nurses are educated to degree level as standard in Irish education today; nevertheless this does not address the issues of nurses that are already in practice. It may be concluded the policies governing the practice of Irish nurses are a source of some of the insecurities surrounding computer use. It is hoped, however, that with the benefits of the findings outlined in the literature, the design and implementation of the electronic database contemplated by this study will be successful in dispelling some of the fears and reluctance reportedly experienced by nurses as revealed by the literature. It is anticipated that the utilisation of the electronic database will make the every day use of a computerised system a reality, thus debunking some of the myths and fears that exist. Following implementation, an evaluation of the benefits of electronic data collection over paper-based records will be performed to assess if in fact implementation goes any way towards improving the attitude of the nurses in the Department. This project hopes as a by-product of the database implementation to address the notion that “nurses’ jobs are not made easier by computers, paper work is not reduced, efficiency is not increased and time is not saved” (Sultana1990) whilst addressing the barriers to successful implementation of computer access and support as identified by Eley et al (2009).

The next chapter will describe the design and implementation of the electronic database for this study.

Chapter Four: The Electronic Register

4.1 Introduction

This chapter will describe how the electronic register for this study was designed and implemented. As stated in chapter 3 an existing database is currently installed on a computer in the HIPE office. Utilisation and adaptation of this system was considered; however the original designer was unavailable to make any adjustments to the system, and from the literature search the author established that involving end users from the inception stage is a priority for the successful implementation of an electronic health system. Consequently the potential utilisation and adaptation of this existing system was rejected. This chapter contains details of the design process used, including how the requirement list was devised. The system pilot and eventual implementation are also described.

4.2 Design

When designing any system there are a variety of different methodologies that can be used to plan, structure, and control the process of developing the required system. As projects rarely have the same end user, system requirements, budget, time and developers, the system development methodology for each project can be very different. A system development methodology refers to the framework that is used to structure, plan, and control the process of developing an information system. A variety of such frameworks have been developed, each with its own recognized strengths and weaknesses. These include:

- Waterfall
- Prototyping
- Incremental
- Spiral
- Rapid application development

(Centres for Medicare and Medicaid Services 2008).

For the purpose of this project the prototyping methodology was chosen.

This project is dependant on the design and implementation of a system that will allow personnel to record, electronically, data that has been previously been recorded on a

paper-based register. From the literature it has been suggested that the involvement of the personnel that will eventually use the system from the inception stage improves uptake and utilisation. Consequently a number of personnel have been encouraged to participate from the inception stage.

“The ability to tailor electronic format of the clinical documentation to make it similar to the hospital’s existing paper documentation has the benefits of improved workflow while also providing both a comfort level that eases the transition from paper to electronic charting.” Manjoney 2004

The initial stage in the iterative design process was to interview the Theatre Department nurses, the doctors who were interested in the collected data and the hospital’s data information officer who was responsible for collating and publishing the statistics that are obtained from the information in the register. The results of these interviews helped to generate a requirements list that was then incorporated into the prototype system design.

4.3 End user involvement

To involve end-user in the design of the system a selection of personnel was chosen to provide their input into the prototype design. The sample that was chosen was purposive. In purposive sampling the researcher deliberately selects who to include in the interviews because those selected are considered the most suitable people to provide the data required for the system (Parahoo, 1997). Wilson et al., (1997) confirm this with their findings that identifying the right end user is essential. Carefully selecting from the end user population will ensure that the needs of all individuals are met. They expand on this by confirming that selection should be a cross-section of users who will accurately represent the needs of individuals on every level, not just the needs of the senior most “super users”. This is supported by Harris, (1994) who suggests that finding the right end users to include in the design process will ultimately lead the creation of systems that will increase the level of literacy of the overall user population (Harris, 1994). Consequently the current sample contained 8 nurses, four doctors and the hospital’s data information officer.

4.3.1 The Nurses group

4.3.1.1 Nurses selection

An initial focus group discussion was held with the eight nurses about their design specifications for the system in January 2009. The selection process used was purposeful. The nurses that were chosen were a selection of two nurses who had IT interests and considered themselves proficient in IT to varying degrees and were keen to have an electronic database in place, and six nurses who considered themselves IT illiterate and were resistant to the implementation of anything IT related. The group participants were identified through informal questioning and observation of present use of computer based services within the Department, for example the use of electronic retrieval of blood results versus telephone retrieval.

4.3.1.2 Focus group discussion

The first question to the nurses explored their familiarity with computer programmes and methods of data collection.

The majority of staff agreed that they were most familiar with Microsoft applications. Six of the nurses expressed that they had used various Microsoft office documents. Two of the group stated they were not familiar with any computer applications, however they agreed to go with the majority. Therefore it was agreed that the database would be built using Microsoft Access. One member of the group had experience putting patient details on a computer and asked about using a touch screen layout. This suggestion was put to the group, however the majority were unsure of this technology and were happier using a conventional mouse and keyboard. It was also decided that a one page layout would be best as all the information per patient visit could be viewed in one glance prior to moving on to the next episode.

Having agreed on the application design, the group were then asked about their opinions of the present system.

Most of the group were happy with the paper register and voiced an initial contentment with the method in which the data that was captured. The two nurses in the group who were responsible for collating data did however point out the considerable time this took. The next question however revealed that there was extra information that the nurses were keen to include if possible.

The third question presented the content available from the paper system, and the group were invited to suggest any other data they would like to capture.

It was agreed that the electronic register should have the same eleven fields that the register contains. These fields are date, time in and time out, name, address, date of and age, surgeon, anaesthetist, nurse, operation and notes and remarks. As well as these fields the columns allow for date of birth, whether the patient had a G.A. (general anaesthetic) or L.A. (local anaesthetic) was an inpatient or day patient.

A group member asked whether it would be possible to include a box to say whether or not a specimen had been sent for analysis. This would reduce confusion as to whether or not there had been a specimen, for example a piece of excised tissue, retrieved from the procedure. It was agreed this could be included.

Another group member asked if was possible to record somewhere what sex of baby had been born following a caesarean section. This was agreed upon.

Following another suggestion, the group decided it would be very beneficial to be able to record the source of ambulatory patients. These are patients who come directly to Theatre and are not admitted to the hospital; both the gynaecological surgeons and the general surgeons perform minor surgeries on these patients in the Theatre Department.

One of the group asked if we should be recording the names of the midwives and paediatric doctors who attended the Theatre during a caesarean section but the group decided that this was not necessary, so it was decided not to enter this data for this project but the suggestion would be considered again in the future.

Another member of the group asked if it would be possible to include the instruments that were used for the procedure. The present method of traceability is to stick the instrument CSSD label to the patients' operation record in the notes. Whilst this is all that is required, legally, it was agreed that in the unlikely event of something like a series of post operative infections, it would be really useful to identify if it corresponded to the same instruments being used. It would also be useful for tracing the nurses that had used particular instruments, in the unlikely event that an instrument or part of a set went missing.

As a result of some of the other issues that were raised during the discussion it was also decided that another two fields would be included to allow for extra nurses to be

present for the procedure as, due to the nature of operations, sometimes there are more than three nurses present during surgery.

4.3.2 The Doctors interviews

Four doctors, two surgeons and two anaesthetists, all consultants, were also interviewed about their requirements from the system. It was decided to include only consultants as non consultant hospital doctors change where they work every six to twelve months. The doctors were interviewed individually as it was not possible to arrange a time that would suit them all. Again their selection was purposeful. They were chosen because they showed an interest in the project when it was first mooted and had also been observed collating data from the paper register on a regular basis. Despite the fact that they did not enter data into the register, they were seen as end users. Consequently it was deemed important to establish if there was other information they too would like to collect.

As they were interviewed after the nurse group discussion, their familiarity with a Microsoft Access database was assessed. Whilst none of them had ever built or used one they had all seen one before and were happy, and indeed encouraging, for data to be collected in this way.

The first doctor, a surgeon, suggested that the consultant surgeon in charge of the patient should be recorded for each entry. At present only the doctors present during the procedure are recorded. Consequently it is difficult to assess from the register how many procedures are carried out under the care of an individual surgeon. As this was the first doctor interviewed, the question of this inclusion in the database was put to the others. The other doctors agreed this would be very useful.

The first anaesthetist also suggested that the consultant anaesthetist in charge of the case should also be included in the register and whether they were present or not. Another suggestion from the first anaesthetist was the different type of anaesthesia; for example, spinal or epidural top-up. The present system only allows for general anaesthesia or local anaesthesia to be recorded so it is not possible to tell from the register if a patient undergoing caesarean section has had a spinal anaesthesia or epidural top-up, and it is only possible to determine if the procedure was performed

under general anaesthetic or not. At present if this information is needed it can only be found by collecting the patient's notes and reading the anaesthetic sheets.

The other anaesthetist asked that the patients Mallampatti airway score, and laryngoscopy grade be included. The Mallampatti Classification is based on the structures visualized when a patient opens their mouth and protrudes their tongue in the sitting position. It is graded I to IV and is used to predict the difficulty of an intubation. The laryngoscopy grade refers to the visibility of the chords when a laryngoscope is used during the intubation of a patient. Again it is graded from I to IV and is an actual assessment of difficulty of intubation. It was hoped that data collected would aid the determination of the link between Mallampatti and laryngoscopy grade. This information would be provided by the anaesthetic pre-operative assessment and from the anaesthetist post intubation. Otherwise, the doctors interviewed concurred with the extra data collection suggestions from the nurses group.

4.3.3 The Data Information Officer

The Data Information Officer who is responsible for collating Theatre Department activity was interviewed for her input for the design and build of the electronic register. The use of Microsoft Access was discussed and she was very happy that this would fulfil her needs. The fields and relational tables that had been suggested by the other groups were discussed and she was asked if there was any other data she would like to be available from the register.

The remit of the Data Information Officer is to collate data and statistics for the HSE. Included in those statistics is Theatre activity, some of which is not available from the paper-based register. As a consequence she often has to get information from more than one source. For example, as she needs to gather statistics on elective versus emergency procedures, the present register does not include the patient source so she has to compare the Theatre register with the consultants' admission list. She then has to confirm this information by checking the patient's records. Often a patient will not be on an elective list and will have non emergency surgery. However the information the Data Information Officer gets presently from the Theatre register doesn't contain patient record numbers. All notes are stored by their medical record number, which means she has to check the PAS system for patient record numbers before she can find the notes. The Data Information Officer also asked if was possible to record the patient's county as a quantifiable field as, in the present economic situation, proof that

the hospital is providing services to a multitude of counties is vital, and having this information easily available may have influence when national and regional budgets and service provision is being considered.

4.4 The system requirements

From the interviews the number of required fields in the database was established. In addition to the 11 fields present in the paper register, there would be a number of extra fields included. The first additional field allowed the person entering the data to include the patient hospital number. The rest of the new fields were relational tables. These included: patient, county, category and source. The new field of patient's obs\gynae consultant and anaesthetic consultant in charge were related to whether they were present or not. Five fields were provided for the nurses present. Fields for the type of anaesthetic, airway type, Mallampatti airway score and laryngoscopy grade were included. A field for specimens retrieved and the instrument sets used was also included.

Having established the system requirements, the author built the database using Microsoft Access 2003 (Bast et al 2006). The database was designed and installed on a laptop belonging to the author. It was hoped that it could be replicated on 2 further networked laptops to allow it to be used in all three Theatres simultaneously. The security of a network was raised as a possible issue when such sensitive data would be stored on it. Solving this issue was beyond the scope of this project, and so, in consultation with the Theatre manager and the data information officer, it was suggested that just one data capturing instrument be left in the admissions area of the Theatre. The practicalities of this suggestion were discussed amongst the key personnel and it was decided that as only the admission data would be available at this stage, a major change of workflow would be required to allow this to happen. Another suggestion was that the data collection could be carried out in the recovery department but this suggestion was also ruled out for 3 reasons: firstly not all patients enter the recovery room, secondly only a few nurses work in the recovery room hence limiting number of staff that would be exposed to the system, and thirdly (and possibly most significantly) details of the surgery instruments and staff present would have to be conveyed to the person inputting the data so that the details could be put onto the system. This last point could potentially lead to more data being collected on

paper. After much discussion it was decided to place the register in one Theatre for the initial implementation, until the networking issues could be resolved. This is supported by the literature which suggests point of care documentation reduces error and omission.

The Gynaecological and Obstetric Theatre was chosen because most of the nursing personnel work in this Theatre at some stage during the week, either during the working week or when they are on-call and all nurses would definitely work here within the months of the projects trial period. The Gynaecological and Obstetric Theatre was also chosen because the number of procedures carried out in this Theatre is limited and a nearly exhaustive list of procedures can be preloaded to allow data entry from a “drop down” list.

4.5 The Pilot

A pilot of the system was required as part of the design process chosen for this project. The objective of this was to observe the personnel who would be using the system, to identify any design modifications that may need to be carried out, and to identify any more user requirements based on these findings. It was also used to establish what the training needs of the personnel might be. There was also the added bonus of familiarising some of the personnel with the product before it was implemented into full use. It was hoped that some of the anxieties surrounding the implementation of the system might be alleviated thereby.

Once the electronic register was ready, it was decided that it should be trialled on a weekend when the author was not working. This would enable the author to observe the nurses completing the database. As there would be fewer people around, individual attention could be paid to the personnel that were trialling the system. Also the anticipated case load was expected to be lighter than during regular Theatre hours, so the number of entries wouldn't be problematic, and there should be time between cases to review problems and resolve issues. On the day in question there were three cases in the Obstetric and Gynaecology Theatre. The nurses on duty carried out their work as normal and during the case the electronic register was completed, this is the same practice as for the paper register.

Two issues arose. The first issue observed was that the layout was not intuitive. The order in which the data was required was different to the order in which the paper-

based register was completed. The nurses' details were on the form following the patient's demographics, unlike the paper register which demanded the completing of the doctor's details first. This was a minor issue and just required the alteration of the layout of the form. Secondly the free field for typing in the instruments used was considered laborious as up to three sets of instruments could be used per Theatre episode. As the instrument list for the Theatre is exhaustive it was possible to include a "look up" table for these. Also as this information could be needed in relation to a specific case, a relational table was built.

Once the database had been amended the system was trialled again; this was carried out on another weekend day. The data entry became smoother as the day progressed and staff became more familiar with its use. On this day there were six cases in the Department and staff raised reservations about the extra work of filling in both systems when it was very busy. This was discussed for a long time but no solution could be found as it was necessary to keep the paper register until successful implementation had been achieved and management agreed that the electronic register was an adequate source of record keeping.

4.6 Implementation

4.6.1 Introduction

Following the design phase and piloting, the implementation of the system was officially undertaken on 1 April 2009. As a result of the decisions reached in the design and pilot phases' the database was installed in the Gynaecological and Obstetric Theatre alone. As considerable training had been undertaken during the design and piloting phase, on the morning of the system "going live" each of the nurses who would be entering the data for that day was individually "walked through" a data entry example and any questions answered. There was still a lot of nervousness but the reassurance of the backup concurrent paper register helped. The fact that the trainer was also on duty provided additional reassurance for the personnel.

4.6.2 Diary of implementation

In order to record the implementation process, a diary of events and issues that arose was kept. Despite the lacklustre nature of the diary it was decided that its inclusion

was pertinent to the study, as the chronicling of issues shows that it was not uncomplicated.

Diary Extract:

On the first day of implementation everything went well and all data was entered with only an occasional query for what the real names of the doctors were. Most of the NCHD doctors working in the hospital use first names, and in some cases shortened versions of their names, this is the name that is often entered in the register. When the doctor's lists were compiled, the official name of each doctor was entered onto the system. The data entry was delayed so that personnel could establish who each doctor actually was. There was also a debate about whether a procedure that involved the removal of something and replacement of a new one should be entered just as a change of said item. It was agreed that as two procedures took place it is better for statistics to enter the two separate procedures. So, for example, a change of Mirena coil as it is recorded in the paper-based register gets entered as a removal of Mirena coil and then another entry for insertion of Mirena coil. The HIPE office agreed that this was the best way to ensure all activity is recorded. There were no entries overnight.

On Day 2, there was one member of staff from the previous shift on duty and three new members so before surgery started the new personnel were "walked through" the data entry with the reassurance that the trainer was available for any queries. There were no issues on that day. All nursing personnel working in the Theatre had an opportunity to fill in the database at least once during the day, with no errors or omissions. There was one entry overnight which was competently completed by the personnel involved.

Day 3: there was one new person to learn the data entry so again the trainer walked the person through the first entry of the day. Data entry was uneventful during the day and there was no problems identified. Overnight procedures were entered without any identified errors or problems

Day 4, the weekend: the trainer went in to the Department as two new personnel were going to be involved in the data entry. They were "walked through" the data entry. One issue arose about a procedure that was not on the procedure list so the table was amended and the procedure was added.

Day 5: a number of issues arose because there was a serious emergency during the night, before midnight. The personnel could not enter the data at the time so they tried to enter the data the next morning. The date created a problem because it was set to automatically record the date of entry and when they tried to change the date an error message came up saying the data did not fit the input mask and refused to allow any further entries. Because they didn't want to disturb the trainer on a Sunday no further entries were input on that day. This meant seven entries required inputting before day 6 could begin.

Day 6: the date error was explored and a change of date format was incorporated so that it was easier to enter omitted or delayed entries. The data entries were brought up to date again and there were no further issues that day.

Day 7-day 10: there were no data entry issues. A few new members of personnel were trained and a few extra instruments and procedures were added to the forms. It was very interesting and enjoyable to observe a self-professed technophobe teaching one of the other members of staff how to enter in the data.

Day 11: the date became an issue again as the system again locked out staff with the error message "data entered does not meet the input mask" the required format was 00-abc-0000 but the personnel were trying to put in various different formats such as 00-00-00 and 00 00 00. Once the error message appeared the personnel got nervous and couldn't figure out how to determine and change the date. Unfortunately, again no further entries were recorded that day.

Day 12: a phone call from the trainer identified the issue so a trip to the Department and a quick teaching session allowed the error to be problem solved. To assist with this problem an example of the required input mask was permanently embedded in the data entry form.

Day 13- day 18: no issues arose and further members of personnel were familiarised with the system. A few more procedures required entering onto the system so it was decided for the present to include an "other procedure" option on the drop down menu for the operative procedures. Then the procedure could be typed in manually in the comments box. This free text could be observed when the implementer was available and the required operative procedure could then be added to the list.

Day 19: another Sunday proved difficult again as the date entry issue re-occurred. Despite a reassurance phone call from the trainer, the personnel were unable to get out of the error message loop so were told to leave the data entry until Monday morning.

Day 20: the omitted data was entered. As the date issue was worrying staff it was decided to change the format completely and so two new dropdown boxes for the day and the month were introduced as part of the form instead of the date format. The personnel appeared happier with this compromise. As this is only a prototype the year was not included but a further dropdown box can be added in the future if the system is taken up full time.

Day 21-day 90: a few more procedures and instrument sets were added and further staff were trained. No further issues arose.

4.6.3 Screen shots of the electronic database

Screen shot of Database Form 1

Day	▼	Month	▼	2009	Patient's Obs/Gynae consultant	▼	Anaesthetic Consultant in charge	▼	Procedure 1	▼
Patient in theatre time					Patient's obs/gynae consultant present	No ▼	Anaesthetic consultant present	No ▼	Procedure 2	▼
Out time					Surgeon	▼	Anaesthetist	▼	Procedure 3	▼
Patient hospital no.			0		Surgeon	▼	Anaesthetic Registrar	▼	Child born	▼
DOB					Surgeon	▼	Anaesthetic Registrar 2	▼	Child 2 Born	▼
Last name							Anaesthetic Type	None ▼	Instrument set 1	▼
Firstname							Extra anaesthetic	▼	Instrument set 2	▼
Address					Instrument Nurse	▼	Airway Device	▼	Instrument set 3	▼
Address2					Circulating Nurse	▼	Mallampati airway score	▼	Specimen to Lab	No ▼
County			▼		Anaesthetic Nurse	▼	Laryngoscopy grade	▼	Remarks	
Category			▼		Assisting Nurse	▼				
Source			▼		Other Nurse	▼				

Screenshot 1 is the form that the nurses see when they log onto the database. All the elements of the form are visible on one page and can be completed without scrolling up and down between pages. The next form cannot be started until all required fields are completed.

Screen shot of Database 2 the look up field for anaesthetic type.

The screenshot shows a form with the following fields and their current values or options:

- Anaesthetic Type:** A dropdown menu is open, showing a list of options: "None", "Epidural Top-up", "General" (which is highlighted), "Local", "None", "Regional", and "Spinal".
- Extra anaesthetic:** An empty text input field.
- Airway Device:** An empty text input field.
- Mallampatti airway score:** A dropdown menu with a small arrow icon on the right.
- Laryngoscopy grade:** A dropdown menu with a small arrow icon on the right.

Screenshot 2 shows the “Lookup field” for selecting the type of anaesthetic used during the procedure. This allows the person entering the data to select a value from a list of existing values that are stored in a table in the database. The electronic collection of this information is of particular interest to the anaesthetists who, at present, have to search through the paper register to count the number of a particular type of anaesthetic they have performed.

Screen shot of Database 3 look up field for procedure performed

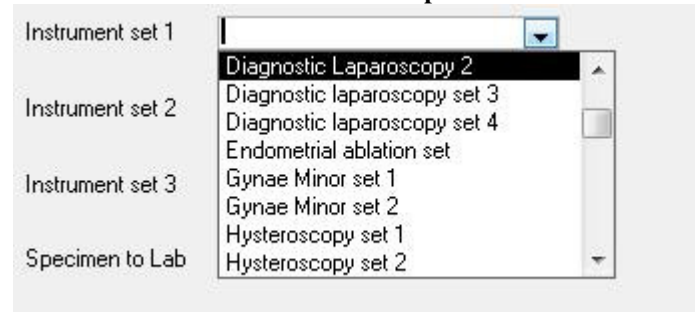
The screenshot shows a form with the following fields and their current values or options:

- Procedure 1:** A dropdown menu is open, showing a list of procedures: "Anterior Repair", "bartholins abscess", "Bilateral Oophorectomy", "Cervical cerclage", "cervical polypectomy", "Colposcopy", "Colposcopy and LLETZ", and "Colposcopy and punch biopsy".
- Procedure 2:** An empty text input field.
- Procedure 3:** An empty text input field.
- Child born:** An empty text input field.
- Child 2 Born:** A dropdown menu with a small arrow icon on the right.

Screenshot 3 is another lookup field, of the operation performed, which is linked to a relational table. The list is alphabetical and allows the person entering the data to select the procedure which is being performed on the patient and enter it. This allows

for easy gathering of the number of a particular surgery that is performed in a given period.

Screen shot of Database 4 the look up field for the list of instruments.



Screenshot 4 is a lookup field of the list of instrument sets. This allows the person



entering the data to save the details of the instrument sets used during the procedure. As you can see from the screen shot, the user has the option of choosing up to three sets used during the procedure. This information has no field in the paper-based register. In most Theatres the instruments used during a procedure are reusable and are stored in pre-defined sets. These sets are washed after the procedure and then packed again and autoclaved to sterilise them for their next use. A sticker attached to the set during sterilisation is placed in the patients notes as a record of this sterilising. This is the only

evidence of when each set is used. Providing this field allows easy access to a sets previous use and allows an easy investigation of which patients are involved if a problem occurs.

4.6.3 Conclusion

It would appear from the daily use of the electronic database that the system has been successfully implemented. However this assumption needs some evidence to support it. Consequently the nurses were invited to participate in an evaluation of the register. Chapter 5 describes how this was undertaken.

Chapter Five: Evaluation of the electronic register

5.1 Introduction

As established during the literature search, “the measure of success of any system is the end users satisfaction and ultimate utilisation” (Lapointe and Rivard 2006). As the system is in daily use its utilisation is evident. Consequently, to measure user satisfaction a questionnaire was designed. The purpose of this questionnaire was to test the end-users’ satisfaction with the system. The questionnaire was also used to test the opinions of the end users as to the benefits of electronically captured data. The literature suggests:

- data entries will be complete;
- data entries will be more legible;
- data entries will be more accurate;
- data compilation is easier and quicker;
- data entries will be easier to search;
- data entries be easier to retrieve;
- data can be stored for longer and will not be subject to degradation;
- in the present environment where space is a premium, electronic data storage is cheap and requires very little space;
- if extra data is needed, it is easy to adjust the data collection system to reflect this requirement;
- it will be possible to view the record simultaneously in more than one place;
- information will be more visible;
- it will be easy to adapt the database to collect more information; and
- reproduction of data is easier as paper output can be tailored to specific personnel needs.

A positive result from the questionnaire would imply successful implementation. It would also help validate the findings of the author’s literature review.

5.2 The Questionnaire

In 2007 Otieno et al, developed a tool for measuring the nurses' views on the use, quality and user satisfaction with electronic medical records (Otieno et al.2007). From their findings "user satisfaction" was defined as the extent nurses to which believe electronic records are important in improving their work. Their final instrument, which contained 34 items, was tested. The instrument was sent to 72 hospitals and 1666 usable questionnaires were returned by the nurses from the 72 hospitals. The initial results were positive and consequently their instrument can be used as a method for evaluating electronic medical records in hospital. One section of their questionnaire was deemed appropriate for testing the users of the present system. From their findings Otieno et al suggest that for some projects part of the instrument can be used. Consequently some of the questions from their instrument (see Table 4) which relate to nurses' satisfaction with an electronic system were used in this study. These were modified using the findings of the literature search on the comparisons of paper versus electronic data capture to produce a questionnaire. The end user could not be expected to have the knowledge or the experience to validate all the claims about the advantages of electronically captured data from merely using it to record patient episodes, so the questionnaire included only some of the advantages (as listed in section 5). Similar to Otieno et al's work, the questionnaire is based on a Likert type scale. However unlike their work the questions are in the form of statements. An informal pilot of the questionnaire highlighted the difficulty of agreeing or disagreeing with a question; consequently the questions are posed in the form of a statement for the respondents to agree or disagree with accordingly.

Table 3: Questionnaire for end users

Rate each item in the questionnaire below indicating your level of agreement

1= Strongly Agree 2= Agree 3= Uncertain 4= Disagree 5= Strongly Disagree

		1	2	3	4	5
1.	An electronic register provides information that : Is more accurate? ⁱ					
2.	Is easier to retrieve? ⁱⁱ					
3.	Is easier to search? ⁱⁱⁱ					
4.	Is more legible? ^{iv}					
5.	Is more complete? ^v					
6.	The electronic register requires you to change the way you perform other nursing duties? ^{vi}					
7.	It is more difficult to fill in an electronic register than a paper-based register? ^{vii}					
8.	The electronic register provides extra information that is not captured on the paper register? ^{viii}					
9.	The electronic register is useful? ^{ix}					
10.	The electronic register has been successfully implemented? ^x					
11.	The electronic register is important for the Theatre? ^{xi}					
12.	Do you have any comments on the electronic register?					

The following references are related to table 4 and were formulated using language related to the literature search.

ⁱ Relates to q.1

ⁱⁱ Relates to q. 1 and q 6

ⁱⁱⁱ Relates to q.1, q.2 and q.6

^{iv} Relates to q.1, q.2 and q.6

^v Relates to q.1,q.2 and q.6

^{vi} Relates to q. 9

^{vii} Relates to q. 5

^{viii} Relates to q.1 and q 8

^{ix} Question 8

^x Question 7

^{xi} Question 6

Table 4: Source questions for End-users questionnaire

Adapted questions from the questionnaire on Nurses' views on the use, quality and user satisfaction with electronic medical records, the expression EMR is replaced with Electronic Database (Otieno et al. 2007)

1	Do you feel quality of information has improved due to the ELECTRONIC DATABASE?
2	Do you feel your performance has improved due to ELECTRONIC DATABASE?
3	Do you feel ELECTRONIC DATABASE is an important system for your hospital?
4	Do you feel ELECTRONIC DATABASE has been successful in your hospital?
5	Have you been trained in using ELECTRONIC DATABASE?
6	Do you feel safety of patients has improved due to ELECTRONIC DATABASE?
7	Do you feel ELECTRONIC DATABASE is worth the time and effort required to use it?
8	Do you feel ELECTRONIC DATABASE is useful?
9	Does the computer workstation derange your workflow?

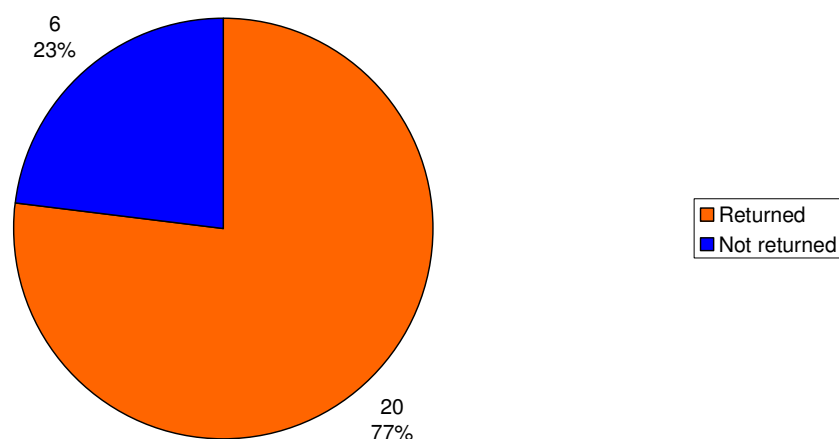
Question 12 on the questionnaire, “Do you have any comments on the electronic register?” encouraged the participants to give their opinions of the system.

All 26 nurses in the Department were given a copy of the questionnaire, with a covering letter (see appendix 2) explaining how to complete it. To ensure anonymity and to remove prejudicial results, envelopes and a sealed box were provided in the Department for return of the completed documents.

5.3 Reliability and validity

20 of the 26 questionnaires were returned completed and deemed usable. The validity of the results are presumed as the questions asked were based on the use of a previously validated instrument (Otieno et al 2007). This is qualified by the authors, because they also suggest that part of the instrument may be adapted to a given circumstance. The reliability was assessed using an instrument reliability calculator (Siegle D. 2009). The Cronbach Alpha Coefficient was measured using Siegle's reliability calculator. Cronbach alpha coefficient is a test reliability technique that provides a unique estimate of the reliability for a given test (Gliem and Gliem 2003). When all 11 questions were analysed the Cronbach Alpha Coefficient is .711. Alpha coefficient ranges in value from 0 to 1 and may be used to describe the reliability of factors extracted from multi-point formatted questionnaires or scales. The higher the score, the more reliable the generated scale is. Whilst a score of .711 suggests that .289 are unreliable Santos (1999) suggests that 0.7 is an acceptable reliability coefficient. This is supported George and Mallery (2003) who suggest the following rules of thumb for the results of this particular reliability score "> .9 – Excellent, > .8 – Good, > .7 – Acceptable". There is also some suggestion that the number of questions in the survey increases the results and this questionnaire only tested 11 variables consequently the merely "acceptable result" can be deemed satisfactory.

Responses to the questionnaire

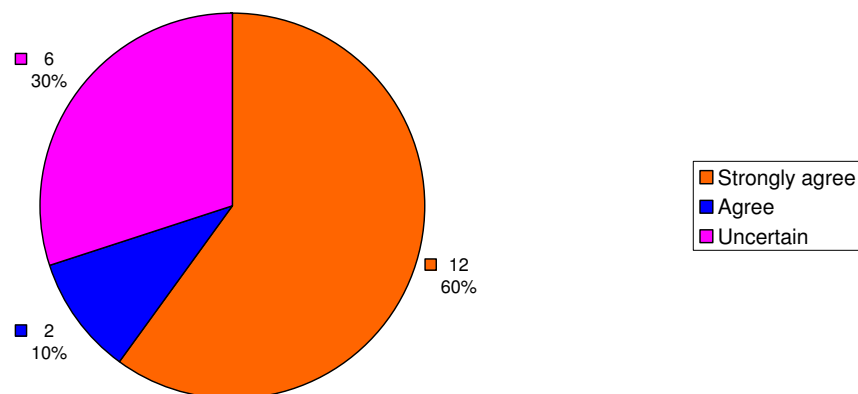


5.4 The results of the end user questionnaire

The results of the returned questionnaire were compiled on a Microsoft Excel spreadsheet. “A picture speaks a thousand words” so the results of the questionnaire are presented here in chart format.

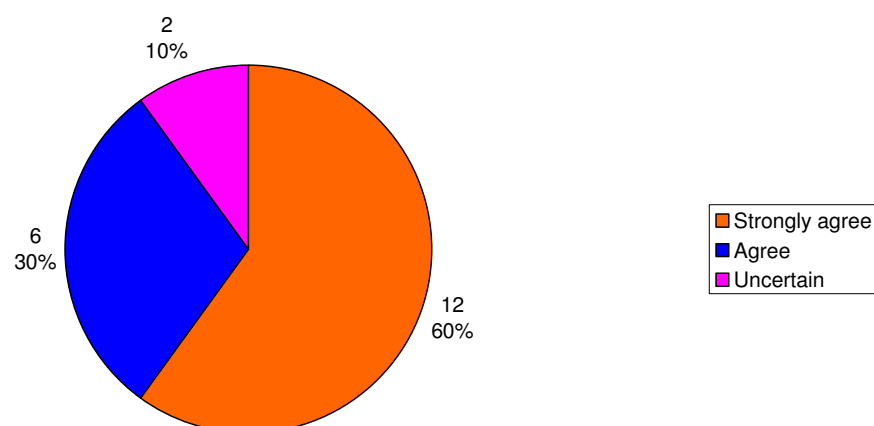
Results of the end user questionnaire q. 1

An electronic register provides information that : Is more accurate?



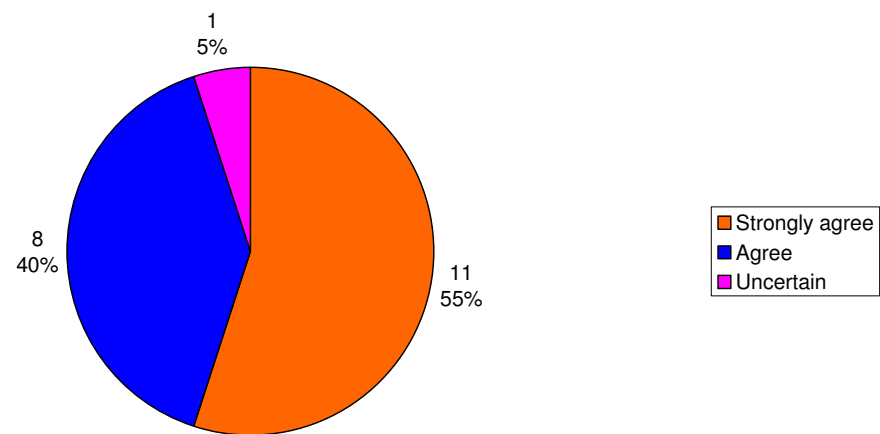
Results of the end user questionnaire q. 2

Is easier to retrieve



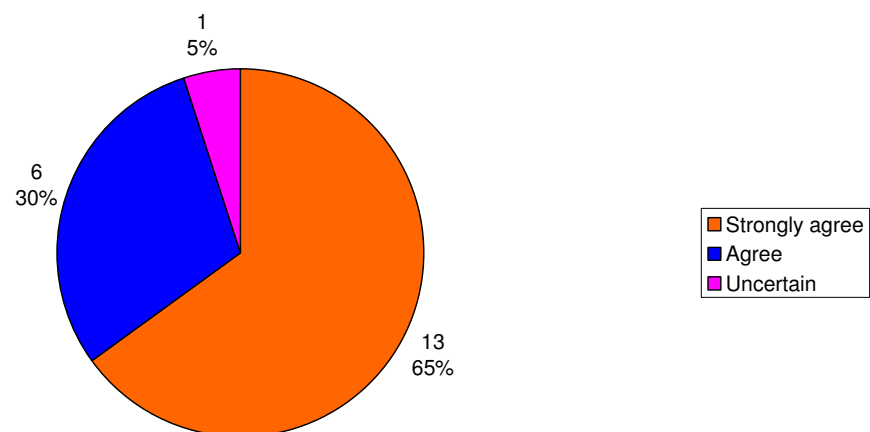
Results of the end user questionnaire q. 3

Is easier to search

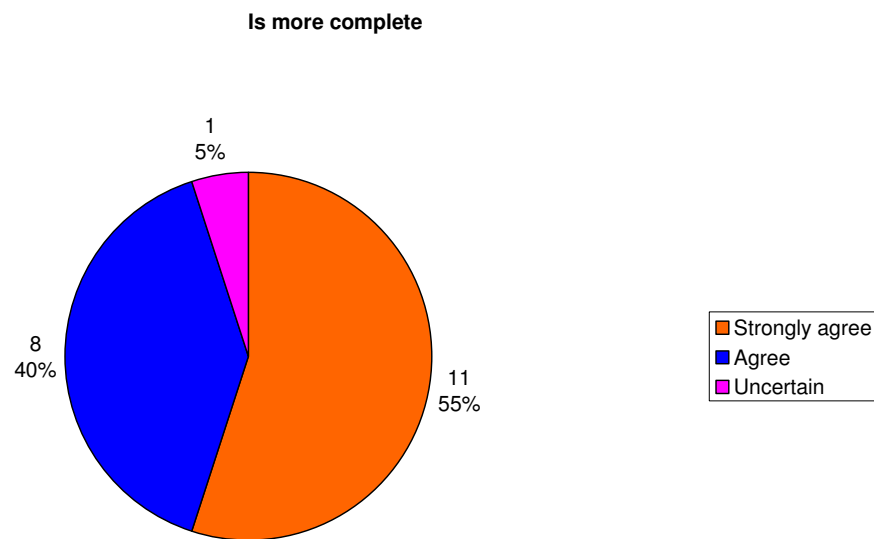


Results of the end user questionnaire q. 4

Is more legible



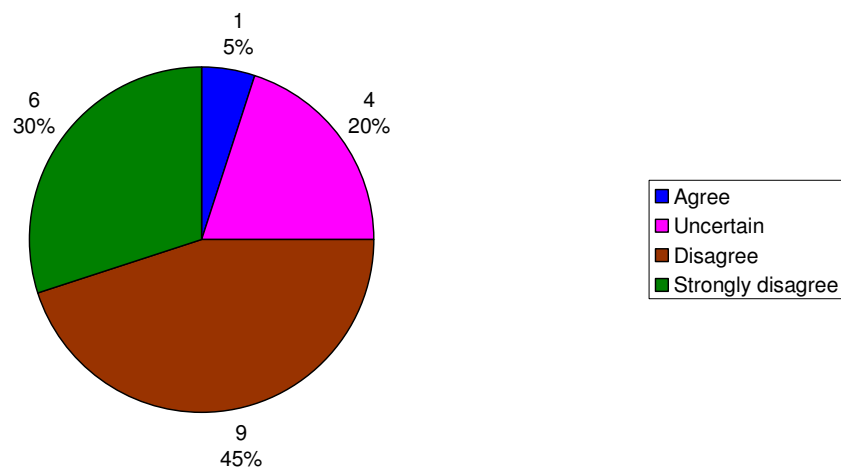
Results of the end user questionnaire q. 5



The first five questions were positively written and whilst some of the respondents answered in a neutral manner, none of the respondents answered in a negative manner. The mean of these five questions are 1.7, 1.5, 1.5, 1.4 and 1.5 respectively. The average result is 1.525 for these 5 questions. This suggests that the respondents agree, as the literature suggests, that the quality of information collected in the register is more accurate, easier to retrieve, easier to search, is more legible and more complete. One person did however comment that accuracy and completeness are subject to user error.

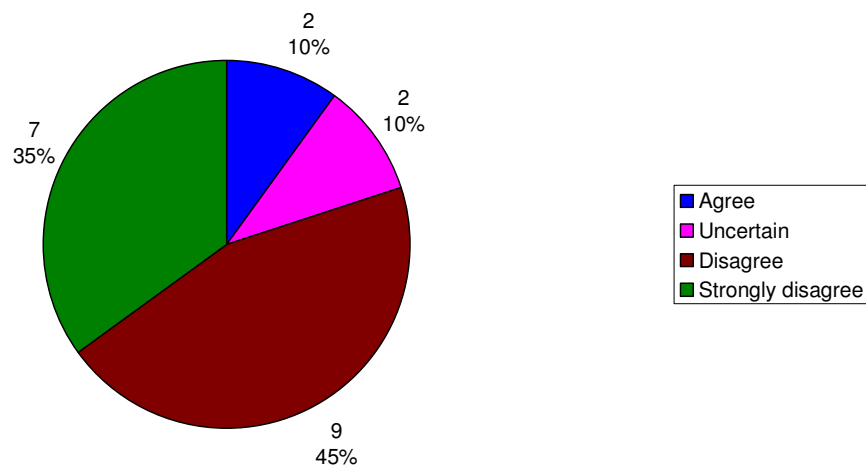
Results of the end user questionnaire q. 6

The electronic register requires you to change the way you perform your nursing duties



Results of the end user questionnaire q. 7

It is more difficult to fill in an electronic register.

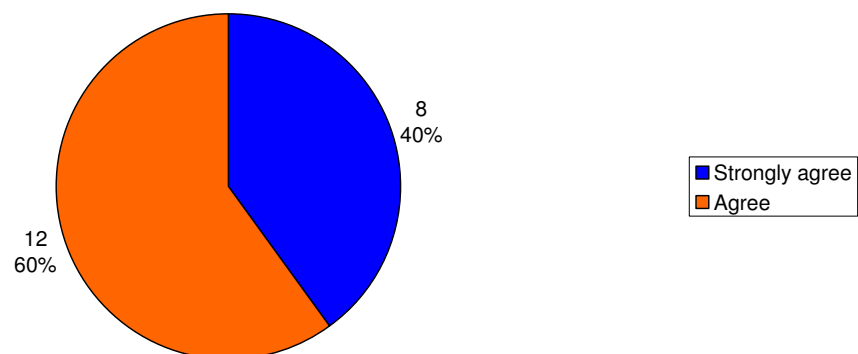


Question 6 and 7 are negative statements. They relate to the physical impact the data entry has on the subjects' workload. The mean of these 2 questions is 4.0 and 4.05 respectively. In the responses to question 6, 5% (one respondent) agreed that the electronic database required a change in the way they performed their other duties and 10% (4 respondents) were uncertain, however the majority (15 respondents) disagreed or strongly disagreed with the concept that it required them to change their practice.

The responses to question 7 showed that 2 respondents felt the electronic register was more difficult to complete and 2 were uncertain, again however the majority were confident that it was not more difficult to complete.

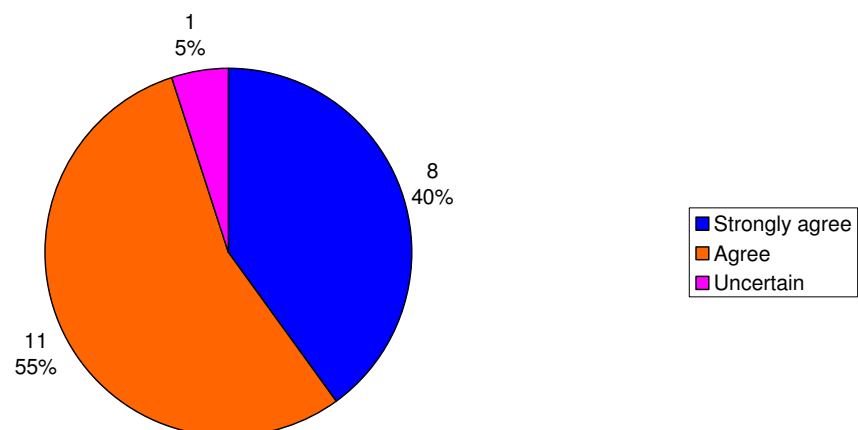
Results of the end user questionnaire q. 8

The electronic register provides extra information that is not captured in the paper register



Results of the end user questionnaire q. 9

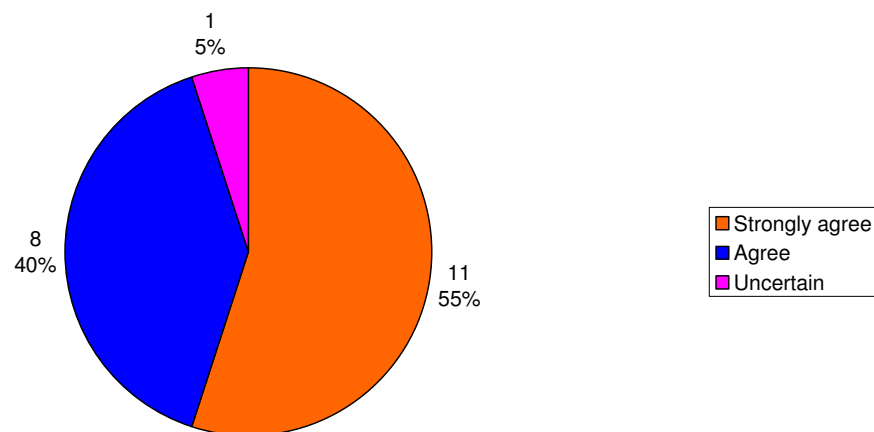
The electronic register is useful



Question 8 and 9 address the functionality and usefulness of the database. From the responses it is evident that all the nurses agree that the electronic register can provide extra information. Only one respondent is uncertain that the register is useful.

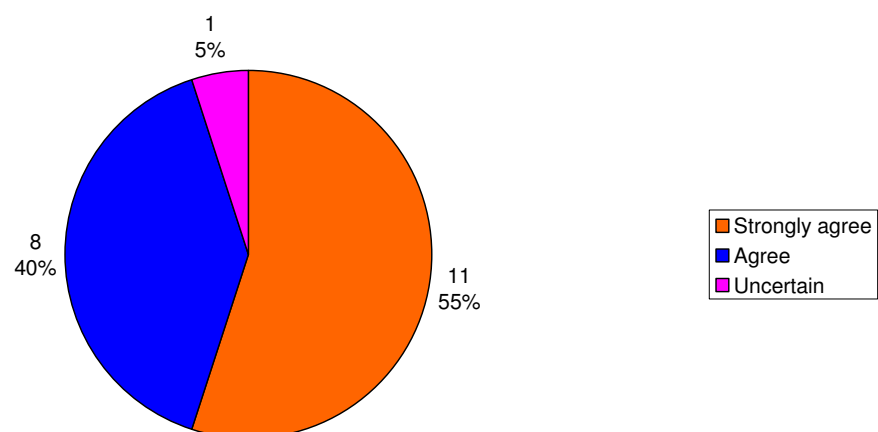
Results of the end user questionnaire q. 10

The electronic register has been successfully implemented



Results of the end user questionnaire q. 11

The electronic register is important for the theatre department



Question 10 and 11 assesses whether the nurses feel the register has been successfully implemented and whether they think it is important for Theatre to collect data in this way. The results confirm that the nurses think that the register has been successfully implemented and also that they agree that it is important for the Theatre.

Comments that were written in response to question 12 were also all very positive.

“When can we have the system in all Theatres?”

“We need it [an electronic database] in our Department?”

These comments were a good insight into how the subjects felt about the system and its possible replication in the other Theatres.

Another comment that was reassuring to read was

“Using it [the database] is a lot easier than I expected”

5.5 Conclusion

It is possible to deduce from these results that the electronic register has been successfully implemented in the Theatre. Whilst the results are not unanimous, there is a majority of positive responses to the positive statements and negative responses to the negative statements. The results show that the end users deem the electronic database useful and important for the Theatre Department. The findings from the respondents also agree with the literature in respect of the advantages of electronically captured data.

Chapter Six: Other Investigations

6.1 Introduction

The objective of this study was to investigate if there is any value to be had from introducing an electronic register to replace a functioning paper-based register. Having established the successful implementation of an electronic register it is possible now to examine the other objectives of the project

To validate any improvements found in electronic data, it was necessary to scrutinize the paper-based register. This was undertaken to identify any imperfections of the hand written paper register. Following this, to investigate the possible value of implementing the system in other hospitals, the following investigations were undertaken. This chapter will present the findings of the other investigations. These are:

1. an audit of the paper-based register;
2. the cost of paper-based registers was investigated;
3. a time and motion study compared paper and electronic data; and
4. an exploration of data capture practice in other Irish hospitals.

6.2 Audit of the paper register.

6.2.1 Introduction

From the literature search the author suggested that there were a number of advantages to implementing and using an electronic register. This, of course, has to be qualified by identifying if any of the merits of the electronic register are indeed deficient in the paper register. To substantiate the inferiority of the data in a hand written paper register, a small audit of the paper-based system was undertaken.

6.2.2. Method

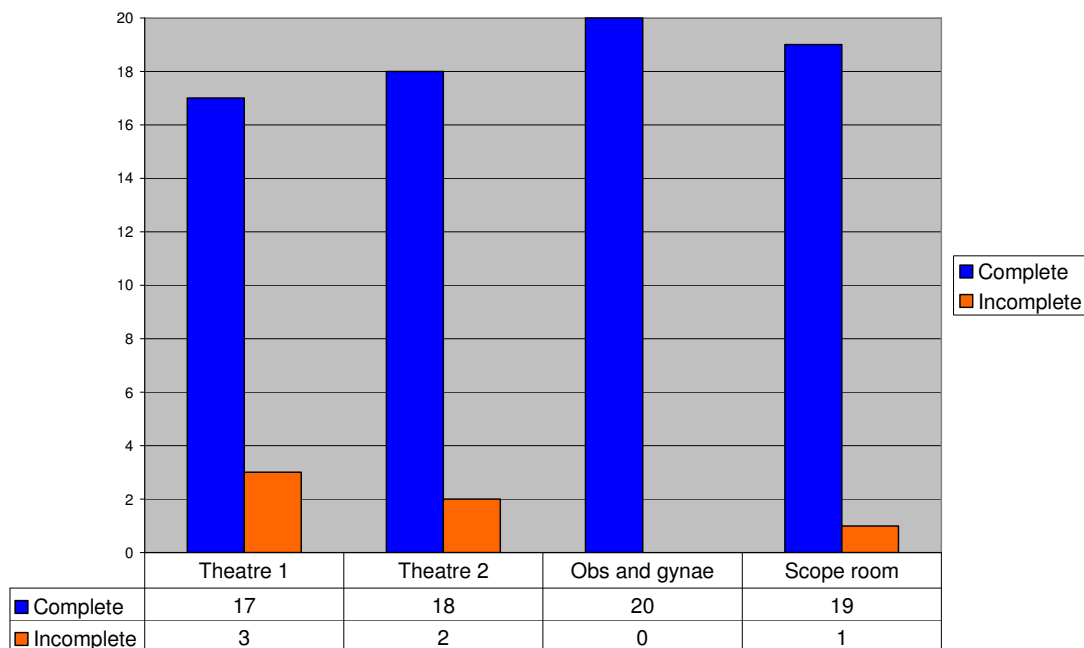
This audit, which was carried out by the author and 2 other examiners, looked at 80 entries, from four of the completed registers. Starting on a specific date that was available in all four registers, the first entry on that date and the subsequent 19 entries were examined in each of the four paper registers. The entries in the register were examined for completeness and legibility. As the only method of reproducing the data from the paper register within the hospital is to re-transcribe it or photocopy it, the

entries were photocopied to examine how easy it was to extrapolate the data from the photocopy. A form was devised and three examiners were given a form each for each register. When the forms were completed the examiners assembled and compared their results. The results of the audit show that the three examiners agreed on the majority of the results. However there was a disagreement about the legibility of 2 of the entries. Consequently these entries were deemed illegible.

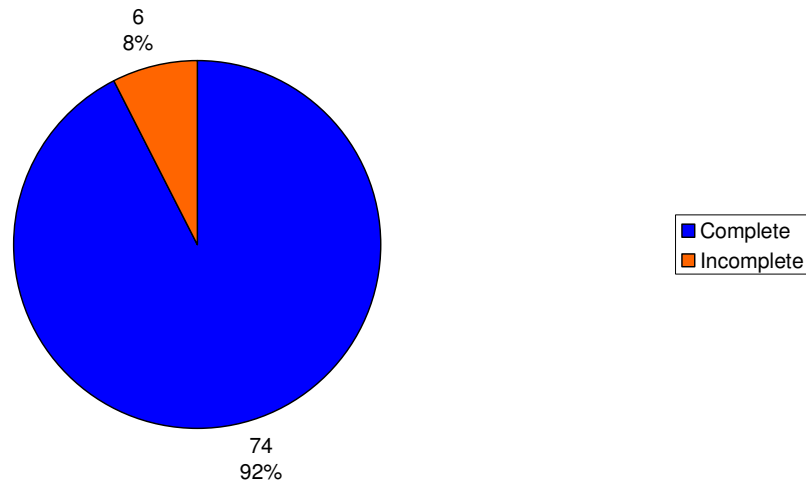
6.2.3 Results

Q.1 Were all the appropriate fields completed?

Results of paper register audit 1



Total no. of entries examined for completeness

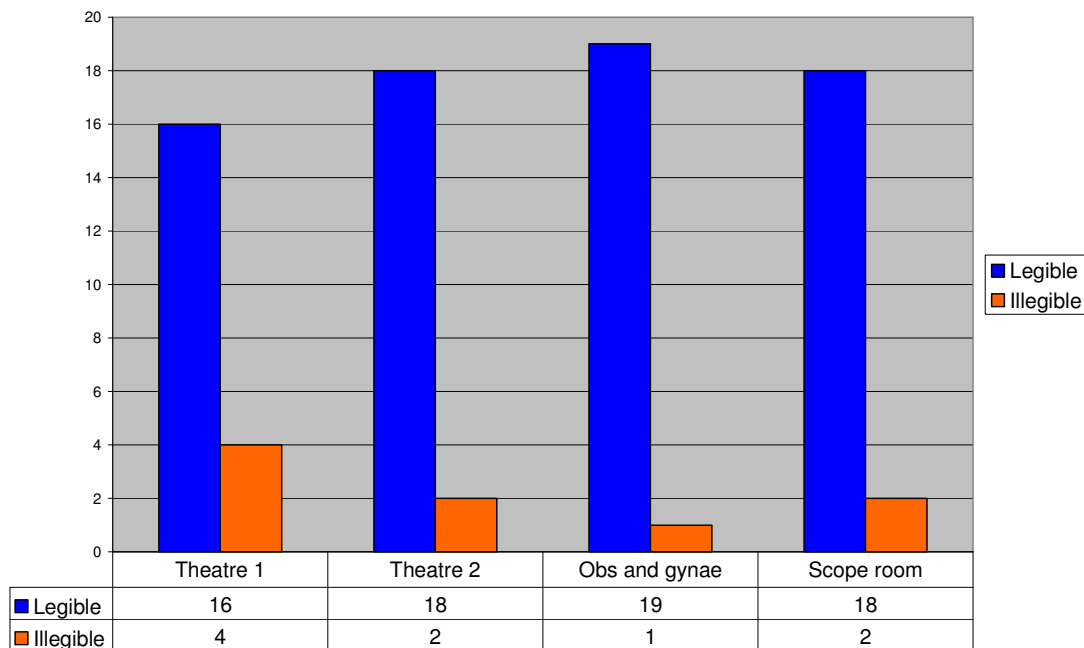


This shows that of the 80 entries that were examined 6 were considered to be incomplete. This incompleteness ranged from a missing time out (3 entries), patients county of residence (2 entries) and whether the patient was an inpatient or day patient (1 entry).

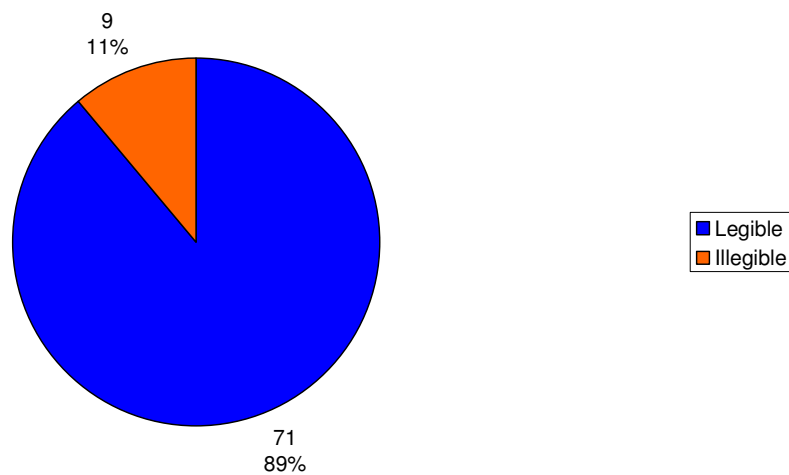
The next claim from the literature to be explored was legibility. This examination was performed quite critically. Most of the staff in the Theatre Department are familiar with each others' handwriting, however future readers may not have the benefit of this familiarity. Therefore whilst some of the entries could be interpreted by some of the examiners, if even one person found it illegible it was deemed to be so.

Q.2 Were all entries legible?

Results of paper register audit 2



Total no. of entries examined for legibility



This examination revealed that the examiners deemed that some piece of data in 9 of the entries in the register was considered illegible. The details that could not be read were name of the nurse (3 entries), surgeon's name (2 entries), patient's address (2 entries) a patient's surname (1 entry) and a patient's date of birth (1 entry).

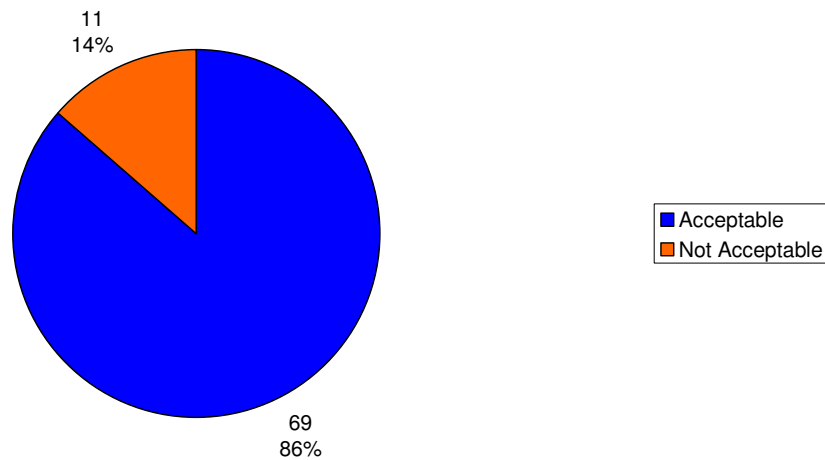
The third claim that was examined explored the notion that electronic data is superior due to the ease of reproduction. To undertake this part of the audit the relevant pages of the register were photocopied. This proved quite difficult as the registers are A2 size and the biggest photocopier in the hospital only copies A3 size. Consequently each side of the register was copied separately. Following this each photocopied entry was examined and without having the original to hand the examiner tried to extrapolate the data from the record. If any detail from the entry could not be extracted from the photocopy, the entry was deemed not acceptable.

Q.3 Is the photocopy of the register entry acceptable?

Results of paper register audit 3



Total no. of photocopied entries examined



The photocopied entries were the same entries that included the missing and illegible data but for the purpose of this audit these details were not included in the issues that deemed the photo copy acceptable. The main issue highlighted by this examination was the lack of clarity of the photocopy due to the type of ink used in the original entry, (6 entries). The other issue of reproducibility that was highlighted by the photocopy was caused by the binding of the register which reduced the opening capacity of the register. This meant that it wasn't possible to read the photocopy (5 entries) easily.

6.2.4 Conclusion

The results of this audit shows that the hand written paper register does, as suggested by the literature, have some limitations. A number of the entries have missing illegible or entries that can not be copied. Whilst the audit identified "errors" in the register, the missing and illegible data in no way puts patients at risk. This missing data can be obtained from other sources; however if this data is needed for any reason an even longer investigation will be required.

6.3 The cost of a paper-based register

Three printers who are used by the HSE to print paper-based registers were contacted to establish an average cost of a Theatre register. This information was difficult to establish because different hospitals had different contractual arrangements with the printers. There was also a different pricing schedule depending on the order; for example, if a large order for 50 or more registers was made then the price was significantly reduced. However an order this size could lead to storage issues plus the possibility of a change of practice resulting in the registers becoming obsolete prior to use.

The telephone survey of the printers established a further significant point. Each hospital had its own version of the Theatre register. This was because each hospital had sometimes small, but none the less significant, differences in the data collected or the order in which it was collected. Also all hospitals have their hospital name at the top of each page, which meant that every hospital register is unique to that hospital.

To get an average price for a register, the companies were given the specifications and asked to quote for the delivery of 10 registers (which is 2 years supply for the project hospital). The average price quoted was €250 plus VAT per register. This makes the cost of the paper register roughly €3037.50 for 2 years or €1518.75 per year for the Department, or roughly €379.50 per Theatre. It can not be a definite amount as some of the registers last less than six months and some last more. On average though in the project hospital, 6 registers are used per year between the 4 areas, which consists of three Theatres and one endoscopy unit.

6.4 Time and Motion Study

6.4.1 Introduction

The purpose of keeping this register is to create a record of the details of each Theatre visit. This is done so that a legal record can be kept of the details. A secondary function of the register is the compilation of these records from these entries to establish productivity and trends. Both of these duties require time to perform. Consequently it is possible to establish if there is any value in doing this electronically by assessing if any time can be saved from this process. To achieve this some sort of time and motion study must be undertaken.

6.4.2 Methodology of time and motion

Three possible types of time and motion study have been identified from the published literature. These are time and motion observation, work sampling and self reporting (Poissant et al 2005). As this is a small scale study of very specific tasks, work sampling was identified as the most appropriate testing method for this project. To do this, tasks which are regularly undertaken by personnel, were identified. The performance of these tasks was timed, by the author, using a stopwatch. The timings of these could then be analysed to identify which system is the most time efficient. The hospital's data information officer and the personnel responsible for compiling the data were consulted to identify suitable tasks that are regularly performed in relation to the data. Four examples were initially chosen to examine, these were:

1. the data entry for a single patient episode;
2. the extraction of details for a specific Theatre case within the month;
3. the compilation of data on the number of a specific procedure performed in the month; and
4. the identification of the number of general anaesthetics performed on patients whilst under the care of a specified anaesthetic consultant.

Having commenced the time and motion study, it was identified that observation no.4 could not be carried out as it was not possible to identify from the paper record which of the patients were under the care of the particular anaesthetic consultant, as he was not present during all the cases he was responsible for and consequently his name was not entered in the paper register. So for the time and motion study in respect of this project only three tasks were completed.

6.4.3 Work Sampling

The first piece of work sampling, data entry for a single patient episode, was performed in the Theatre during real patient episodes. It is known that watching people changes their practice; this is known as the Hawthorne effect which claims that observing practice causes behavioural change due to an awareness of being observed (Holden 2001). However as both data entry in the paper register and data entry in the electronic register were being observed, this effect was not considered to be a prejudicial issue.

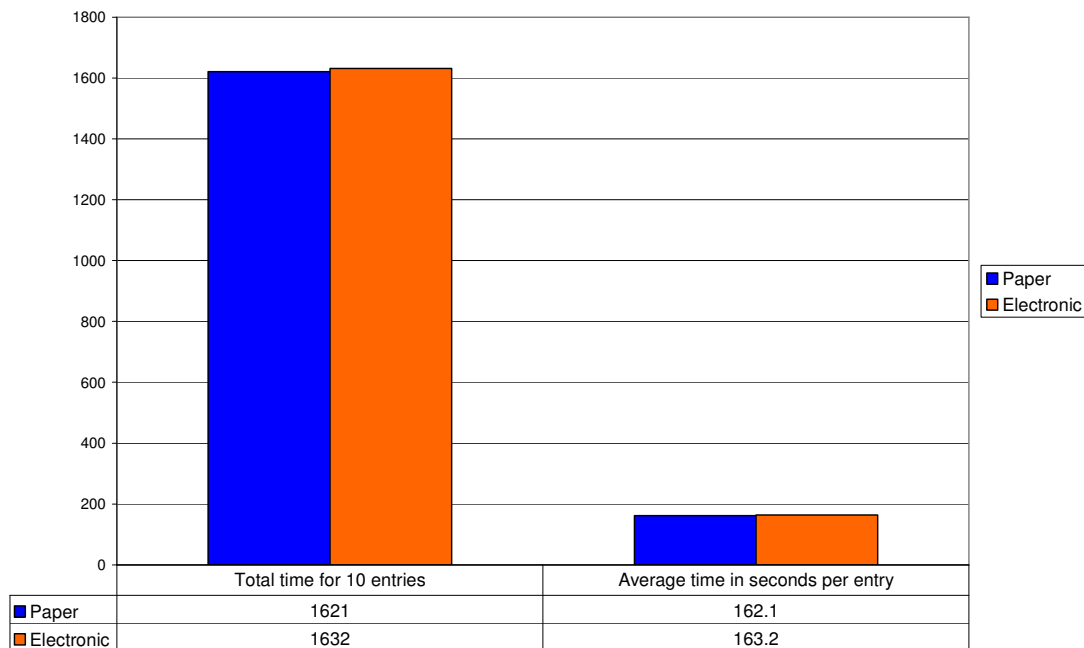
6.4.4 The results

6.4.4.1 Task 1: Data entry

Firstly, 10 different patient episodes were timed using a stop watch. Measures were taken to rule out anomalies in the results. Factors such as user proficiency, fast writing, and memory of data required were considered. To avoid these issues producing erroneous results, a variety of nurses were timed entering the data into both the paper-based register and the electronic register. Also, the order in which the data was entered was varied from case to case: first the paper register followed by the electronic register. For the next observation the order was reversed: electronic register first, paper register second. Ten nurses were involved in the study so each nurse could undertake both types of data entry, although not on the same patient.

The time taken for this showed there was very little difference between the two data entry systems. The electronic record took slightly longer on average (just over 1 second) than the paper record; however it could be argued that as the electronic register collects more information, the relative time taken is shorter.

Time and motion study task 1



6.4.4.2 Task 2: Extracting Details

Having completed the observation of the first task, the second set of work samples was performed. This was performed during Theatre “down time” as the register was required at other times. 4 members of staff who regularly compile numbers for the HIPE office were taught how to view the data in list view and how to perform a simple query.

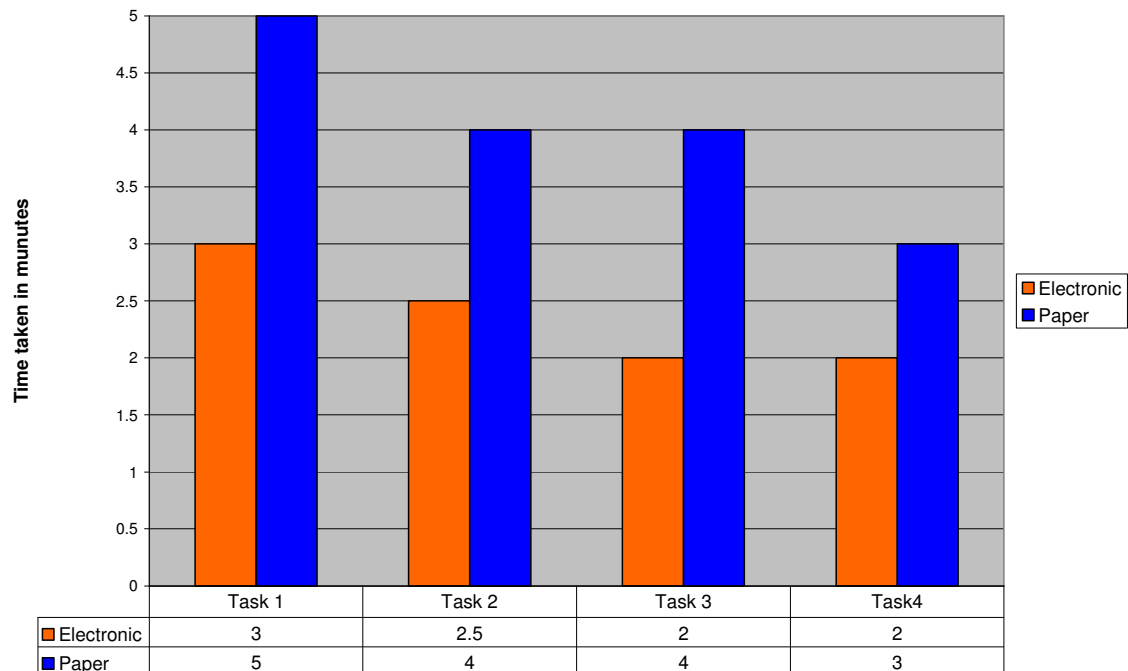
For this task the participants were timed performing a task which required them to discover particular data from a patient episode. Various details were provided and the time taken to locate the particular case was recorded.

Firstly a member of staff was timed retrieving the information about a particular case. The information was retrieved from the paper register first using the date of birth of the patient and the procedure involved. Then same case was retrieved on the electronic register by a different member of staff so as not to bias the result.

The next query involved extracting data about a patient using their name and the procedure they underwent. The third query was a specified procedure carried out by a surgeon with a specific nurse. This third query was repeated, for a different case,

using the same procedure and surgeon but a different scrub nurse. Four queries in total were timed.

Time and motion study task 2

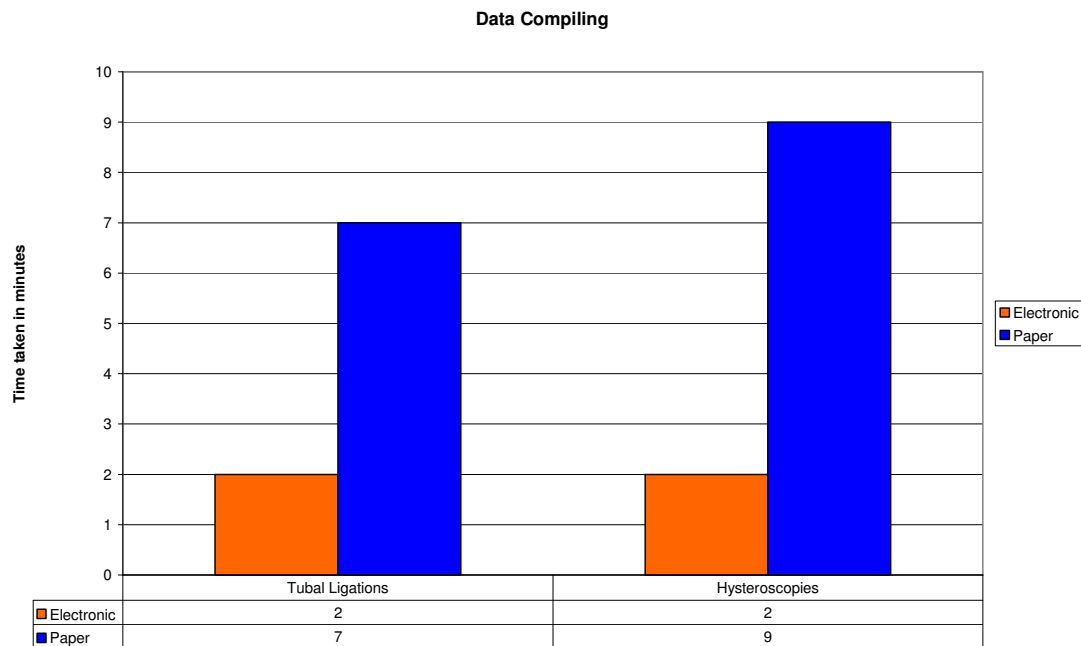


6.4.4.3 Task 3: Gathering data

From the author's personal experience, the task which takes the longest is the compilation of statistics from the register. As stated before, a member of staff is regularly responsible for adding up the quantity of different procedures carried out every month, so it was agreed that a count of 2 procedures regularly undertaken in the month would give a good insight into any time savings that may be made.

Therefore the final task was to determine the total numbers of a specific surgery performed in the month. The two surgeries chosen were Tubal ligations (female sterilisations) and hysteroscopies. These procedures were chosen because they were not necessarily stand-alone procedures. Both these procedures were often carried out during other procedures; for example a woman having a caesarean section could electively choose to have a tubal ligation performed during the procedure. These procedures were counted both in the paper register and on the electronic database. The time taken to retrieve the number was recorded in minutes to the nearest half minute.

Time and motion study task 3



6.4.5 Conclusion

The results of this time and motion study prove that significant time can be saved when using electronic data. The first task, data entry, took on average slightly longer. However it was recognised that the electronic database has extra fields. Therefore the timed comparison was slightly biased towards the paper register. The proof of the time that can be saved by using the electronic register was very evident in the other tasks. The second task was quicker to perform on all of the queries. A total of six and a half minutes was saved on these four tasks aggregated together. The final task took a full twelve minutes longer. To collect the number of tubal ligations and hysteroscopies performed in one month from the paper register took sixteen minutes compared with four minutes to perform both tasks on the electronic register.

6.5 Data capture in Operating Theatres in Irish hospitals

6.5.1 Introduction

As part of the project to investigate if there is any value in implementing an electronic register, it was important to compare the practice in the project hospital with other hospitals around the country. This information also helped establish the “state of the art” with regard to data capture in Theatre Departments in Irish hospitals. As there was no literature obtainable on the data collection practices of Irish Hospital Theatre Departments, an inspection of these practices was required. To obtain the pertinent information the hospitals listed on the HSE website were each contacted by telephone. The Theatre Departments were telephoned and a person involved with data collection within the department was established. This person was then asked a small number of questions.

6.5.2 Questions for HSE Hospitals

To compile the results below, a member of the data collection personnel was asked the following questions. The person who responded from hospital to hospital varied from a nurse to a clinical nurse manager an anaesthetic secretary and a Theatre clerk.

- How many Theatres are there in use in the hospital?
- Do you use a paper-based or electronic register?
- If paper-based how many registers are there in the Department?
- If electronic which system do you use?
- Do you also keep a paper record?
- Any comments, problems?

The results of the telephone poll to the hospitals on their system of record keeping in the Theatre Department are listed below.

6.5.3 The results of telephone poll to Irish Hospitals

As decided during the inception stages of this project, a comprehensive investigation of the data keeping practice in Operating Theatres in the other hospitals in Ireland is long overdue. There would be little point undertaking this project and reporting on the benefits resulting from such an exercise if the practice of paper-based record keeping is unique to the project hospital. The above questions above were put to the responsible nurses in the various Theatres around Ireland.

Table 5: The results of the telephone poll of Theatre Departments in Irish hospitals

Hospital	No. of Theatres	Paper System	No. of Registers	Electronic System	System name
Bantry General	2	X	2		
Beaumont Hospital	12	X	12	X	BTS ^{xii}
Cappagh National Orthopaedic	4	X	1	X	Bluespier CIS ^{xiii}
Cavan / Monaghan Hospital Group	4	X	12 ^{xiv}		
Children's University Hospital, Temple Street	4	X	15+ ^{xv}	X	PAS ^{xvi}
Connolly Hospital Blanchardstown	5			X	SAPPHIRE ^{xvii}
Coombe Women's	2	X	1		
Cork University Hospital	10	X	10+ ^{xviii}	X	DATABASES and PIMS ^{xix}
Cork University Maternity Hospital	3	X	2		
Galway University hospital	12 + 3	X	20 ^{xx}	X	CIS ^{xxi}

^{xii} Beaumont Theatre System, locally developed, staff not confident that information on system is as accurate as paper system.

^{xiii} Information is copied from register onto clinical information system

^{xiv} 1 register per consultant

^{xv} Each consultant has his own register, the number of consultants is not fixed

^{xvi} Register information is entered onto the Patient Administration System each night by clerical staff

^{xvii} Browser-based healthcare information system (HIS) with a relational database and open-systems architecture
(http://onlinebuyersguide.himss.org/product.asp?VendorId=6108&ProductId=8574&F_SearchType=Cat&F_CategoryId=33)

^{xviii} Some Theatres have own book some consultants have their own register

^{xix} 2 consultants have their own databases that nurses filled out simultaneously with the paper register, while in some other Theatres nurses use a Patient Integrated Management system.

^{xx} 1 paper register per consultant plus one for all emergency cases.

^{xxi} Computer Information System in Cardiothoracic Theatres, these are completely computerised no paper registers used

Hospital	No. of Theatres	Paper System	No. of Registers	Electronic System	System name
Kerry General	5	X	8 ^{xxii}		
Letterkenny General	7			X	IPMS ^{xxiii}
Lourdes Orthopaedic, Kilcreene	2	X	1		
Louth County Hospital, Dundalk	2	X	2		
Mallow General	1	X	2		
Mater Misericordiae University Hospital	11	X	11	X	HIS ^{xxiv}
Mayo General	4	X	4		
Mercy University Cork	5	X	1		
Merlin Park University Hospital Galway	2	X	1		
Mid Western Regional Hospital, Dooradoyle	9	X	9		
Mid Western Regional, Ennis	2	X	2		
Mid Western Regional, Nenagh	2	X	1		
Mid Western Regional, Maternity	2	X	2		
Mid Western Regional Orthopaedic Croom	3	X	3		
Midland Regional Hospital Mullingar	3	X	3		
Midland Regional Hospital Portlaoise	2	X	2		
Midland Regional Hospital Tullamore	3	X	3		
Naas General Hospital	3	X	3	X	SAPPHIRE ^{xxv}
National Maternity Hospital, Holles St.	2	X	1		
Our Lady Of Lourdes, Drogheda	5	X	6		
Our Lady's Hospital, Navan	4	X	4		

^{xxii} One register per general and gynaecology consultant and one for all orthopaedic and ENT surgery

^{xxiii} Integrated Patient Management System

^{xxiv} Not all consultants use the computerised records

^{xxv} Browser-based healthcare information system (HIS) with a relational database and open-systems architecture

(http://onlinebuyersguide.himss.org/product.asp?VendorId=6108&ProductId=8574&F_SearchType=Cat&F_CategoryId=33)

Hospital	No. of Theatres	Paper System	No. of Registers	Electronic System	System name
Our Lady's Children's Hospital Crumlin	7			X	TMS ^{xxvi}
Portiuncula Hospital Ballinasloe	4	X	3		
Roscommon County	2	X	1		
Rotunda Hospital	3	X	3	X	HIS ^{xxvii}
Royal Victoria Eye and Ear Hospital, Dublin	5	X	5		
Sligo General Hospital	3	X	3	X	IPMS ^{xxviii}
South Infirmary-Victoria Hospital, Cork	7	X	7		
South Tipperary General Hospital	3	X	2		
St Colmcille's Hospital, Loughlinstown	2	X	1		
St James's Hospital	11	X	11	X	SAPPHIRE ^{xxix}
St John's Limerick	3	X	2		
St Luke's General Hospital Kilkenny	3	X	3		
St Luke's Rathgar	1	X	1		
St Mary's Orthopaedic Hospital, Cork	2	X	3		
St Michael's, Dun Laoghaire	2	X	1		
St Vincent's University Hospital, Elm Park	12	X	12	X	ADAPTED ACCESS ^{xxx}
Tallaght Hospital	12	X	12	X	xxxi
Waterford Regional Hospital	11	X	11		
Wexford General Hospital	2	X	2		

^{xxvi} Theatre management services

^{xxvii} A paper register is kept and information is later transcribed onto a Hospital Information System

^{xxviii} Sligo use the same system as Letterkenny, unfortunately the software for the system is loaded on an old unreliable computer which necessitates the simultaneous capture of all data on a paper register, for when the computer "crashes". The data is now entered onto the electronic system later in the day.

^{xxix} Browser-based healthcare information system (HIS) with a relational database and open-systems architecture

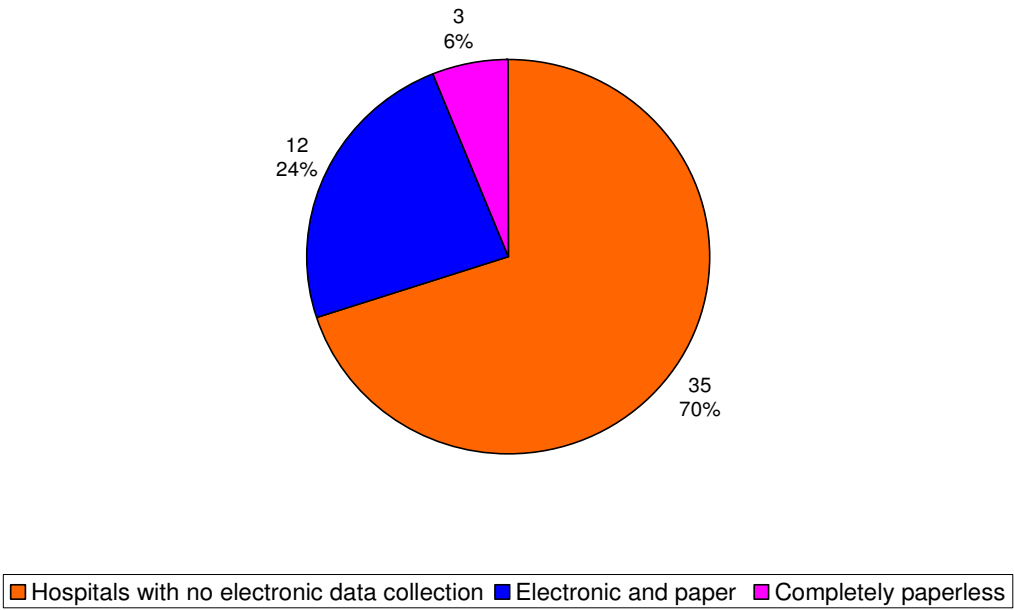
(http://onlinebuyersguide.himss.org/product.asp?VendorId=6108&ProductId=8574&F_SearchType=Cat&F_CategoryId=33)

^{xxx} Data is collected in a paper register which is then loaded onto an adapted access database by clerical staff

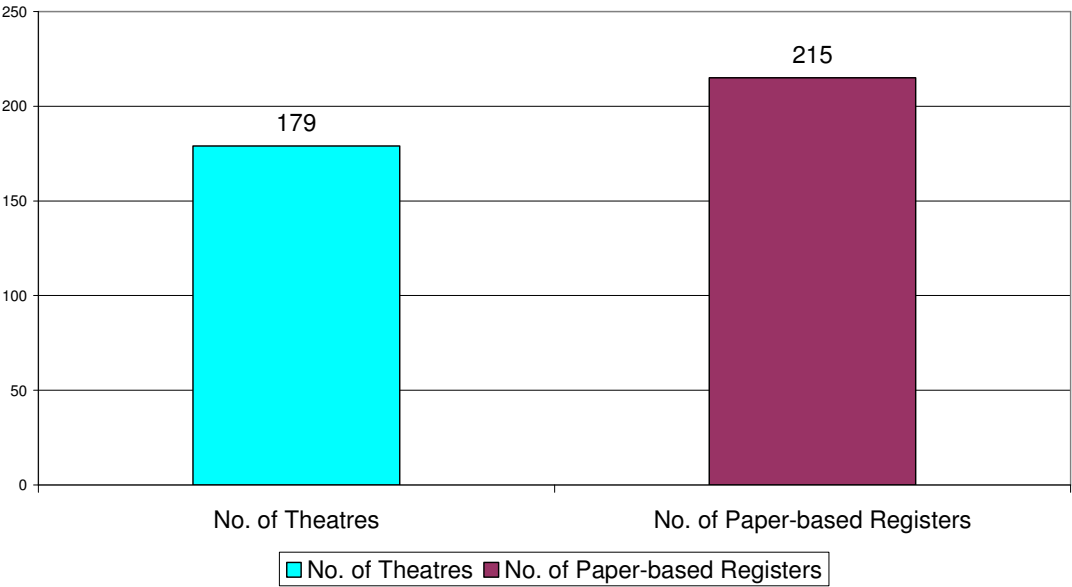
^{xxxi} There is a database on trial in one of the Theatres. The paper register is running concurrent to it.

Results of the data collection methods in Theatre Departments in Irish hospitals survey

Comparison of data collection methods in operating theatres in Irish Hospitals



Results From Hospital Survey



6.5.4 Conclusion

From this investigation it was possible to conclude that the majority of hospitals in Ireland are still using paper-based registers. All of the 50 hospitals in Ireland listed on the HSE website have an Operating Theatre. There are 179 Theatres in use at the time of compiling the data for this project. There are at least 215 paper registers in use at the time of the survey. This figure can not be guaranteed' however, as some of the hospitals provide a different register for each Operating consultant and the number of surgeons fluctuated. From the survey it was established that only 15 hospitals use any form of electronic data capture in their Theatre. Of those 15 hospitals, only three hospitals are completely paperless. The survey revealed that 12 of the hospitals who use an electronic system are also capturing the data on a paper register. The survey revealed also that in most of the hospitals where data is stored electronically, the data is transcribed later in the day by a different person. If the paper register practices in other hospitals are the same as or similar to those in the project hospital, it is safe to assume that the data that is being transcribed onto the electronic system is also susceptible to the same "errors".

The number of actual theatres in Ireland is 179. From the average cost of sourcing a register (as obtained in section 6.3) and speculating that each theatre uses at least one register per year, a minimum of €54,371.25 is being spent on this method of data collection each year.

Chapter Seven: Discussion and recommendations

7.1 Introduction

This chapter presents a discussion of the main conclusions from this study. It will attempt to answer the question posed at the outset of this report by describing findings from the different actions performed. This chapter also discusses the limitations of the study and makes recommendations for future work in this area.

7.2 Main findings

The approach taken to answer this research questions posed at the outset of this report was multi faceted. Firstly an electronic database was designed and introduced into the work place. This occurred following interviews and discussions, with the main stakeholders, to determine their specific user requirements. Following implementation, the users were questioned about their satisfaction with the system. This also afforded an opportunity to test the opinions of the respondents about the advantages of electronic data. To validate any advantages expressed in relation to electronic data it was also necessary to assess the paper-based method of data capture. The advantages of electronic data that were identified during the literature review were used to formulate these questions. This audit was carried out on the present method of data capture in a non-metropolitan hospital. The cost of these paper waste registers was established. An assessment of the time savings that can be made using an electronic database was made. And finally an evaluation of data capture practices in Irish hospitals was carried out.

The electronic database designed for the purpose of this study is now in place in the Gynaecology and Obstetric Theatre and being used daily to capture data about Theatre episodes. The success of implementation has been also been verified by the resoundingly positive responses from the user satisfaction questionnaire cited in this paper.

The user satisfaction survey also allowed the author the test the opinions of the respondents with regard to the advantages of electronic data capture. Again the results

were very positive and all the nurses agreed that electronic database provides data that is: more accurate, easier to retrieve, easier to search, more legible and more complete. Respondents also agree that the electronic register is useful and provides extra information that is not captured in the paper register.

The relevance of these findings was verified by the audit of the paper-based register.

In the course of the project the hospital's present method of data capture was described and analysed. It was discovered that the present data collection method, the paper-based register, is prone to "error" either by omission, illegibility or through the inability to reproduce an acceptable photocopy. Whilst these particular results do not affect patient care the findings suggest that within this practice there may be other issues with such a method of data capture.

The time and motion study also revealed the substantial benefit of time savings that can be made from implementing an electronic system. The study revealed a cumulative time saving of 18 and a half minutes on just 6 tasks. These tasks were only a sample of the tasks that are undertaken every month in hospitals across the world.

From the telephone poll of other hospitals in Ireland it was revealed that this system of data keeping is repeated in most Theatre Departments across the country, 47 out of the 50 hospitals in Ireland have a paper based register in their Theatre Department. It may be concluded from this information that the 35 hospitals which have no form of electronic data capture would benefit in the same way as the project hospital from the introduction of a similar system.

7.3 Limitations of the study

There are a number of limitations in this study.

In hindsight a pre and post implementation survey of attitudes may have added more weight to the findings. Also this study was performed in a Theatre Department where the system "champion" was a regular member of staff which, inadvertently, may have skewed the results. Consequently the ability to reproduce the findings elsewhere may prove difficult.

As mentioned within the report, the issue of establishing a secure network limited the introduction of the electronic register to just one Theatre within the Theatre Department. With more time and more technical expertise this issue may have been

overcome. The synchronous use of electronic registers in all Theatres may have allowed the removal of the paper-based register; however the paper register still exists and is being filled in alongside the electronic register. The author regrets the fact that nurses are now required to enter data in two places and the duplication of effort this entails.

Initial contact with other hospitals attempted to identify the fields that were present in each paper-based register, however this information proved very difficult to collect. Each Theatre Department has its own minimum number of fields within the paper register and within each Theatre Department there are variations of these registers as some surgeons have their own customised registers.

7.4 Future work

As referred to in the limitations of the study, further investigation of the data collected in the other Theatres throughout the country proved too time consuming for this project. Such an investigation could form a project on its own.

An attempt to do a financial comparison for both systems was attempted as part of this study however due to the individuality of each theatre and indeed each register it was only possible to produce an estimated annual cost of using a paper register. It also proved to be beyond the scope of this project to establish the actual cost of implementing an electronic database in each of the Theatre Departments throughout the country. It proved very difficult to try to work out the training costs and hardware costs for each Department as these may easily be different for each department. Another study could factor in the time taken by the database builder and the cost of providing a trainer for implementation of an electronic database to perform a proper comparison of the cost of maintaining a paper-based record as opposed to an electronic record.

7.5 Conclusion

The author feels that there is a significant amount of value to be gained from implementing electronic data capture into a theatre department. The benefits of electronic data capture that have been highlighted here with regard to obvious time savings and the production of data that is more accurate, legible, and complete are but

a few of the seemingly limitless possibilities. This project has proven to be very interesting and some of the findings were surprising to the author. The author expected that more Theatre Departments in the country would be using electronic data capture for their patient episodes and was surprised by the number of hospitals that had good integrated hospital information systems in place but persisted to collect Theatre data manually. A nice surprise from the project was the growing confidence of the end users in adopting electronic data capture, which was witnessed during the database implementation in the project hospital.

Ultimately, as budgetary constraints and ever increasing demands for time efficiencies become critical to the provision of healthcare both in Ireland and elsewhere, integration of accessible, multi-user electronic data capture systems in place of familiar paper-based records in Theatres and elsewhere in hospitals seems both inevitable and beneficial. As has been demonstrated by this study and reported widely in other literature, it will be the active involvement of the ultimate end user that is key to producing a product which is both comprehensive and comprehensible. As the results of this project reflect, with inclusive system design and development, use of an electronic record system can be perceived as a useful tool rather than a cumbersome technology and can be embraced by technophiles and technophobes alike. It is hoped that the findings of this study can be replicated elsewhere; ensuring Irish hospitals are at the forefront of technological efficiencies increasingly demanded of healthcare providers in the 21st century.

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Appendices

Appendix 1 Nurses Questionnaire

Rate each item in the questionnaire below indicating your level of agreement

Place an “X” in the appropriate box

1= Strongly Agree 2= Agree 3= Uncertain 4= Disagree 5= Strongly Disagree

Q. No.	Question	1	2	3	4	5
1.	Do you think an electronic register provides information that : Is more accurate?					
2.	Is easier to retrieve?					
3.	Is easier to search?					
4.	Is more legible?					
5.	Is more complete?					
6.	Does the electronic register require you to change the way you carry out other nursing duties?					
7.	Do you think it is more difficult to fill in an electronic register than a paper based register?					
8.	Do you think the electronic register provides extra information that is not captured on the paper register?					
9.	Do you think the electronic register is useful?					
10.	Do you think the implementation of the electronic register was successful?					
11.	Do you think the electronic register is important for the theatre?					
12.	Do you have any comments on the electronic register? _____ _____ _____ _____					

Appendix 2 Covering letter for Questionnaire

Niamh Bonner
Theatre Department
Mullingar

Dear Colleague,

As you may be aware I am undertaking an MSc in Health Informatics. My area of interest is whether or not an electronic register is valuable for data collection in a theatre department. In order to achieve this I have implemented an electronic register in the theatre department for a limited period. As part of the project I would like to assess whether you consider this implementation to have been successful and how you perceive electronic data capture. I would be grateful if you would fill out the attached short questionnaire. Please place an x in the box which best describes how you feel about the statement. Please feel free to provide any comments and feelings you may have about electronic data capture. The completed questionnaires can be placed in the labelled box in the kitchen. I would appreciate your replies by Friday 21st.

Thanks in advance

Niamh Bonner

Appendix 3 Theatre Register Audit Tool

Please inspect each of the 20 entries following the first entry on 02-02-09

Please put a ✓ if the entry passes in all fields and an X if it fails. Please give details of any failure in the comments box.

Register name:

Entry no.	Complete	Legible	Photocopy	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				