Operative note writing: barriers to an electronic record and the possible implications for patient safety

Katherine M. Browne

A dissertation submitted to the University of Dublin, in partial fulfilment of the requirements for the degree of Master of Science in Health Informatics

2009

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.

Signed: _____

Katherine M. Browne
11 September 2009

Permission to lend and/or copy

I agree that the Trinity College Library may lend or copy this dissertation upon request.

Signed: _____

Katherine M. Browne

11 September 2009

Acknowledgments

Thank you to Dr. Lucy Hederman, director of the Masters in Health Informatics for her patience, help and understanding with this dissertation. Thanks to her also for her organization of the two year course and how much she has taught us all.
Thank you to Trish King and Trish Connolly for their help with the initial planning of this project and to Maeve McLaughlin for her help with execution and follow up of this research.

Summary

Background

At the conclusion of an operation it is practice for the operating surgeon to complete a note or record of the procedure. Many hospitals now possess electronic theatre management systems. However, moving paper based practice to an electronic work model is a challenge for all health informatics managers. Legibility has previously been shown to affect patient safety with respect to prescriptions, but such research is lacking in operative notes.

Aim

1. To investigate if electronically created operative notes improve patient safety when compared to traditional hand written operative notes.
2. To investigate the reasons why surgeons fail to use an electronic operative note function on existing theatre management systems in two separate institutions.

Methods

1. Four sample surgical procedure notes were created both on the theatre management system and identical records in traditional handwritten format. Pre-registration house officers were asked a range of questions based upon both electronic and handwritten records. Differences in responses were calculated using a chi squared test.
2. Operating surgeons were surveyed regarding their use and potential difficulties with the theatre management system in relation to an operative note creation in the two institutions.

Results

1. There was no statistically significant difference between the two groups of surgical operative notes; however the general trend of results favoured the use of an electronic patient surgical record.
2. The main factors for failure to use the theatre management system for creation of an operative note were related to lack of clinician ownership and leadership of the programme, lack of initial education and an absence of user support for the theatre management system.

Conclusion

The electronic operative record has the potential to improve patient safety. The main reasons for failure of surgeons to complete an electronic record were lack of clinical leaders, lack of technical support and difficulties with coding for procedures.

TABLE OF CONTENTS

LIST OF TABLES AND ILLUSTRATIONS

Tables **Page**

GLOSSARY

A&E	Accident and emergency department
EPR	Electronic patient record
ICD-10	International Classification of Diseases and Related Health Problems
IT	Information technology, computer services helpdesk
Intern	Pre-registration house officer
MRN	Medical record number
NCHD	Non-consultant hospital doctors (Intern, SHO, Registrar, SpR)
ORIF	Open reduction and internal fixation
PACS	Picture archiving and communication system
PIMS	Patient information management system
PIS	Patient information system
RCSI	The Royal College of Surgeons in Ireland
Recovery	Patients are taken here in the immediate post operative period
SAPPHIRE	Theatre management system
SHO	Senior house officer
S/N	Staff nurse

SpR	Specialist registrar
SPSS	Statistical Package for the Social Sciences
Theatre	Operating theatre in which procedures are carried out
TURP	Trans-Urethral Prostate Resection
UROC	Urology registrar on call
WHO	World Health Organisation

1. CHAPTER 1: INTRODUCTION

1.1 The patient pathway in theatre

The patient is at the centre of all surgical operations. However, the journey for the patient begins long before the actual procedure and involves numerous people. It is a largely linear journey from preoperative to operative to the post operative period, but within these distinct sections there exists a myriad of people and procedures interweaving. To map that process is not within the remit of this dissertation. However, the diagram below represents the first level of people involved in the process—those who have direct contact with the patient (the second level of people would involve laboratory, administration and support staff).

Patient Journey

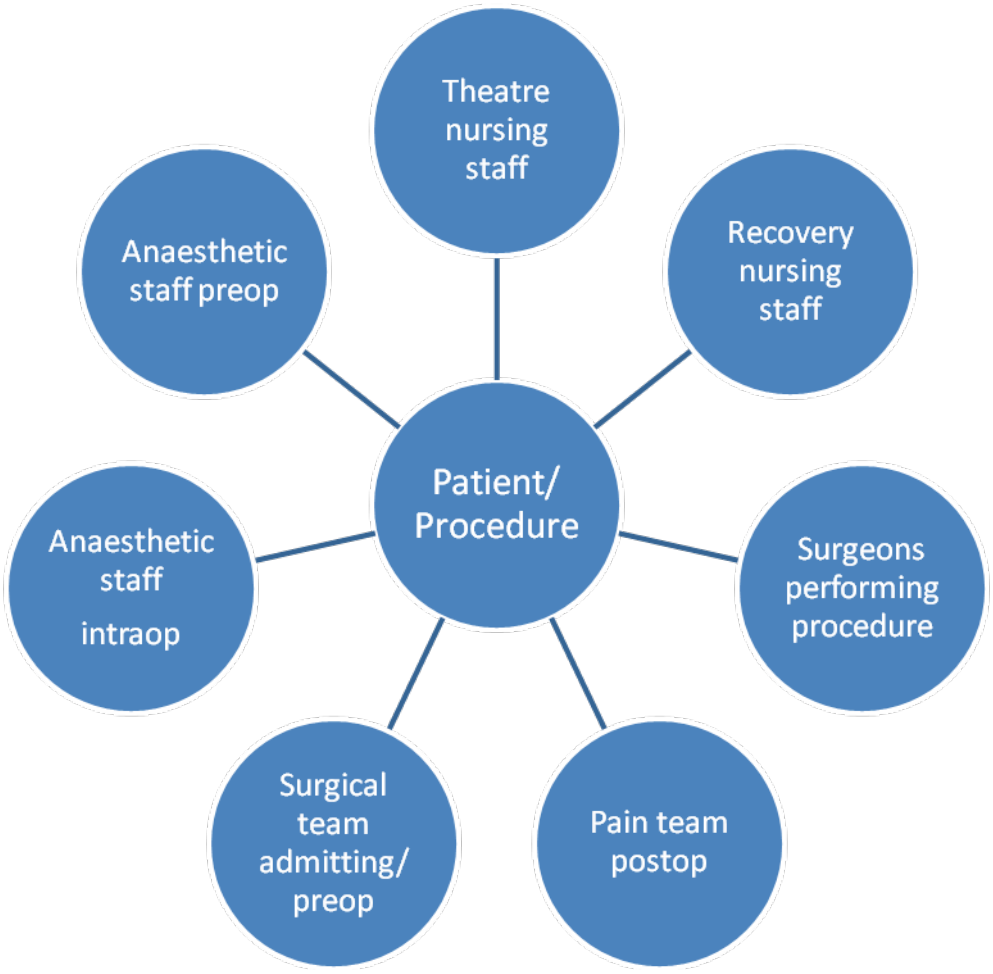

Figure 1. Patient interaction with staff in the perioperative period

1.2 The operative note

An operation note is written by the operating surgeon or assistant and is a legal and medical record of the procedure that took place. This document helps to inform postoperative management by other health care professionals and ensures a safe and efficient hand over of responsibility to colleagues. In the event that a further operation is planned, it gives details of the procedure undertaken. The operative note, by convention, comprises the following information:

- Patient name
- Patient date of birth
- Patient identifier
- Consultant surgeon
- Consultant anaesthetics
- Scrub nurse
- Surgeon performing procedure and assistants names
- General or local anaesthetic and type of anaesthetic used
- Position of patient on the operating table and tourniquet if appropriate- time and pressure used
- Title of procedure and if elective or emergent
- Incision
- Dissection performed (blunt or sharp)
- Findings intra-operatively
- Excision, if appropriate
- Other procedures
- Samples sent to Microbiology or Pathology
- Haemostasis and the use of diathermy—monopolar or biploar
- Closure of viscus or wound and the materials and methods used
- Dressings
- Post operative management including when patients can resume oral intake and type of intake, antibiotics in the postoperative period. Removal of sutures and post operative follow up if being discharged e.g. as a day case.
- Signature and identifier (e.g. bleep number and position in team)

1.3 The importance of the operative note

Though the operative note may be as brief as a single page, it informs a number of decisions in the peri operative and post operative period in terms of management, nursing care, possible complications and often instructions for prescribing of fluids or antibiotics. Plans for discharge are often included and it is the operative note that is referred to on patient follow up in the outpatient setting.

In the wake of new regulations governing the European Working Time Directive, the importance of an efficient and safe handover will become increasingly important (Jones, 2004). An operative note is read by the nursing staff and doctors on the ward, and serves to give post operative instructions both in the immediate postoperative period and at discharge. Currently these notes are written by hand at the completion of a procedure. There exists a standard form in most institutions, asking for the patient details, operator details and the identities of associated nursing and anaesthetic staff. There is also an area for free text to describe the procedure. The form must be signed by the doctor. Specimens sent to laboratories such as Histopathology or Microbiology are recorded on the operative note in order that the results may be followed up on discharge.

Theatre management systems are part of the spectrum of management and decision support software. They aim to streamline and either reconfigure or adhere to current work practices. Currently two university teaching hospitals in Dublin have theatre management systems installed. They are separate programmes in different institutions. Both management systems were installed within the past five years and have run without hiatus. Both systems are multifunctional but are being used in a somewhat limited capacity. In particular, both have the functional ability to create a theatre list and then once in progress, allow the operating surgeon to create a patient note based upon the procedure undertaken. However, both institutions have failed to use the function which allows the operating surgeon to create an electronic record of the patient operation. In both locations the function is readily available, but yet is completely unused.

1.4 Research question and dissertation outline

From the preceding observations, two research questions emerged. Firstly, is the electronic patient operative note a safer alternative to the traditional handwritten note? Is there any evidence to suggest that an electronic operative note creates a safer pathway for a patient? In an attempt to answer this question a literature review was undertaken to evaluate the previous research in the area. Following this an experiment was performed to test the hypothesis that the electronic surgical record is a safer tool of communication that the traditional handwritten record.

Secondly, why is the functional ability to create an electronic patient operative note not used in two hospitals, each with differing management systems already installed? Why, if the management systems are in place is this potentially useful functionality not being used? In investigating this question we sought to review the literature regarding theatre management systems and their functionality and the problems of 'usability' of healthcare software initiatives. We sought to identify whether the problem lay with the product itself or management factors surrounding its installation and running.

To first assess whether the onus lay on the system itself, a second experiment was undertaken to investigate the usability of the system. Since the system was not currently in use, we arranged a tutorial for volunteers and then asked them to complete surgical operative notes while observed. We then surveyed them in relation to their experience of the software and the perceived problems with the system using a detailed questionnaire. Finally we surveyed the surgical non-consultant hospital doctors (NCHD's) regarding their opinion and experience of the theatre management system in more general terms.

The remainder of this thesis is divided into six further chapters. The first details the background to the research. The following three chapters investigate each of the three experiments in detail. The concluding two chapters detail the evaluation and conclusion of the project.

2. CHAPTER 2: BACKGROUND

2.1 Theatre management systems

Theatre management systems are part of the spectrum of management and decision support software. Theatre management systems, in line with other decision support and management systems, can either map or change practice in a non-electronic workplace. Most systems appear to map practice, but may introduce extra features for audit, safety or cost/time saving measures.

Many feel that the development of theatre management systems stemmed from an economic desire to capture spending practices rather than to streamline or aid practice (Bemmel, 1997). Data was initially pooled into what was termed a management information system. The operating theatre, being one of the most costly areas of practice within a modern healthcare facility, was an obvious target for the development of a management system. It is not within the remit of this discussion to focus on network architecture, however, most models of management systems are based upon one with which a database interface links a management system and a patient database. This database interface may also act as a common bridge between the patient database and other decision support and management tools (Hovenga, 1996).

The success of a theatre management system was found to have benefits beyond that of audit and cost control. Job satisfaction increased fourfold when a theatre management system was streamlined in a single institution in the United States. The paper describes how the authors used a system whereby the basis for delivery was to pair technology with an individual process for resultant success (Bozelli, 2009). In this study they had aimed to improve efficiency but found that this efficiency also drove user satisfaction and satisfaction with the work process, thereby driving further productivity.

A theatre management system can, as previously discussed, either map current practice or to try to improve upon that practice and alter the workflow. There are several examples of projects where workflow was inefficient but in an attempt to change inefficiency in a system was resisted by the users (Lorenzi, 2002). Trying to map a human process to a technological design provides constant difficulties (Van der Castle, 2004). If these processes are incorrectly mapped or a system imposed upon an individual without due

consideration, the system is likely to fail or be rejected by the user (McDaniel, 2002). Lorenzi describes the failure of systems broadly under four main headings: technical shortcomings, project management shortcomings, organizational issues, and the continuing information explosion (Lorenzi, 2002).

In the workplace people and organisational issues are central to both implement the system and managing the change in the organisation that is affected by the system (Lorenzi, 1997). The 'people' element of software integration has been recognised as one of the most important issues in software success. When a rural prescribing programme was introduced in the United States Stevenson was puzzled when only one institution out of five successfully ran the programme. When he analysed the different groups it was noted that organisational factors were key to the success or failure of the project rather than the software design (Stevenson, 2005). The human factors seem, at times, to almost overshadow the software design itself.

The need for clinical leadership has also been cited as an important factor predicting success of a project. Often clinicians are not involved at the planning or procurement phase of a project and understandably therefore have no sense of ownership when the programme is introduced (Frame, 2008). However, clinicians must be facilitated in their involvement (Soutehn, 2003). Many clinicians have a desire to become involved but the scheduling of meetings conflicts with their clinical commitments and they fail to become involved more fully with a project due to organisation of the project rather than a lack of desire (Wyatt, 1995).

Suggesting methods of technology introduction and software integration has led some to believe that an iterative approach, like that used in software testing, should be seen as best practice. In place of a 'going live' event and then training around the system, they suggest a step by step collaborative approach one in which

> *'distinctions between 'analysis', 'design', 'implementation' and 'evaluation' blur.'*
>
> (Berg, 2004)

The implications of a theatre management system have been discussed but the implications to patient safety can often be more difficult to quantify (Page, 2009).

Poor handwriting alone is thought to be related to over a third of episodes of 'poor communication' between healthcare professionals (Bewick, 1996). Physicians' handwriting has also been found to be a source of medical error (Hirshborn, 2000). There exists a large body of research suggesting that electronic prescribing provides multiple safety benefits to patients (Agrawal, 2009). These results may be extrapolated to suggest that theatre management systems, if fully used would confer the same benefits to patients (Christian, 2001).

However, studies related to operative notes have tended to focus on dictation as a comparative method. This stems from the fact that most studies are based in North America where dictation would be the normal practice. However in Ireland, current practice involves a written operative note. The accuracy of electronic templates for surgery operative notes have been found to be beneficial when compared to oral dictation (Cowan, 2007).

2.2 Usability

Usability largely refers to the ability of a user to interact efficiently and elegantly with a web or computer based programme. Jacob Nielsen, one of the main developers of usability testing, defined several important questions which one needs to investigate when researching a software product:

- *"Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?*
- *Efficiency: Once users have learned the design, how quickly can they perform tasks?*
- *Memorability: When users return to the design after a period of not using it, how easily can they re establish proficiency?*
- *Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?*
- *Satisfaction: How pleasant is it to use the design"*

(Nielsen, 1994)

If we have defined what usability refers to, we must then formulate a method to address this measurement. Interestingly, Virzi investigated four methods of evaluation of a software

product**:** heuristic evaluation, software guidelines, cognitive walkthroughs, and usability testing (Virzi, 2007). Usability testing was found to be the most efficient. Usability testing is now a major part of any software development and will be investigated in terms of a theatre management system in the course of this dissertation.

2.3 Coding systems

Coding is a major part of healthcare informatics as it is a method of efficient information capture. It allows audit capture to be performed effectively and informs choices for resource allocation and disease epidemiology. However, it is not without difficulties.

ICD 10 is the archetypal coding system for patient record abstraction. The first edition was published in 1900. It consists of a core three digit code. The baseline is meant to be used for coding diagnostic terms, but also can encompass other families of medical terms. These terms can be mapped to procedures. However, for the user of a theatre management system, this may not be apparent. If codes are unable to be found easily for a designated procedure frustration arises and often the user may opt for an inaccurate but compromised code. (Krall, 1997).

ICD is used internationally for comparison of statistical returns. It is a multiple axis classification system based around a single list of three alphanumeric codes. As the ICD continues to be used for a wider variety of applications than its initial intent, the World Health Organisation (WHO) revised the list in its 10^{th} edition to develop a family of related classifications surrounding the core set. It is this expansion that has caused difficulties in correctly applying the code to examples such as surgical procedures (Wokenfuss, 2009). In addition modern advances in medicine and diagnosis have seen ICD criteria become unreliable (Goff, 2000).

Both hospitals referred to in this study have theatre management systems installed, both using ICD 10 as their framework code. However, each procedure must be mapped back to a disease specific code. The problems with this framework as it relates to the surgical operative note will be discussed in further detail in the course of this dissertation. It is worth noting that both theatre management systems discussed require the theatre list to be uploaded including the operative codes, prior to the procedure. Therefore the difficulties encountered with submission of the theatre list are likely to be found in the surgical note.

2.4 Hospital A

Hospital A is a university teaching hospital of with a 620 bed capacity. The Hospital includes all nine surgical specialties[1] and has twelve full time functioning operating theatres with a link to an interventional radiology suite in the adjoining radiology department. The hospital has its own information technology and computer department staffed by 15 people. This includes the development of a computer programming department for the hospital with access to software engineers for in house building of programmes. As with many institutions, the overall patient management systems are somewhat of a patchwork. Systems are as yet, not fully integrated, but use a patient identifier or MRN (medical record number) common identifier. There are four main software packages: a system for A&E (Accident and Emergency), a PIMS— patient information management system, a facility for booking patient appointments. In addition there exists a theatre management system with a bridge to the PIMS.

2.5 Procurement of management system for Hospital A

The system in operation at Hospital A was purchased after the vendor approached the hospital without solicitation. The company was of European origin that wanted to pursue business interests outside their home country. Though an exact pricing was unavailable, the Department of Computer Support motioned that the bid was very reasonable and that full installation support was offered.

Indeed predesigned software packages can be very successful. They are usually pretested and have been trialled in a number of locations. In essence the overall structure of a patient encounter is similar in each institution preoperative, operative and postoperative. In this sense the major work process in each different institution can be facilitated though the use

[1] There are nine surgical specialities recognised by the Royal College of Surgeons in Ireland: Ophthalmology, Neurosurgery, Plastic Reconstructive and Aesthetic Surgery, General and Vascular Surgery, Orthopaedic and trauma surgery, Urology, Cardiothoracic surgery, Paediatric Surgery and Otolaryngology and Head and Neck Surgery. www.rcsi.ie/surgicaltraining

of a predesigned package. Integration of patient details and patient identifiers is key to any system and therefore with most systems a bridge is necessary to integrate it into an institution.
The product brochure for the system states that it:

> *covers all the processes of an operating theatre, from the planning and allocating of theatre time, the booking of a surgical interventions, to the recording of critical information before, during and after the operation…. manages the operating theatres and the associated medical staff of a hospital structure, and is tightly interconnected with all the other services inside the hospital.*[2]

2.6 Installation of theatre management system Hospital A

A support network was initiated and the lead support and integration person appointed was a theatre staff nurse with previous experience of project management. Unfortunately the scarcity of qualified theatre nurses meant that the support person was required to return to a full time position in the clinical arena and no further funding was available to support this role.

The system has now been operational for six years. Currently there is no one in a dedicated support role and at the commencement of the study it was unclear who provided the main user support. Following several interviews it became apparent that the role is shared between nursing management and the computer services department in Beaumont Hospital, though true responsibility has yet to be assumed by any individual. In the current economic climate there are no plans for further development of a support role.

2.7 Hospital B

[2] http://www.engitech.ie/OperRoom_Brochure.pdf?12012005 (accessed 11 September 2009)

Hospital B in a university teaching hospital with 759 beds. The hospital includes an eleven theatre suite and an interventional radiology suite. In addition there is a three theatre day ward suite. Both the day and main theatre have a theatre management system installed.

There is a well developed health informatics network throughout the hospital, having evolved from a more basic patient information system. Two systems run concurrently in the main hospital, a patient information system and an electronic patient record (EPR). In addition three other systems work within the hospital: a separate software package in A&E and a PACS system in radiology for the management of films and radiological reporting. There is a further system in the intensive care unit for bedside ordering which links to the patients EPR.

2.8 Procurement of management system for Hospital B

The process of procurement for Hospital B was quite different. Another of the major teaching hospitals in Dublin was engaged in a complete refurbishment of the theatre suite and had asked the Department of Health for money to fund the development of a theatre management system for their individual hospital. The Department felt that the most cost effective way to procure a system was to involve three other hospitals in the Dublin area and to install they system throughout the four institutions. The project went out to tender and after much debate, the contract was awarded to one vendor who promised to install and offer support for installation phase of the project. When project managers were interviewed, they had concerns regarding the lack of input from the surgical community. Meetings were organised during main working hours where surgeons were unavailable. When members of the working group were interviewed they stated that they felt the surgeons had not been brought on board until very late in the project and stated this as a reason for project failure, or limited success.

The product that was chosen and installed across the hospitals was one also favoured by the NHS that boasts:

- *Real time data capture using touch screen technology*
- *Procedural Notes capture*
- *Record all persons present during a procedure*

- *Access to theatre schedules via an online "Weblists" module*
- *Waiting List Management*
- *Ability to choose and book activity across multiple sites*[3]

2.9 Installation of theatre management system for Hospital B

The theatre management system in Hospital B had a different installation from that of Hospital A. A theatre nurse was seconded to the project as in Hospital A and acted as a project manager in the procurement phase and then a support officer during the initial roll out. Initially the theatre nurse manager, as one of the stakeholders, was trained in the system and then in turn, through a domino effect, trained others.

The seconded project manager remained in the role of theatre software development, but after the initial roll out period returned to the computer services department, left the nursing and clinical staff to run the theatre management system. Computer services were on hand at the helpdesk should any questions arise. Individuals interviewed in the Computer Services department for this research, felt that the responsibility for support largely rested with the theatre management, i.e. nursing staff, but that if any technical issues arose they would be prepared to help.

Many examples of poor prescribing practice are evident in the literature, several attributable to ineligible prescriptions (Charatan, 2000). There have been several articles stating that the written operative note can generate errors and this has serious consequences for patient management (Lefter, 2008). The use of diagrams is also found to be useful in the transmission of operative information to colleagues (Rogers, 2008). One of the strongest proponents of the electronic surgical operative note suggested that

'*… electronic note templates can improve the timeliness and comprehensiveness of operative documentation, while decreasing transcription costs and requiring minimal additional effort on the part of surgeons'* (Laflamme, 2005)

[3] http://newgatetechnology.co.uk/theatre.aspx (accessed 3 September 2009)

3. CHAPTER 3: EXPERIMENT 1—THE SAFETY OF OPERATIVE NOTES

3.1 Aim

The aim of this experiment was to assess the potential benefit of typed, electronic operative notes when compared to traditional hand-written records in relation to legibility, and possible implications for patient safety.

3.2 Methods

Four operative notes were created. These notes, in principle, were designed to be a close representation of surgical practice and experience, though were not transcribed from actual patient notes. Initially it was thought that patient notes might be used, but the ethical implications of consent and the possible dissemination of individual patient information made the study prohibitive. A surrogate note was thought, in the circumstance, to be a viable alternative for the study.

The operative notes were based upon common hospital based procedures from the specialities of Plastic Surgery, Orthopaedic Surgery, General Surgery and Urology. All procedures were well-recognised and formed part of the curriculum for undergraduate medical education at the RCSI. All interns who were recruited to participate in the study were graduates of the RCSI.

Each surgical operative note took a standard format as outlined in the introduction. All information was equally available on both the hand-written and the electronic record. Thee surgeons asked to write the operative notes in their own handwriting were blinded to the fact that their handwriting and the clarity of detail would be assessed. They were given a standard five minute period in which to create the note, in the theatre complex. This is most akin to the conditions in which the operating or assisting surgeon is required to complete a traditional hand written operative note in the post operative period. They were The surgeons were then asked to create an electronic record which was identical to that of the paper based record which they had created. Technical and educational support was on hand to ensure that there were no difficulties with the electronic note creation.

The interns were selected at random, as volunteers. All surgical inters were invited to enrol in the study (n = 25). Out of this total 2 interns volunteered to complete the study. The group comprised those who possessed English as a native language and those who used English as a second language. In the Irish healthcare setting, we rely heavily on doctors trained outside the Republic of Ireland, and so it was felt that a representative sample of the intern population should be used in the sample. In addition the ration of male to female participants was of equal number. (male n = 9, female n = 11). Study size was determined by the number of surgical interns available at the institution, Hospital A. Hospital A was chosen as a location for the study as the group of interns all had the same undergraduate education at the RCSI, whereas the groups' training at Hospital B was not homogenous.

Each intern read each of the four operative notes and answered questions based upon the notes. They were then questioned as to whether they had ever had difficulty comprehending a surgical operation note whilst an intern. In addition they were asked whether they would prefer to have access to an electronic operative note whilst on call. The exercise took place on the ward, at the nurses' station to recreate the context in which interns would usually read the operative notes. The interns were given five minutes uninterrupted time to review the notes and complete the questionnaire.

The interns (n = 20) were asked to complete a list of questions on individual patient management based upon the handwritten and electronic operative record (Appendix 9.1). The answers were then scored out of a possible 20 marks. Marks were allocated for post operative instructions, legibility and comprehension of the operative process.

Comprehension of the operative process was assessed by means of a surrogate, of possible post operative complications, as intraoperative complications will inform an interns' differential diagnosis and management of a possible pos operative complication. Four standard procedures were selected, all frequently reviewed by an intern at the relevant institutions. No specialist procedures or complex nomenclature was used beyond that of which would be comprehended by a surgical intern.

The scoring sheet was broken down into five main areas: patient details and identifier, operator identity and identifier, legibility, intraoperative details and postoperative instructions. Patient safety could be most affected by illegibility and intraoperative and postoperative instructions and these were weighted accordingly (Appendix 9.2).

Statistical difference between groups was performed using a chi-squared test with the assistance of Statistical Package for the Social Sciences (SPSS). A p value of less than 0.05 was taken to be statistically significant.

3.3 Results

The results are listed for each speciality and then combined between all four sections of the experiment to increase the power.

There were 20 interns who took part in the study. There was an almost equal mix of male and female candidates (11 Female: 9 Male). All had qualified from the same medical institution in June 2008 and had completed 7 months of intern training. Each intern was currently working on a surgical service and had daily contact with operative notes. 70% of the group were native English speakers and (n = 14) and the remainder (n = 6), while fluent in English had another language as their native tongue. When this subset was analysed there was no statistically significant difference between the two groups. This was to exclude the possibility that results were related to comprehension.

90% (n = 18) felt that they would prefer an electronic patient operative note and 75% (n = 15) admitted to having previously had difficulty comprehending post operative instructions on surgical operative notes during their internship.

The results are listed below

A. Urology case

Question	Marks allocated (possible total for each)	Typed note (Total, n = 20)	Hand-written note (Total, n = 20)	Statistical difference *p* =
Patient details	1	80	74	-
Operator details	1	80	57	-
Operator identifier	1	76	62	**0.092**
Legibility	4	320	308	**0.053**
Post operative complications	4	308	286	**0.061**
Post operative instructions	4	309	295	**0.067**

Table 1. Results for urology case

B. Orthopaedic case

Question	Marks allocated (possible total for each)	Typed note (Total, n = 20)	Hand-written note (Total, n = 20)	Statistical difference *p* =
Patient details	1	20	20	-
Operator details	1	20	20	-
Operator identifier	1	20	19	**0.627**
Legibility	4	80	72	**0.124**
Post operative complications	4	76	68	**0.063**
Post operative instructions	4	75	75	**0.061**

Table 2. Results for orthopaedic case

C. General surgery case

Question	Marks allocated (possible total for each)	Typed note (Total, n = 20)	Hand-written note (Total, n = 20)	Statistical difference *p* =
Patient details	1	20	18	**0.620**
Operator details	1	20	19	**0.067**
Operator identifier	1	20	16	**0.072**
Legibility	4	80	76	**0.652**
Post operative complications	4	76	71	**0.831**
Post operative instructions	4	75	73	**0.451**

Table 3. Results for general surgery case

D. Plastic Surgery case

Question	Marks allocated (possible total for each)	Typed note (Total, n = 20)	Hand-written note (Total, n = 20)	Statistical difference *p* =
Patient details	1	20	20	**-**
Operator details	1	20	18	**0.745**
Operator identifier	1	20	14	**0.303**
Legibility	4	80	75	**0.688**
Post operative complications	4	76	71	**0.680**
Post operative instructions	4	75	70	**0.016**

Table 4. Results for plastic surgery case

E. Combined cases

Question	Marks allocated (possible total for each)	Typed note (Total, n = 20)	Hand-written note (Total, n = 20)	Statistical difference *p* =
Patient details	1	20	16	**0.620**
Operator details	1	20	12	**0.067**
Operator identifier	1	20	8	**0.012**
Legibility	4	80	56	**0.052**
Post operative complications	4	76	72	**0.831**
Post operative instructions	4	75	68	**0.421**

Table 5. Results for combined cases

3.4 Discussion

All operative notes chosen were of a standard format. Interns within a team are usually responsible for the review of patients and of immediate post operative complications on the ward. Interns frequently refer to the operative note when called to review a patient on call. In addition, the intern would use the post operative information to inform his decision regarding post operative management and appropriate follow up. The operative note therefore has direct implications on patient management. Therefore if operative practice or instructions were misinterpreted, through illegibility or otherwise, the possibility for medical errors would exist.

There was no statistically significant difference between the two groups when each electronic operative note was compared to its handwritten counterpart. However when the two groups were combined we found results that were approaching statistical significance.

Legibility as expected was greatly improved by the electronic record ($p = 0.053$). As previously discussed, the introduction of the electronic record to prescribing practice has been shown to greatly increase patient safety. However, there could be no such direct correlation between an operative note and safety, as the surgical note is a retrospective record of that which has already happened. However, as previously noted, the operation note also gives instructions for the post operative period and for discharge, and in this way may be a potential source of error. When the electronic patient note and the handwritten note were compared, the results were approaching statistical significance ($p = 0.061$). In addition, when potential post operative complications were as a result of intraoperative findings the resultant difference between the electronic and handwritten record were also approaching significant results ($p = 0.067$).

The study may have been hampered by a small sample size, but this was the only available group at the time of study. In addition, it would have been valuable to have the electronic record available as part of the patient's EPR, so that the true value of accessing the patients' operative note in the context of other results may have been explored. This experiment could be repeated this year with a separate group of interns at the same institution. Other institutions might be used, but interns would have to be selected to have qualified from the same institution so as to minimize the knowledge bias when observing the differences in intra operative and post operative management.

3.5 Conclusion

It is intuitive that the typed note may inherently be a more accurate record of the surgical procedure in terms of legibility and format. However, this study is likely to be too small to show a statistically significant difference between the two groups. Though the likelihood of a chance finding cannot be out ruled, the general trend throughout the four exercises may suggest the electronic record to be a safer alternative. Taken within the healthcare setting, the likelihood of a safer alternative would suggest that this is a valid alternative to the hand written operative record. Further studies with a larger sample are needed to confirm the findings.

4. CHAPTER 4

EXPERIMENT 2: CREATION OF AN ELECTRONIC SURGICAL RECORD

4.1 Aim

The aim of this experiment was to assess the usability of a surgical operative note record in a pre-existing theatre management system in Hospital A, from the perspective of the end user.

Usability testing usually involves investigation of the following four areas as described by Nielson. Firstly, performance, that is, how much time is required to complete simple steps and are the steps intuitive and easy to follow. Secondly, how much can be recalled regarding the use of the system after a period of non-use. Thirdly, the accuracy of the interaction and how many mistakes the user made and finally, the emotional response e.g. is the user anxious or calm after the interaction and would they choose to use it again if given the opportunity?

4.2 Methods

The facility to create a patient note exists on both software packages in Hospital A and B, but is not used in either institution. We sought to create a patient note in the software package of Hospital A, involve a group of NCHD's in the training of this facility and then to assess the usability of the facility by means of a survey.

Eight NCHDs out of a possible sixteen agreed to partake in the study, and the group was broken into two for a twenty minute tutorial regarding the system. In choosing the number of subjects to partake in a usability study the work of Nielson was investigated regarding the number of subjects needed to reveal usability problems.

It replicates work done by Jakob Nielsen and extends it by incorporating problem importance into the curves relating the number of subjects used in an evaluation to the number of usability problems revealed. The basic findings are that (1) with between 4 and 5 subjects, 80% of the usability problems are detected and (2) that additional subjects are less and less likely to reveal new information. Moreover, the correlation between expert

Judgments of problem importance and likelihood of discovery is significant, suggesting that the most disruptive usability problems are found with the first few subjects

Each tutorial was facilitated by the author and aimed to teach the functionality in a step by step process. An opportunity for questions was facilitated. An operation of the NCHDs choice was created, but not saved, so as not to disrupt patient records.

Each NCHD was given one tutorial of 20 minutes in a group and then observed while creating their first surgical note using the theatre management system. They were observed using the system for the number of mistakes they made, their inability (if any) to complete the task and then were then asked to complete two operative notes using the theatre system within the next week.

Following this exercise the NCHD's were asked to complete an anonymous questionnaire discussing their experiences of the usability of the operative note system.

The questionnaire consisted of closed questions which sought to gather demographic information. The remainder of the survey sought to assess the opinions of those who had taken part in the study by means of an 'attitudinal' line of questioning. The majority of questions were scored according to a Likert scale. This is most appropriate for a spectrum of responses. In line with usability testing guidelines they were also asked how the experience made them feel. All questionnaires were anonymous. The questions were created in three main areas: usability of the system, comfort with the hardware of the system, perceived difficulties with the system and their attitude to coding.

The questionnaire had clear instructions and took fewer than three minutes to complete.

4.3 Results

Results are represented after each survey question. Raw results, where appropriate, are shown below each response. The total number of respondents was 8 / 8. All questionnaires were fully completed.

Part 1- Usability

Candidate	1	2	3	4	5	6	7	8
Log on	yes	Yes	Yes	Yes	Yes	Yes	Yes	yes
Select procedure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes
Coding	difficulty	Failed	Failed	Yes	Yes	Yes	Failed	Failed
Type procedure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes
Printing procedure	Yes	Yes	Yes	No paper, difficulty	Yes	Yes	Yes	yes
Signing	Failed	Yes	Yes	Yes	Yes	Yes	Yes	Failed
Patient chart	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes
Mental state	frustrated	Happy	Happy	frustrated	Happy	Happy	happy	anxious

Table 6. Usability testing of theatre management system, Hospital A

Results of questionnaire of volunteers using the theatre management system

The raw results of each question are marked out of a total 8 participants.

1. **Are you?**	Male	Female
	5 / 8	3 / 8

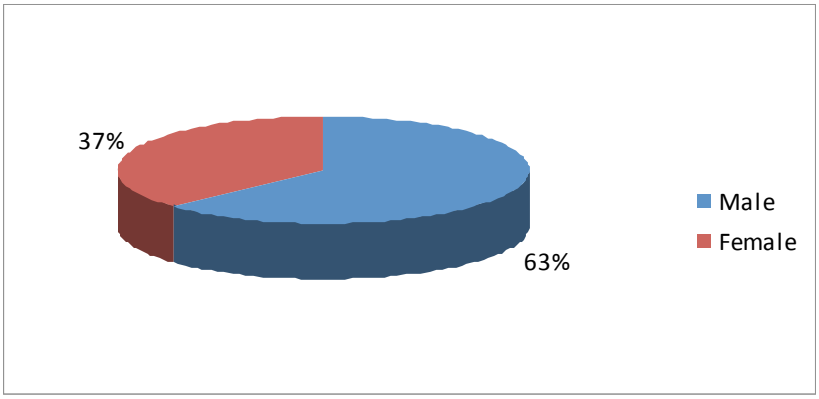

Figure 2. Sex of participants

2. What age range are you in?

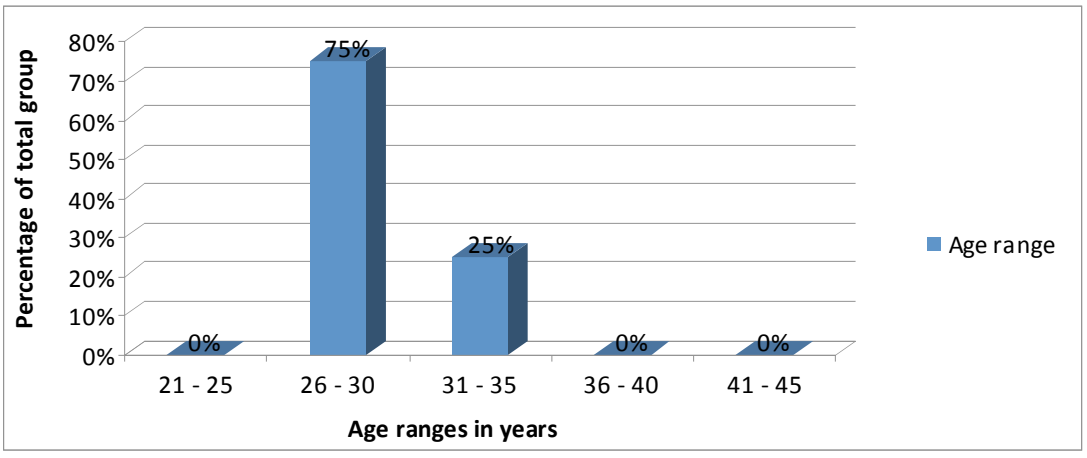

Figure 3. Age range of participants

3. What level of training are you at?

SpR	*Registrar*	*SHO*
0 / 8	**1 / 8**	**7 / 8**

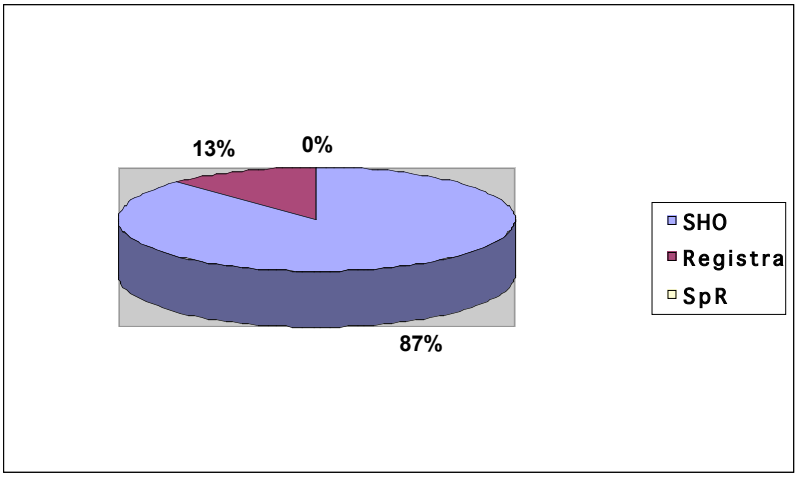

Figure 4. Number of notes completed as a percentage of total by grade

4. How many procedures did you complete on the theatre management system?

Responses	*1*	*2*	*3*	*4*	*5*
Results	0 / 8	7 / 8	1 / 8	0 / 8	0 / 8

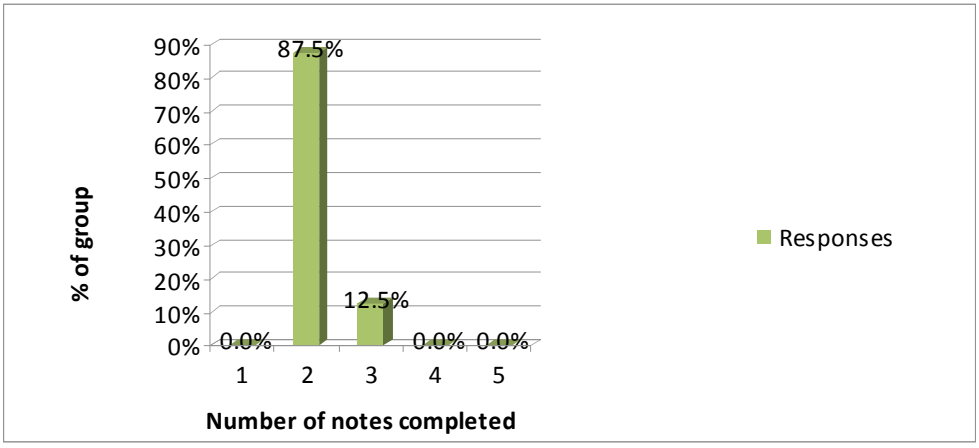

Figure 5. Number of notes completed on the electronic patient management system

5. I found the programme easy to use

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	0 / 8	1 / 8	6 / 8	1 / 8

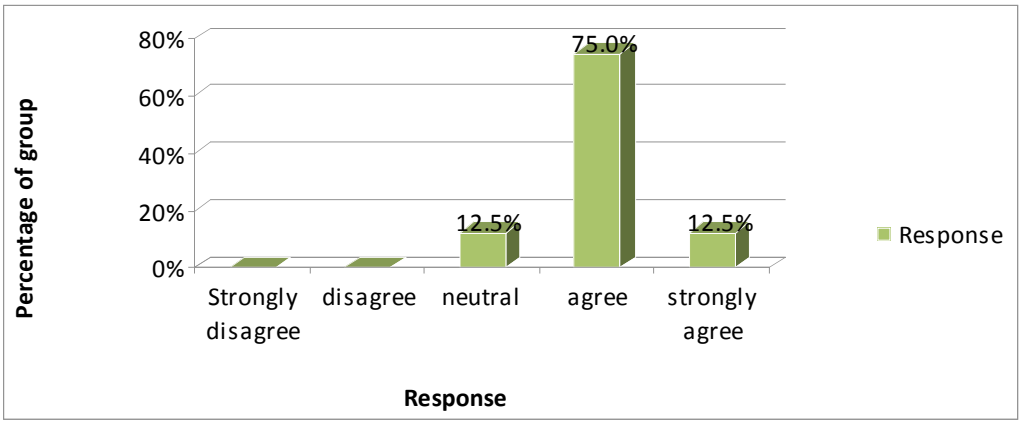

Figure 6. Ease of programme use

6. I am comfortable with coding the procedure

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
1 / 8	5 / 8	1 / 8	1 / 8	0 / 8

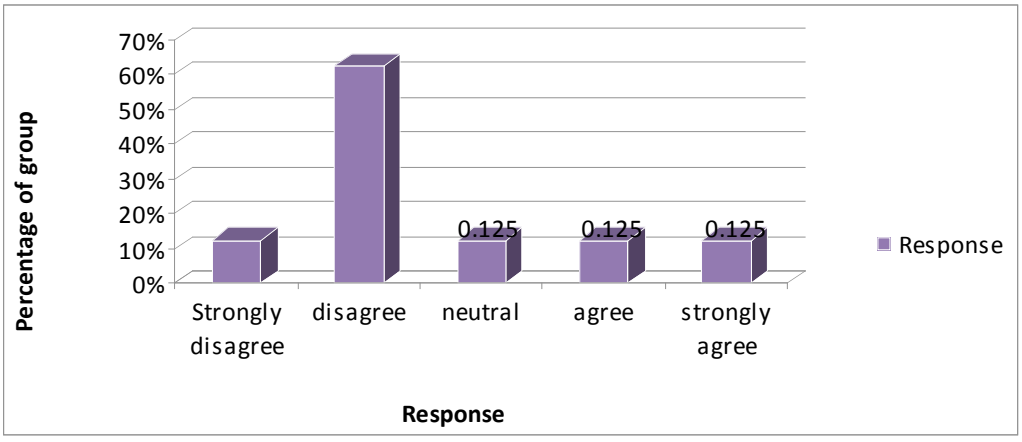

Figure 7. Ability to code for a surgical procedure

7. I am comfortable with the location of the computer and printer

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	**3 / 8**	**5 / 8**	**0 / 8**	**0 / 8**

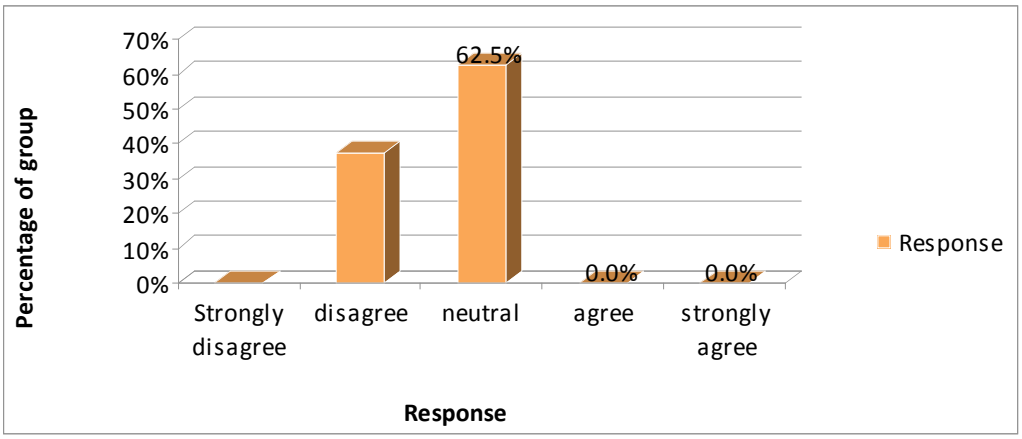

Figure 8. Comfort with the location of the computer and printer

8. I am happy with the finished operative note

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	**0 / 8**	**2 / 8**	**6 / 8**	**0 / 8**

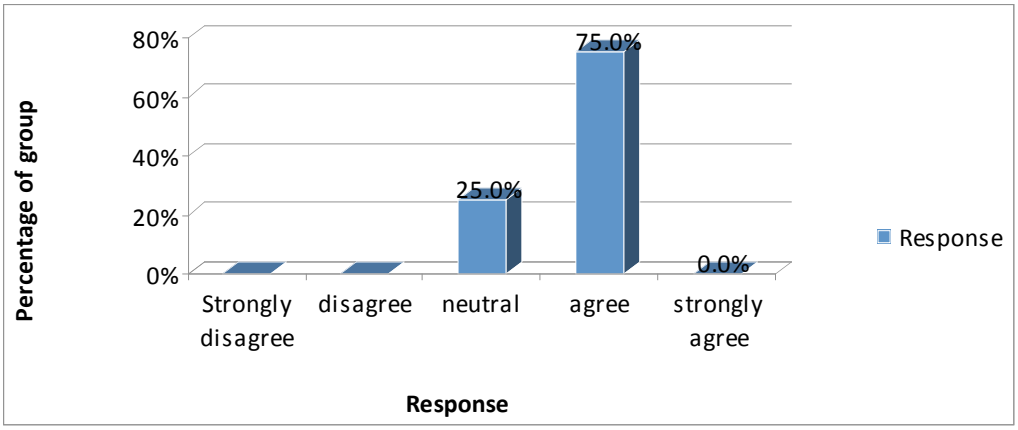

Figure 9. Satisfaction with completed electronic surgical note

9. It takes much longer to complete the electronic operative note than the handwritten operative note.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	**2 / 8**	**4 / 8**	**2 / 8**	**0 / 8**

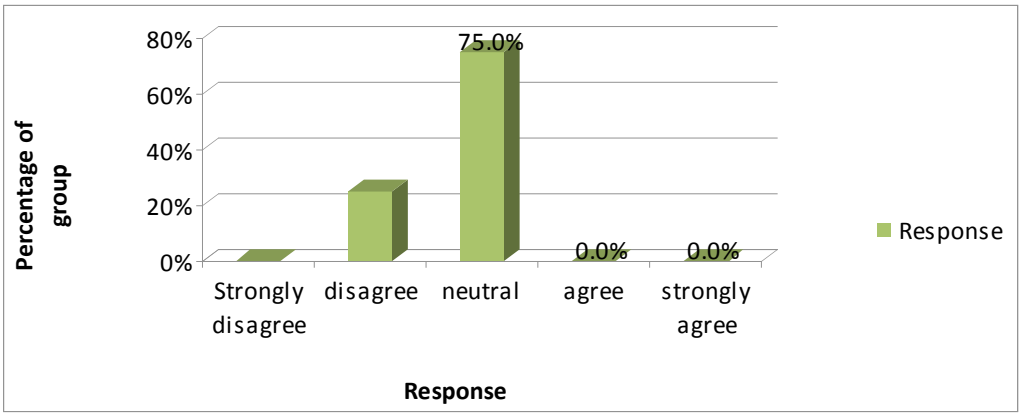

Figure 10 Perceived length of time for completion of electronic surgical note

10. I had difficulty typing the operative note.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
2 / 8	5 / 8	1/8	0 / 8	0 / 8

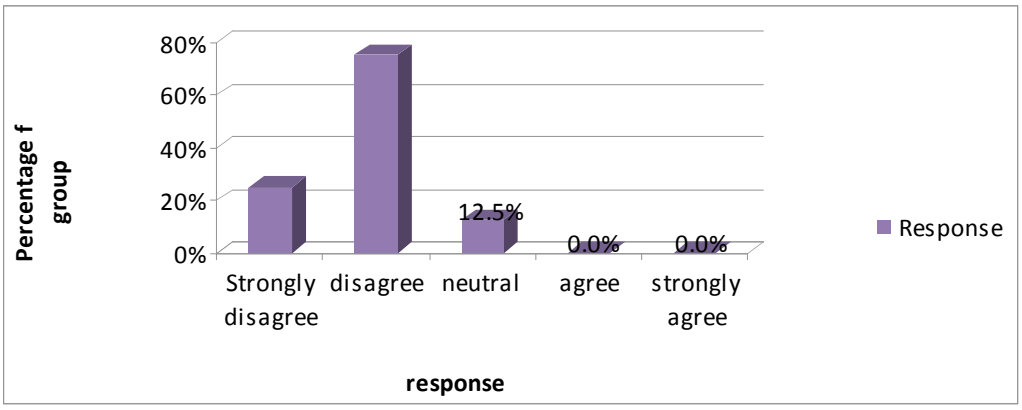

Figure 11. Difficulty typing an electronic operative note

11. I found the system easy to use.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	0 / 8	3 / 8	4 / 8	1 / 8

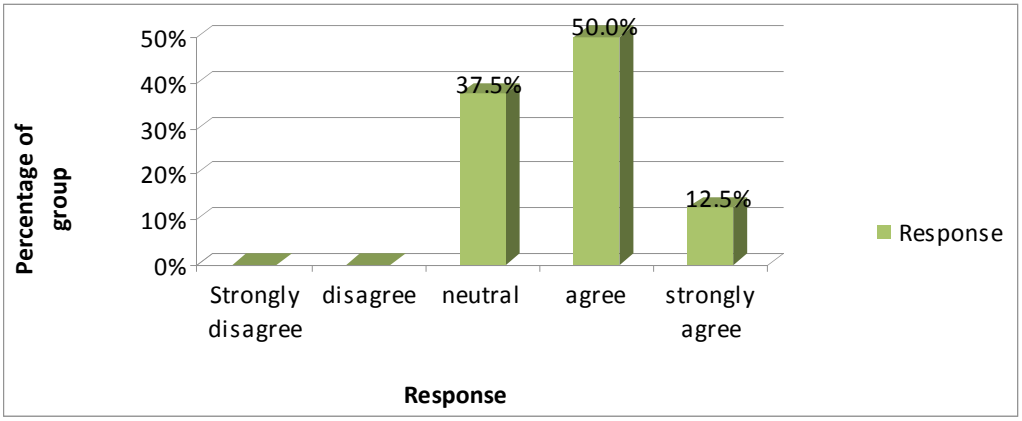

Figure 12. Ease of use of the theatre management system

12. I was comfortable that the codes I chose were appropriate for the procedure.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0/ 8	**3 / 8**	**4 / 8**	**1 / 8**	**0 / 0**

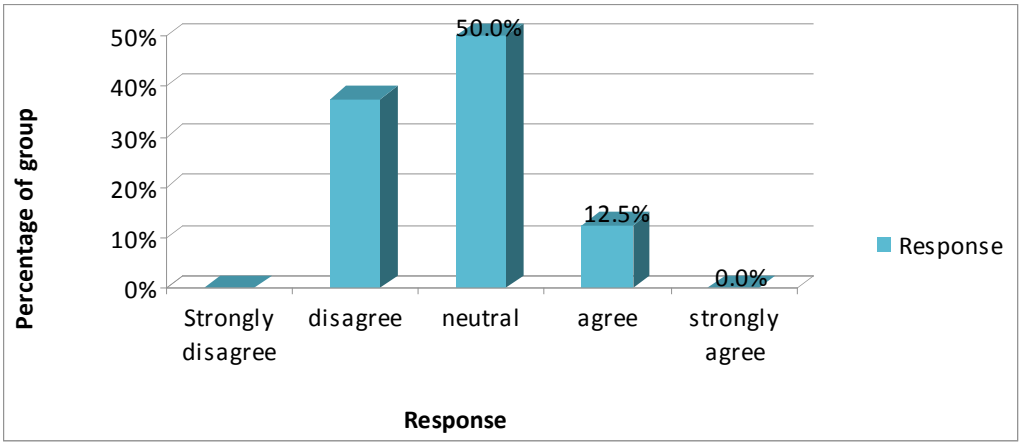

Figure 13. Satisfaction with codes selected for surgical note

13. I had difficulty finding appropriate codes.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
2 / 8	**4 / 8**	**1 / 0**	**1 / 8**	**0 / 8**

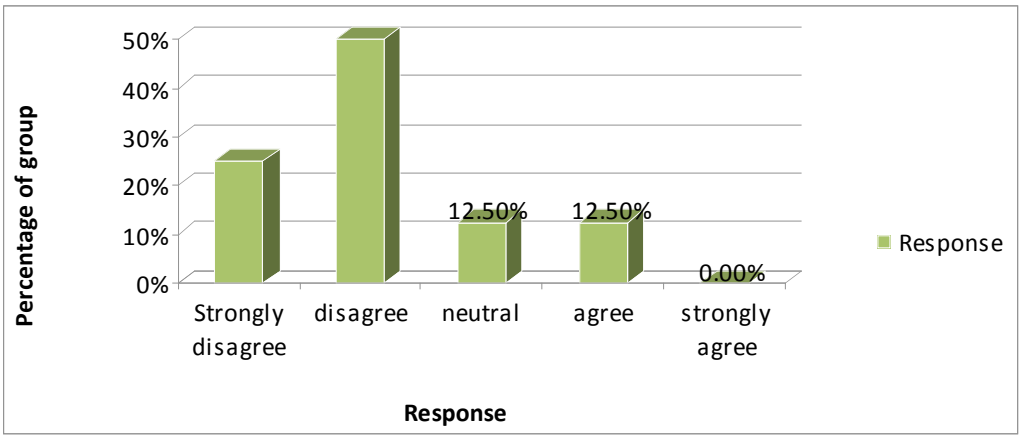

Figure 14. Difficulty finding appropriate operative code

14. I was comfortable with the location of the computer and printer.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	**2 / 8**	**1 / 8**	**5 / 8**	**0 / 8**

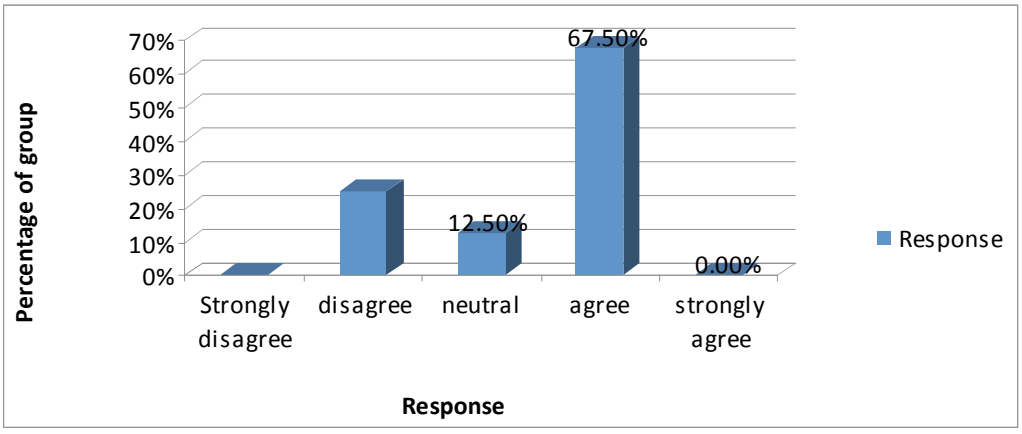

Figure 15. Satisfaction with location of physical hardware for operative note

15. I was happy that the electronic operative note was an accurate record of the procedure carried out in theatre.

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	**0 / 8**	**0 / 0**	**3 / 8**	**5 / 8**

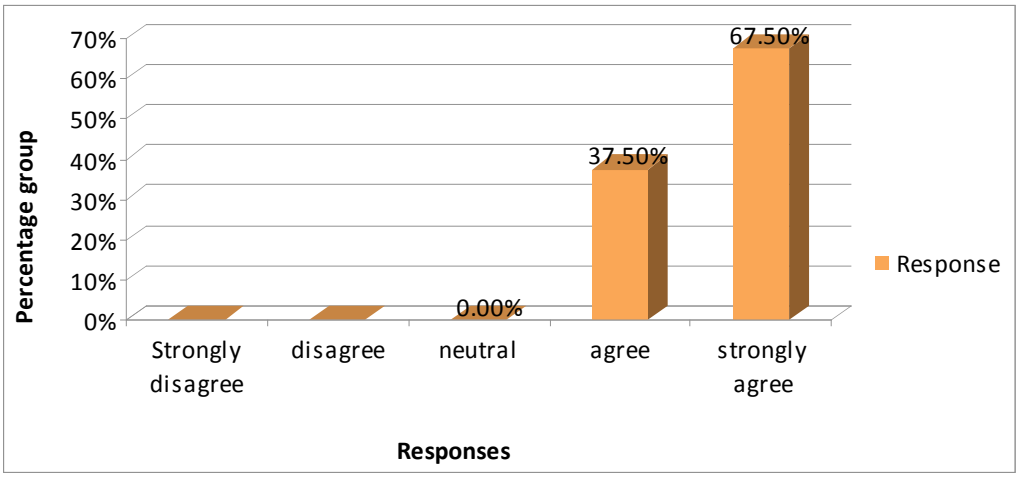

Figure16. Perceived accuracy of electronic operative record

16. Writing an electronic operative note takes longer than traditional handwritten note

Strongly disagree	*disagree*	*neutral*	*agree*	*strongly agree*
0 / 8	1 / 8	4 / 8	3 / 0	0 / 0

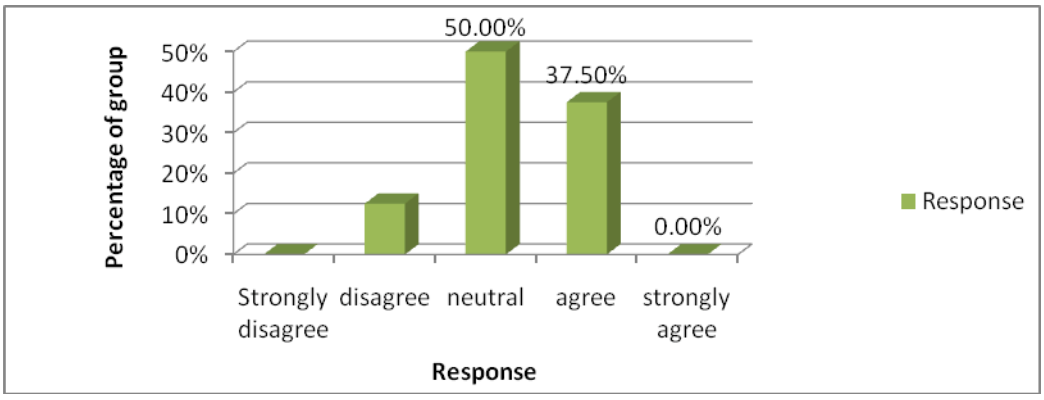

Figure 17. Writing an electronic note takes longer than a handwritten note

4.4 Discussion

Usability

This experiment aimed to observe whether the failure to use the operative note function was as a result of a system that was user unfriendly. When we looked at the usability of the system, a system the participants were largely familiar with, the participants were asked to create an operative note and print it out. Two problems emerged from this testing. Firstly, that the coding difficulties that exist at the submission of the theatre list are still present at the time of writing the operative note. 3 / 8 of the group felt that though the code did not necessarily match the operation, there was 'no point' checking again as they were familiar with the system and knew that a closer match to their desired operation title was not available. In all instances, the participants commenced the operative note by typing the title of the operation. There were no difficulties logging in to the system or recall of the steps to creation of a theatre note.

All users found the inputting of the procedure easy to do and in many instances these were merely transcribed from the original operation note. The current theatre system in use facilitates the production of an electronic patient record and there exist facilities for printing either in the theatre itself or in the main reception and this again was easy to use. In one instance paper was absent from the printer and the surgeon became frustrated, but this was easily remedied and was short-lived. Overall the user still had no problems with the creation of the operative note. Operative notes should be signed and dated by the surgeon, and this was missed by two of the group.

Survey

All eight participants completed the survey after their usability study in an attempt to gain information that had been missed or not observed. Overall, the mood of participants was positive, though coding and a lack of paper for the printer were the two most notable areas of aggravation to the user in the free text comments.

Plastic Surgery is largely a problem solving exercise and many operations are a combination of procedures or techniques. The users felt that these were deemed largely unsuitable for the direct classification system, and had more difficulty with the systems based idea. The users working with general surgery and urology felt the coding system to be more user

friendly. This is understandable given the constant nature of the elective cases and the standardised elective procedures e.g. Hartman's procedure for bowel obstruction or perforation.

Overall 87.5% of the group (n = 7) either strongly agreed or agreed with the statement ' I found the theatre management programme easy to use'. The entire group completed the two procedures asked of them and in addition one participant created three operative notes. In addition

In all the more junior staff felt that they were more amenable to using the typing facility and felt it easier to edit the notes and that they were more beneficial.

The location of computers was noted to be adequate with 62.5% (n = 5) happy with the location. Over 70% of participants were happy with the finished note (n = 5) and 75% (n = 5) found the amount of time taken to complete the electronic note was not appreciably longer than that of the traditional handwritten note.

4.5 Conclusion

The usability testing proved, though small problems existed, that the system for operative note production was usable. The main problems lay within the area of coding for the procedure. This is not unsurprising given that previous studies have shown coding to be a problem in the context of the modern healthcare environment as discussed in Chapter two. This may be overcome by clarifying the details of each procedure with the computer services department in an attempt to map the procedures back to ICD 10. This would most certainly better facilitate the surgeons' choice of code. In all however, the software system could not be cited as the reason for complete non- compliance with failure to use the operative note function on the theatre management system.

5. CHAPTER 5: EXPERIMENT 3—SURVEY OF NCHD'S

5.1 Aim

The aim of this experiment was to assess reasons why operative note recording is not utilised by surgeons within a pre existing theatre management system in two separate institutions (Hospitals A and B).

My aim was to evaluate perceptions of the current theatre system in terms of utilisation of current functions and to assess what difficulties may exist within the system. I aimed to assess the success of this theatre programme from a user perspective. In this sense 'usability' pertains to the surgeon uploading the theatre list and using the operative note function. In each institution, the theatre list must be uploaded the day before surgery for all elective cases. When uploading a suitable code must be found for procedures and coupled with the patient details.

5.2 Method

The intention of the study was to gather surgeons' opinions in relation to the theatre system, specifically that of the operative note function.

The questionnaire (Appendix 9.9) consisted of both closed and open questions. The initial questions were closed and sought to gather demographic information (questions 1 – 3). The remainder of the survey sought to assess the opinions of those who had taken part in the study by means of an 'attitudinal' line of questioning. The majority of questions were scored according to a Likert scale. This is most appropriate for a spectrum of responses such as those sought here. A survey was chosen as the operative note function was not currently in use in either institution. Forty participants agreed to complete the questionnaire out of 52 who were approached. The questionnaire was self administered, having approached the participants directly in the theatre complex of both Hospital A and B.

The participants were asked to complete the questionnaire immediately if possible, or to return directly to the author within the week if they anticipated a delay in its completion. Verbal reminders were delivered at the completion of the week.

The survey was divided into three main areas: demographics (questions 1 to 3) previous experience of the theatre management system (questions 4 to 9), perception and experience of support structures in place (questions 10 to 14) and likelihood of using the system in the future (question 15).

Results were compiled using an excel spreadsheet and percentages obtained.

5.3 Results

40 surgeons, out of a possible 52 returned the completed surveys, 20 from each institution, giving a response rate of 78%. Surveys were handed out personally in the coffee room and in the operating theatre over the period of two weeks in February 2009 and collected during the same month. Reminders for completion were given on a weekly basis, though the majority of questionnaires were completed on fist distribution. All surveys were anonymous and the participants were aware that the survey was for research, and most importantly that the author had no vested interest in their responses in terms of the theatre management system or its use on a daily basis. Only one consultant completed the questionnaire, but as this was incomplete it was excluded from analysis. All the surveys once fully completed were returned to the author. Results were analysed by institution and then in combination.

Results are displayed in terms of the question asked and then responses by institution and in combination immediately following the article involved.

1. Are you?

	Male	*Female*
A.	10 / 20	10/ 20
B.	15 / 20	5 / 20
Comb.	25 / 40	15/ 40

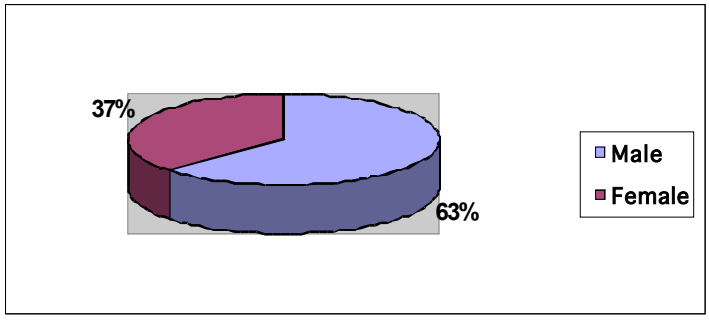

Figure 18. Sex of participants for both centres

2. What age group are you in?

	21 – 25	*26 – 30*	*31 – 35*	*36 – 40*	*41 – 45*
A.	5/ 20	10 / 20	5/ 20	0 / 20	0 / 20
B.	2/ 20	12 / 20	4 / 20	2 / 20	0 / 20
Comb.	7 / 40	22 / 40	9 / 40	2 / 40	0 / 40

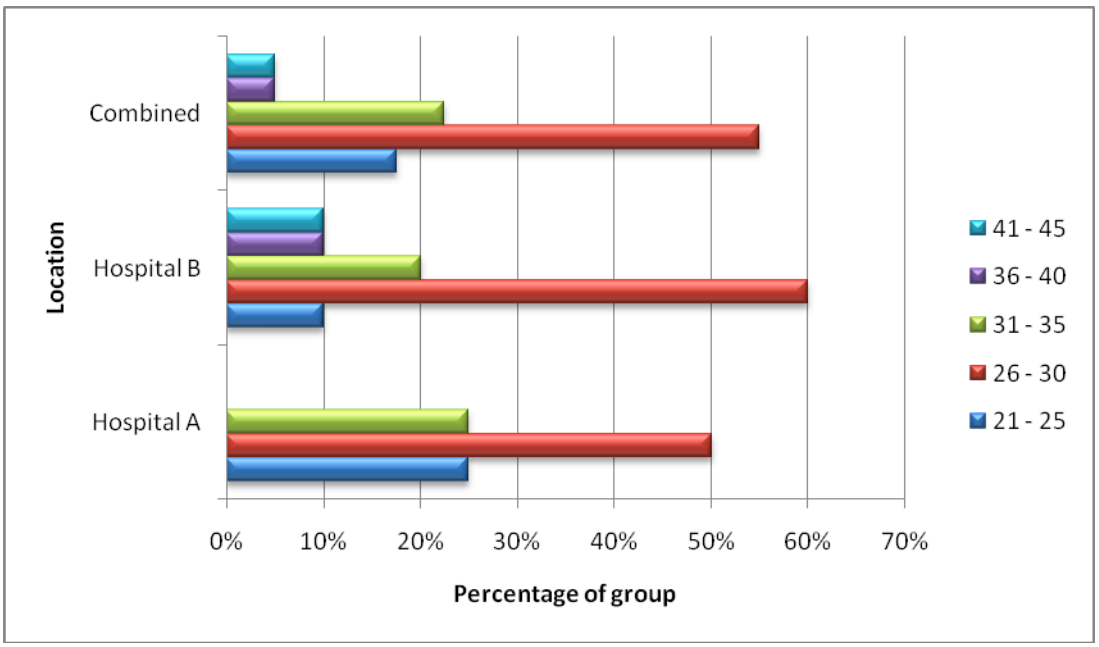

Figure 19. Numbers of respondents by age group in percentage

3. What level of training are you currently employed?

SpR *Registrar* *SHO*

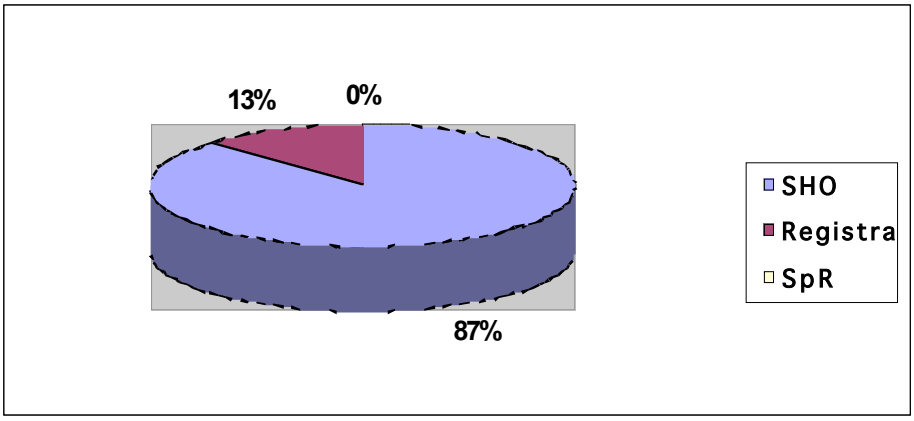

Figure 19. Level of training of participants

4. Have you ever completed an operative note in the theatre management system?

Yes	*No*
0 / 40	40 / 40

5. If yes, how many notes have you completed on the management system?

There were no responses to this question as not one of the participants had completed an operative note.

6. Do you find the theatre list easy to upload?

	Impossible	*difficult*	*neutral*	*easy*	*simple*
A	0 / 20	6 / 20	10 / 20	2 / 20	2 / 20
B	0 / 20	12 / 20	10 / 20	8 / 20	0/ 20
Comb	0 / 40	18 / 40	20 / 40	10 / 40	2 / 40

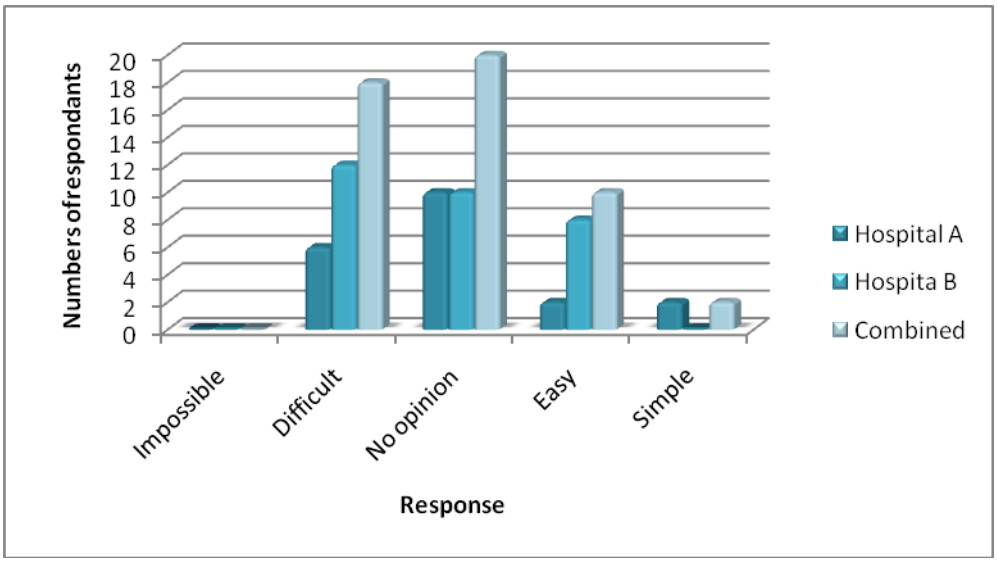

Figure 20. Perception of ease of use of the theatre management system

7. Are the codes easy to find?

	Impossible	*difficult*	*neutral*	*easy*	*simple*
A	0 / 20	8 / 20	2 / 20	10 / 20	0 / 20
B	0 / 20	6 / 20	8 / 20	6 / 20	0 / 20
Comb	0 / 40	14 / 40	10 / 40	16 / 40	0 / 40

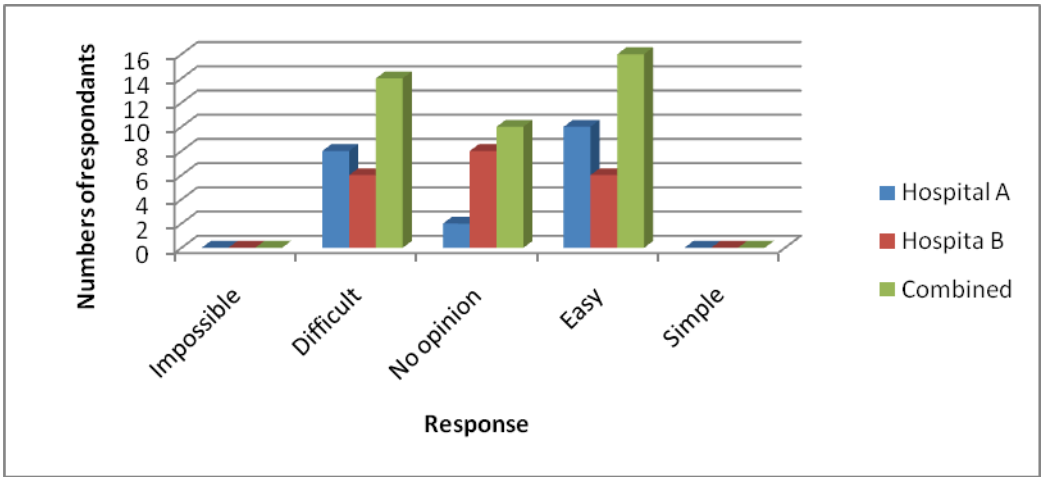

Figure 21. Ability to find codes easily

8. Do the codes correspond to the expected procedure?

	Never	*infrequently*	*sometimes*	*mostly*	*always*
A	0 / 20	1 / 20	5 / 20	14 / 20	0 / 20
B	0 / 20	1 / 20	7 / 20	12 / 20	0 / 20
C	0 / 40	2 / 40	12 / 40	26 / 40	0 / 40

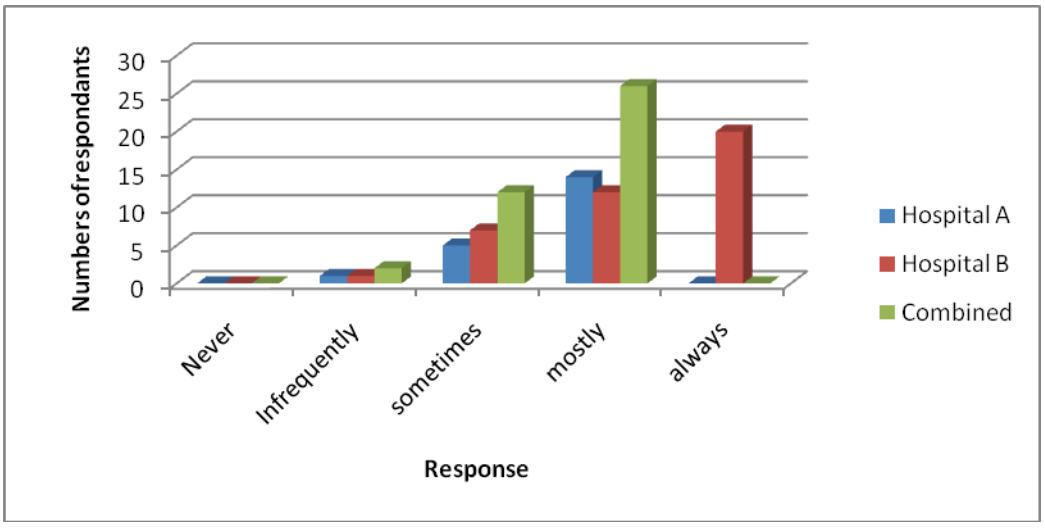

Figure 22. I found the programme easy to use

9. Are the patient details easy to find?

	Impossible	*difficult*	*neutral*	*easy*	*simple*
A	0 / 20	5 / 20	6 / 20	4 / 20	5 / 20
B	0 / 20	0/ 20	7 / 20	6 / 20	7 / 20
Comb.	0 / 40	5 / 40	13 / 40	10 / 40	12 / 40

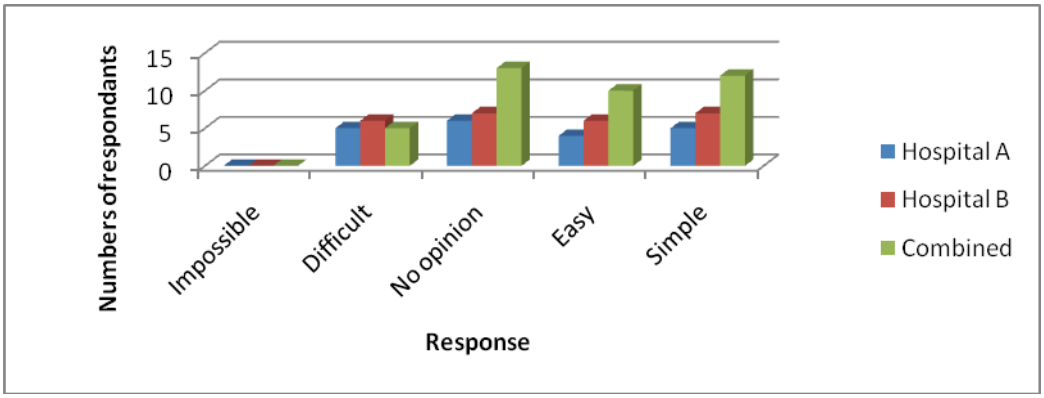

Figure 23. Details of patients

10. Did you receive any training on the programme?

	None	*Yes, but insufficient*	*Yes, sufficient*
A	10 / 20	6 / 20	4 / 20
B	15 / 20	5 / 20	0 / 20
Combined	25 / 40	11 / 40	4 / 40

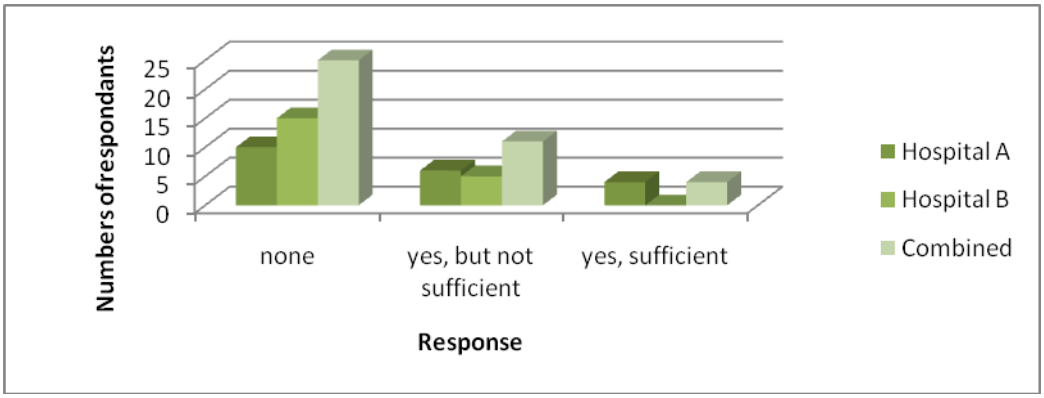

Figure 23. Training received for software by institution

11. Who taught you how to use it?

	Theatre sister	*Theatre super.*	*IT services*	*Colleague/ NCHD*
A	0 / 20	4 / 20	5 / 20	11 / 20
B	1 / 20	7 / 20	2 / 20	10 / 20
Comb	1 / 40	11 / 40	7 / 40	22 / 40

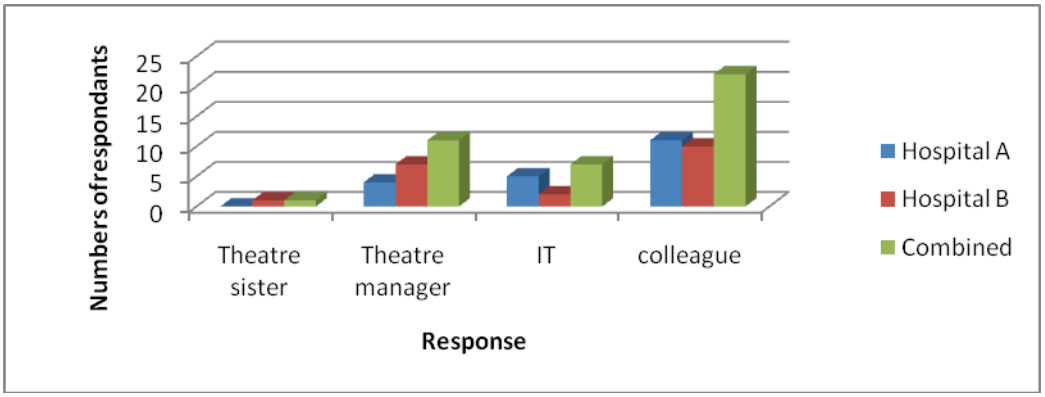

Figure 24. I found the programme easy to use

12. Have you ever contacted IT support for help?

	Never	*rarely*	*sometimes*	*often*	*always*
A	0 / 20	12 / 20	8 / 20	0 / 20	0 / 20
B	1 / 20	15 / 20	3 / 20	1 / 20	0 / 20
Comb.	1 / 40	27 / 40	11 / 40	1 / 40	0 / 40

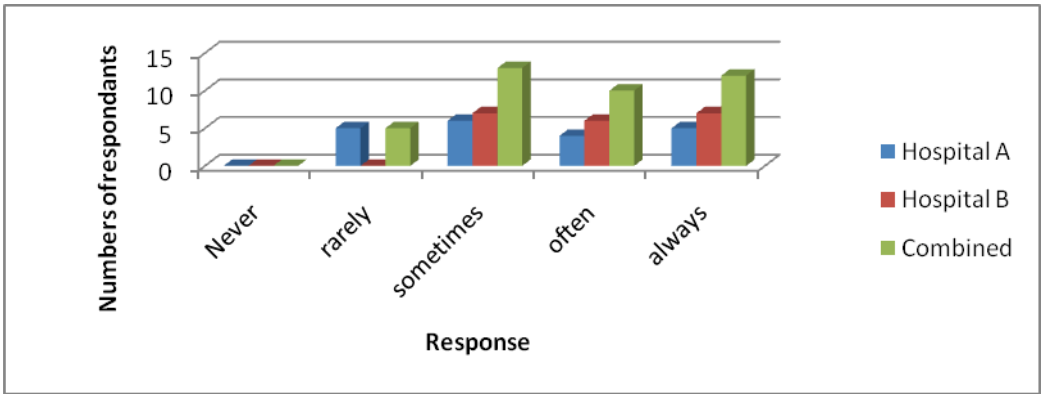

Figure 25. Previous interaction with IT regarding theatre management system

13. Have you ever contacted any of the following people for help?

	Theatre sister	*Theatre super*	*IT services*	*Colleague*
A	1 / 20	0 / 20	1 / 20	15 / 20
B	3 / 20	2 / 20	3 / 20	12 / 20
Comb	4 / 40	2 / 40	4 / 40	27 / 40

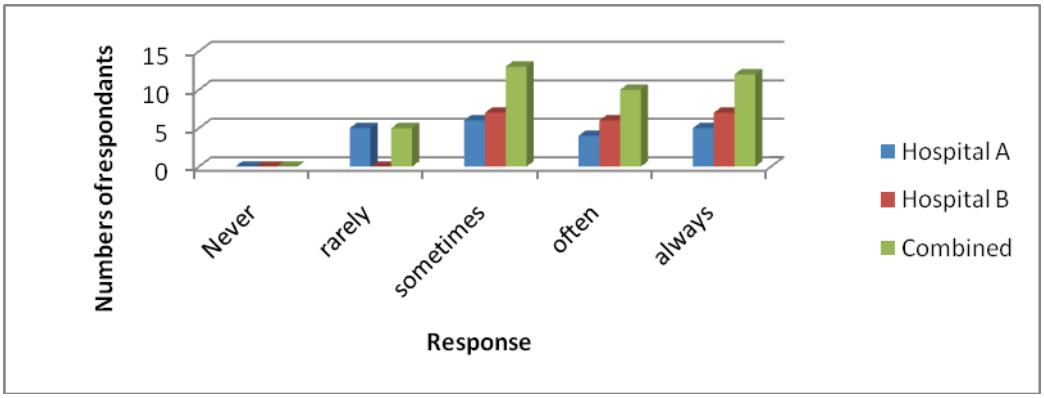

Figure 26. Groups previously contacted for support

14. Who would you most likely contact in the even you had difficulties with the system?

Theatre sister	*Theatre superintendent*	*IT services*	*Colleague/ NCHD*
2 / 20	0 / 20	5 / 20	15 / 20
1 / 20	0 / 20	6 / 20	14 / 20
3 / 40	0 / 40	11 / 40	29 / 40

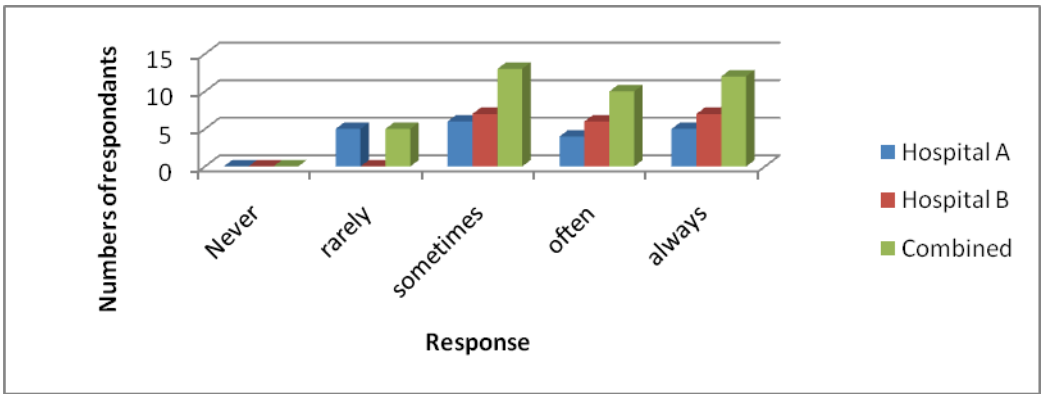

Figure 27. Most likely support

15. Would you be prepared to use the theatre management system to complete the operative note?

	Never	*rarely*	*sometimes*	*often*	*always*
A	0 / 20	0 / 20	5 / 20	14 / 20	1 / 20
B	0 / 20	2 / 20	3 / 20	4 / 20	11 / 20
Comb.	0 / 40	2 / 40	8 / 40	18 / 40	12 / 40

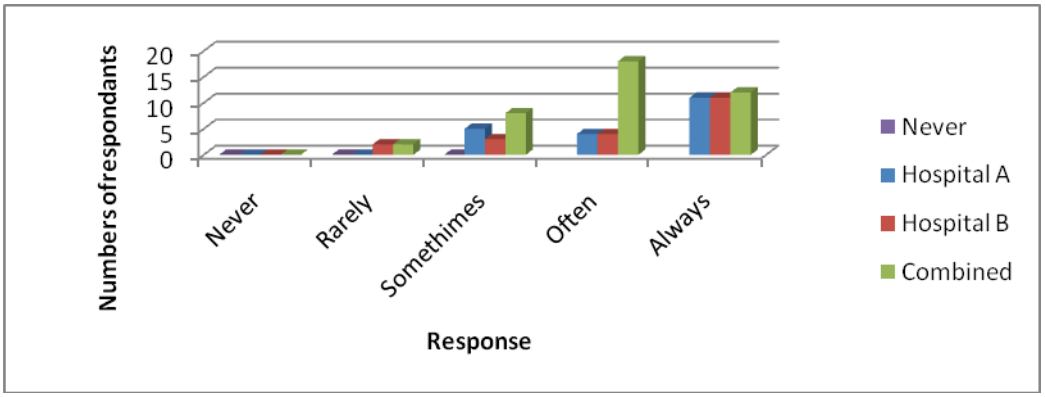

Figure 28. Prediction of future use of theatre management system

5.4 Discussion

The major findings of this study revealed dissatisfaction with current coding of surgical procedures and a lack of user support for the operative note function in both institutions.

Many of the comments in the free text section pertained to the fact that their consultant had never used the programme and as surgery is largely an apprentice modelled specialty the written operative note was completed as their consultant had done. In discussions with computer staff at the commencement of this dissertation, opinions existed that surgical staff had been slow to become involved in the procurement of a theatre management system, and in line with the literature, the lack of ownership translated into a lack of support on the ground for the system.

Interestingly not one of those surveyed had ever produced a surgical note using the theatre management system, indeed fifteen people included a comment that noted they did not know that the possibility existed to create a surgical note.

45% (n = 18) of the participants surveyed found the theatre list difficult to upload and the main difficulty resulted in the inability to find the appropriate code for the procedure. This difficulty with coding was also experienced with the usability study in the previous chapter.

The majority of participants, 62.5%, had had no previous training (n = 25/40) when using the system and over half the group had learned to use the theatre management system from colleagues or previous staff. (n = 22/40). In keeping with the previous findings on lack of support, 55% (n = 22) stated that they would first ask a colleague if they were having problems with the theatre management system, with a second choice being the compute services department 27.5%, (n = 11).

Interestingly, however over 75% (n = 30) of the group stated that they would be happy to use the theatre management system to create a surgical procedure note in the future.

5.5 Conclusion

The main findings from this survey do not differ between institutions. Though there are two separate theatre management systems, the findings in both institutions point to a lack of user support and a difficulty with coding procedures. This is understandable given that both institutions use ICD -10 as the basis for their coding system given problems previously discussed in Chapter two. In addition the lack of senior clinician support was evident from results and free text comments.

However, it was interesting to note that the majority of users would be prepared to use the theatre management system for note production if support was offered. This could be a potential method of supporting the project with a hope to fully implement the theatre management systems in both institutions.

6. CHAPTER 6: EVALUATION

This research aimed to examine the benefit of an electronic operative record for surgical procedures and then to assess the possible reasons why this function, though it exists in two separate hospitals, has never been used in the context of a theatre management system.

An operation note is written by the operating surgeon on assistant and is a legal and medical record of the procedure that took place. This document helps to inform postoperative management by other health care professionals, a safe and efficient hand over of responsibility to colleagues.

At present the hand written record is the only documentary evidence of the surgical procedure. At multiple levels this may cause serious problems. Operating notes contain not only the details of the procedure, but any complications which arose intra operatively and also the postoperative instructions which inform further management. As often happens, clinicians rely largely on personal knowledge and memory of a procedure in the event that the original notes are unable to be found for a clinic or hospital admission. This currently results in an inconvenience, but not a major problem, in Irish surgical practice as teams work long hours and are likely to be present during the patient's visit, regardless of when that may be. However, with the introduction of the European Working Time Directive and the need for a sift system for NCHD's, the need for effective and traceable documentation will assume an even greater importance. If the patient's clinical paper record is unable to be located, the electronic record will ensure a safe and appropriate method of information transfer.

The first part of the study concerned itself with the electronic surgical operation note and the potential benefits that this might generate. Though there was extensive literature to suggest that electronic patient prescribing was of benefit, no such literature exists for the surgical operation note specifically. To test the benefit of the electronic surgical record we created four operative surgical notes in both a handwritten and electronic format. We then asked a group of interns a series of questions based upon clinical management relating to the operation notes.

We found no statistically significant difference between the two groups, though results approaching significant levels were found when numbers were combined between procedures for the areas of legibility and post operative management decisions. This may largely be due to the small sample size (n = 20). A further experiment with larger numbers would be warranted. The point had been made however, that though the numbers showed no definitive statistical significance, the trend in favour or the electronic surgical record when compared to the hand written alternative should be taken in the context of patient safety. In this way, results may be deemed to have significance, if not statistically so. Therefore when viewed within the context- the results are somewhat more significant than the raw numbers may reveal.

The second of the experiments concerned itself with the reasons why the electronic surgical note function is not used in two separate hospitals with two different theatre management programmes in situ. We hypothesised that one of two factors could impact upon the failure of this application. It could either have been a problem with the system itself, the usability of the system, or a deficit in the support or management of the system.

To investigate the first arm of this hypothesis, eight volunteers were chosen as candidates for a usability test for the operative note function in Hospital A. The usability test was undertaken under four separate headings, performance, accuracy, recall and emotional response. The system scored well in all areas with the exception of the coding of the surgical procedure. One could conclude therefore that there was not a major problem with the system itself, or its usability, that would cause the failure of this system. This was not surprising considering that the theatre management system had been used successfully already to plan and manage surgical procedures in the institution for three years.

The second arm of this experiment sought to investigate if there were any problematic areas in the system that had been missed in the observed usability test. To investigate this we surveyed those that had used the system and enquired whether they found the system user friendly and if there were any particular problems that could be addressed. We found that the test group were largely happy with the system, though the issue of difficulty finding appropriate codes for procedures was a concern for over half the group.

The difficulties the participants encountered while coding procedures resonates with international research on the area as previously discussed. However, many noted in comments that they would be happy to assist programmers introduce new codes for their speciality. The issue of the need to draw a surgical diagram also arose in the comments and in discussion with the author during tutorials. This issue has not been discussed in the literature and the current solution was to complete the diagram on the printout of the operative note. This however, is not ideal as it is not recorded conclusively within the management system and therefore lends itself to the same difficulties encountered with the handwritten operative note. This, particularly for problem- solving specialities such as Plastic Surgery which may not use standardised procedures, is a salient deficit and one which requires further research.

The final experimental chapter dealt with general perception and experience of the theatre management system within two separate hospitals. Forty NCHD's were surveyed and questioned with regard to their experience of the system. Interestingly not one of the forty had ever used the operative note function and many were unaware that the function existed.

Findings were comparable between the two institutions, despite using a different theatre management system. The main findings included a perception of a lack of support and a difficulty coding the procedure as previously described. A large proportion had not received any specific training on the theatre management system and were unaware as to what support was available should they require help in the future.

Both institutions failed to have dedicated training for NCHD's in the use of the theatre management system. In Hospital A, a common password was used to complete the theatre list. Information technology training in Irish hospitals is a difficult problem as staff can change every 6 months. Induction days are difficult to run with information overload becoming an ever increasing problem as information technology joust with health and safety, risk management and human resources for time at the induction; this competing with clinical responsibilities running parallel. One may extrapolate that the difficulty in available time at induction has resulted in a poor dissemination of training information for the NCHD's with respect to health informatics initiatives.

The failure of informatics solutions due to lack of support and clinical leadership is a common theme in the literature, and therefore in line with international findings.

7. CHAPTER 7: CONCLUSION

There are numerous examples of poorly designed or barely usable software applications in healthcare. However in this instance, the application in both institutions is in use, but one particular feature, that of the operative note recording, is not currently used. Overall in both institutions, the management system has been successfully used to manage time and ordering of the theatre list in addition to electronically submitting theatre lists with coding embedded.

Premade software packages can be used successfully within a healthcare environment as the process of a surgical operation grossly remains the same i.e. a patient is reviewed preoperatively by a surgeon, placed on the theatre list, reviewed by anaesthetics and then comes to theatre. However, practices can differ between institutions. In addition some surgical specialities lend themselves to strict tiered documentation and recording more than others. For example, a more problem solving based surgical speciality, such as plastic surgery, may have an armament of common procedures to deal with reconstructive challenges but may have to modify these and alter the procedures to fully reconstruct a soft tissue defect. These procedures may be more difficult to classify and diagrams are more necessary to clearly document the surgical procedure. In this way a system needs to be flexible and allow for change.

Whilst we have not shown conclusively that the electronic surgical operative record confers conclusive or statistically significant benefits to patient safety, the trends show in the results would warrant a larger scale study with statistically powered results. We were unable to increase numbers of participants as the actual number of inters in the institutions was too small, even if 100% of those invited to participate had volunteered. Importantly, results for this experiment pointed to the possibility that the operative note would improve adherence to a discharge plan. One might speculate that if more senior clinicians had been asked to participate in the study that this potential difference would be less obvious. Most surgical procedures have a standard post operative management and the more senior clinicians may have used their own knowledge of the procedure and its natural history to inform post operative management in the event that the handwritten note was unclear. On principle however, and in keeping with previous studies in other areas of healthcare, the exclusion of handwritten records and the potential for illegibility results in reduced medical errors and an improvement in patient safety.

The failure of the operative note function can largely be attributed to three major factors, lack of ownership, lack of clinical support and lack of training. The lack of clinician involvement during the procurement phase contributed largely to the lack of ownership. Surgeons involved in the process stated that meetings were scheduled at times they were unlikely to be available and were only asked to contribute toward the end of the procurement phase. The need for ownership of a system to ensure its success has been noted in previous research. Interestingly, however, with the two systems in place- they are used in theatre. One may extrapolate then that a lack of ownership by clinicians was further compounded by a lack of support in theatre.

Both institutions lacked clinical leadership by the operating surgeons. None of the consultant surgeons used the system and therefore failed to direct the NCHD's to use the system. In an apprenticeship based training, junior surgeons will in most instances follow the lead of their consultant. With no such lead, the NCHD's continued to complete a hand written record of the operative procedure.

Through the course of this research we have established that the electronic surgical record is likely to be a safer alternative to the traditional handwritten note. In addition the failure of an surgical operation note function to be used in an existing theatre management system was due in part to a lack of clinical leadership and a lack of training and support and was not due to a failure of the system itself. This function still has the potential to be used in both institutions provided the necessary user support and training are instigated. Overall, the use of this function would be beneficial to patient care.

8. REFERENCES

1. Agrawal A, Wu WY. (2009)Reducing medication errors and improving systems reliability using an electronic medication reconciliation system. *Comm J Qual Patient Saf.* 2009 Feb;35(2):106-14.

2. Bemmel, J.H., Musen M.A. (1997). *Handbook of Medical Informatics.* Houten, Springer

3. Berg, M. (2004). Patient care information systems and health care work: a sociotechnical approach. *International Journal of Medical Informatics*, Volume 55, Issue 2, Pages 87-101

4. Berwick D.M., Winickoff, D.E. (1996) The truth about doctors' handwriting: a prospective study. *British Medical Journal* 1996; 313: 1657-8.

5. Bowen, G. (1997). Cognitive evaluation: How to assess the usability of information technology in healthcare. *Computer Methods and Programs in Biomedicine*, Volume 54, Issue 11 Pages 19-28

6. Bozzelli, M.B., Price, J. (2009) Streamlining the OR. *AORN J*. 2009 Jul;90(1):103-7

7. Caulton, D.A., (2001) Relaxing the homogeneity assumption in usability testing. *Behaviour & Information Technology*, 2001. 20(1): p. 1-7

8. Charatan F. (2000) Compensation awarded for death after illegible prescription. *West J Med.* 2000 Feb;172(2):80

9. Christian, C., Gustafson, M., (2001) A prospective study of patient safety in the operating room *Surgery*, Volume 139, Issue 2, Pages 159-173

10. Coiera, E. (2003). *Guide to Health Informatics*. Oxford, Oxford University Press

11. Cowan DA, Sands MB,(2007) Electronic templates versus dictation for the completion of Mohs micrographic surgery operative notes. *Dermatol Surg.* 2007 May;33(5):588-95.

12. Daniel K Sokol and Samantha Hettige (2006). Poor handwriting remains a significant problem in medicine *J R Soc Med*. 2006 December; 99(12): 645–646

13. David C. Goff, D.C., Pandey, D.K., (2000) Congestive Heart Failure in the United States. Is There More Than Meets the I(CD Code)? *Arch Intern Med*. 2000;160:197-202

14. Dumas, J.S. and Redish, J.C. (1999). *A Practical Guide to Usability Testing* (revised ed.), Bristol, U.K.: Intellect Books

15. European Working Time Directive 2003/88/EC

16. Frame, J., Watson, J. (2008) Deploying a Culture Change Programme management approach in support of information and communication technology developments in Greater Glasgow NHS Board *Health Informatics Journal*, Jun 2008; vol. 14: pp. 125 – 139

17. Henderson, J. Toni B.S. (2006) Quality of Diagnosis and Procedure Coding in ICD-10 Administrative Data. *Medical Care*: November 2006 - Volume 44 - Issue 11 - pp 1011-1019

18. Hirshborn C.(2000) Poor penmanship costs MD $225,000.*CMAJ.* Jan 11;162(1):91

19. Hovenga, E., Kidd, M. (1996) *Health Informatics: an overview*. Melbourne, Churchill-Livingstone

20. http://www.engitech.ie/OperRoom_Brochure.pdf?12012005 (accessed 11 September)

21. http://www.stjames.ie/AboutUs/History/ (accessed 3rd September 2009)

22. http://www.usability.gov/analyze/goals.html (accessed August 27 2009)

23. Hysong S.J, Sawhney M.K., (2009) Improving outpatient safety through effective electronic communication: a study protocol. *Implement Sci*. 2009 Sep 25;4(1):62

24. Johnson, C.W. (2006)Why did that happen? Exploring the proliferation of barely usable software in healthcare systems *Qual Saf Health Care.* Dec;15 Suppl 1:i76-81

25. Jones GJ, Vanderpump MP, Easton M, Baker DM, Ball C, Leenane M, O'Brien H, Turner N, Else M, Reid WM, Johnson M. (2004)Achieving compliance with the European Working Time Directive in a large teaching hospital: a strategic approach. *Clin Med*. 2004 Sep-Oct;4(5):427-30.

26. Krall, M.A., Chin, H., Dworkin, L., Gabriel, K., Wong, R.. (1997) 'Improving clinician acceptance and use of computerized documentation of coded diagnosis'. *Am J Manag Care.* Apr;3(4):597-601.

27. Kushniruk, A.W., (1997) Usability testing in medical informatics: cognitive approaches to evaluation of information . AMIA Annual Fall Symposium

28. Kushniruk, V.L., Patel, A.W. (1997) Usability testing in medical informatics: cognitive approaches to evaluation of information systems and user interfaces. Proc AMIA Annu Fall Symp. 1997; 218–222.

29. Laflamme, M.R., Dexter P.R., Graham ,M.F., Hui, S.L., McDonald, C.J. (2005) Efficiency comprehensiveness and cost-effectiveness when comparing dictation and electronic templates for operative reports. AMIA Annu Symp Proc. 2005:425-9.

30. Lefter LP, Walker SR, Dewhurst F, Turner RW. (2008) An audit of operative notes: facts and ways to improve. *ANZ J Surg.* 2008 Sep;78(9):800-2.

31. Littlejohns, P. (2003**)** Evaluating computerised health information systems: hard lessons still to be learnt. *British Medical Journal* 2003;326:860-863

32. Lorenzi, N.M., Riley, R. (2009) Antecedents of the People and Organizational Aspects of Medical Informatics. *J. Am. Med. Inform. Assoc.*, July ; 16(4): 550 – 560

33. Lorenzi, N.M. (2002) Organizational ISSUES=change. *International Journal of Medical Informatics*, Volume 69, Issue 3, Page 197

34. McDaniel, JG. (2002) Improving system quality through software evaluation.. *Comput Biol Med*. May;32(3):127-40.

35. McKeown, Celine (2008). *Office ergonomics: practical applications*. Boca Raton, FL, Taylor & Francis Group, LLC.

36. "Newgate technology" http://newgatetechnology.co.uk/theatre.aspx (accessed 1September 2009)

37. Nielsen, J. (1994), *Usability Engineering*, Morgan Kaufmann Publishers

38. Nielsen, J. (1994). Usability Engineering, Academic Press Inc, p 165

39. Page, D. (2009) Patient care. Taking the guesswork out of scheduling surgeries. *Hosp Health Netw*. Jun;83(6):12.

40. Pantazi, A., Kushniruk, J. (2006) The usability axiom of medical information systems *International Journal of Medical Informatics*, Volume 75, Issue 12, Pages 829-839

41. Picardi EJ, Peoples JB. (1991) Mesenteric venous thrombosis: ten year record review and evaluation of difficulties with the ICD coding system.S D J Med. 1991 Feb;44(2):33-7.

42. Rogers A, Bunting M, Atherstone A (2008) The quality of operative notes at a general surgery unit. *S Afr Med J*. 2008 Sep;98(9):726-8.

43. Schmettow, Heterogeneity in the Usability Evaluation Process. In: M. England, D. & Beale, R. (ed.), Proceedings of the HCI 2008, British Computing Society, 2008, 1, 89-98

44. Scholtz, J. , Laskowski, J, (2005) - Usability Testing in Medical Informatics: Cognitive Approaches to Evaluation of Information Systems and User Interfaces. Proceedings of the 4th Conference on Human Informatics.

45. Shayah A, Agada FO, Gunasekaran S, Jassar P, England RJ. (2007) The quality of operative note taking: an audit using the Royal College of Surgeons Guidelines as the gold standard. *Int J Clin Pract*. 2007 Apr;61(4):677

46. Southon, G., Sauer, C. (2003). Lessons from a failed information systems initiative: issues for complex organisations. *International Journal of Medical Informatics*, Volume 55, Issue 1, Pages 33-46

47. Stevenson, K.B. Barbera, J. W., (2005) Understanding Keys to Successful Implementation of Electronic Decision Support in Rural Hospitals: Analysis of a Pilot Study for Antimicrobial Prescribing. *American Journal of Medical Quality, November* 1, 2005; 20(6): 313 – 318

48. Van de Castle, B. Kim, J., (2004)**.** Information technology and patient safety in nursing practice: an international perspective. *International Journal of Medical Informatics*, 32:14- 45

49. Virzi, R.A., (1990) Streamlining the design process: Running fewer subjects. *Human Factors and Ergonomics Society Annual* 1990

50. Virzi, R.A., (1992) Refining the Test Phase of Usability Evaluation: How Many Subjects is Enough? *Human Factors*, 1992. 34(4): p. 457-468.

51. Wickens, C.D et al. (2004). *An Introduction to Human Factors Engineering* (2nd Ed), Pearson Education, Inc., Upper Saddle River, NJ : Prentice Hall.

52. William R. Hersh, MD (2002) Improving Health Care Through Information. *Journal of the American Medical Association.* 2002;288:1955-1958

53. Wockenfuss R, Frese T, Herrmann K, Claussnitzer M, Sandholzer H. (2009) Three- and four-digit ICD-10 is not a reliable classification system in primary care. *Scand J Prim Health Care*. 27(3):131-6.

54. Wyatt, J. (1995) Hospital information management: the need for clinical leadership *British Medical Journal* 1995;311:175-178 (15 July)

55. Zielinski, K. Duplag, M., (2006) *Information technology solutions for healthcare*. London, Springer-Verlag

9. APPENDICES

9.1 Operative note I

Name	John Kelly
D.O.B.	14.5.50
MRN	134254
Consultant Surgeon	Mr. Byrne
Consultant Anaesthetist	Dr. Ahmed
Surgeon	K. Byrne
Assistant	L. Seoighe
Anaesthetist	D. Browne
Scrub nurse	S/N Ohmed
Procedure	ORIF fractured left tibia

GA
Tourniquet 350 mmHg x 58mins
Supine
Standard paint and drape- betadine

4cm longitudinal incision over medial aspect right lower limb.
Fracture exposed and reduced under image guidance
Periosteum left intact
Reduced using AO clamp and fixed using 5 hole plate, 3 x 4mm lag screw.
Washout ++ betadine and NaCl
Tourniquet released
Haemostasis ensured using bipolar diathermy
Closure to skin 3/0 vicryl and 4/0 monocryl to skin

Dressing
Mepore
Wool
PoP backslap- foot dorsiflexed
Cling

Post op

Non-weight bearing

r/v OPD x 1/52 with X-ray

po augmentin x 1/52

Signature L. Seoighe, Surgical SHO on call

Bleep 356

9.2 Operative note II

Name	Grainne Deane
D.O.B	32.7.09
MRN	3329504
Consultant Surgeon	Mr. J. Kneafsey
Consultant Anaesthetics	Dr. M. Moore
Operator	Mr. B. Mongan
Assistant	Dr. L. Keane
Scrub Nurse	S/N N. McCauley
Procedure	Emergency laparascopic appendicectomy

GA
Supine
Standard paint and drape, betadine
LA 0.5% marcain + adrenaline 1/200,000

Horizontal umbilical incision
Blunt dissection to rectus sheath
Sharp dissection through sheath
Peritoneum breached, finger sweep to ensure clearance of small bowel
12mm port inserted (blunt). C02 insufflated- no difficulty
2 x 10mm ports inserted under direct vision suprapubic and LIF
Pus++ noted at RIF
Blunt dissection of appendix- perforation noted. Faecal material in peritoneum
Base of appendix dissected.
Artery ligated using clips
2 x suture loop to base of appendix. Appendix removed under direct vision through umbilical port using bag.
Washout ++ to peritoneum NaCl ++
Haemostasis ensured
Removal of ports under direct vision

Closure

Sheath closed with 3/0 prolene J suture

Skin clips to port sites

Mepore dressing x 3

Post op

Continue IV ABX x 48 hours, then po x 7/7

Light diet as tolerated

Continue IV fluids until adequate po intake

Removal of clips x 10/7

R/V OPD x 2/52

Signature M. Byrne

SHO Bleep 653

9.3 Operative note III

Name	Gerard Long
Date of Birth	12.12.32
MRN	123456
Consultant Surgeon	Mr. B. Ryan
Consultant Anaesthetics	Dr. L. Young
Operator	Mr. B. Manion
Scrub Nurse	S/N P. Birido
Procedure	TURP

Spinal Anaesthetic

Lithotomy position- legs held in stirrups

Rigid cystoscopy performed- both ureteric orifices identified- no stenosis. Bladder examined in full- NAD
Prostate- large lateral lobes.
TURP performed using loop diathermy. Bleeing +++
Washout standard glycerine wash.
Good passage remaining at finish
3 way 16 Ch silastic UC left in situ.
For continuous irrigation overnight.

Post op
Continue irrigation
Continue IV abx x 48 hours
Monitor for signs of urosepsis
Contact UROC if catheter clots off/ signs of retention

Signature B. Manion
UROC- 234

9.4 Operative note IV

Name	Shelly Long
Date of Birth	12.6. 65
MRN	5643231
Consultant Surgeon	Mr. B. Ryan
Consultant Anaesthetics	Dr. L. Young
Operator	Mr. B. Manion
Assistant	Ms. G. Maher
Scrub Nurse	S/N P. Birido
Procedure	Delayed right breast reconstruction- latissimus dorsi and implant

GA
Left lateral

Mastectomy scar excised and sent for histology
Skin paddle excised on back with knife. Latissimus dorsi dissected using monopolar diathermy. Fat pad in situ.
Muscle flap mobilised and pedicle dissected in axilla- flap well perfused, no signs of venous congestion.
Pedicle protected and flap pulled through under axilla to anterior chest wall.
Donor site closed 3/0 maxon and 4/0 monocryl in layers.- ¼ inch drain in situ.

Flap inset using 3/0 undyed vicryl. 320g implant placed using aseptic technique.
320 MM McGhan silicone implant left in situ.
Covered completely with muscle flap. Protected during inset- no puncture.
Skin closure to reconstruction 3/0 monocryl to deep, 4/0 monocryl subcuticular.

Dressings
Postop opsite
Mefix to anterior chest wall for support

Post op

Maintain drains on suction

Continue IV antibiotics while drains insitu.

Monitor BP/ Pulse for signs of haemorrhage

Monitor flap 2 hourly obs

Signature K. Hamill

Bleep 354

9.5 Questionnaire paper for interns based upon operative notes

Thank you for completing the following survey. It should take fewer than 3 minutes to complete. If you have any suggestions of questions please contact Katherine Browne at katheribrowne@rcsi.ie. Thank you.

You should complete two of these question papers, 1 for each operative note given, one written and one electronic copy.

Operative note	Lap appendix	Latissimus dorsi breast reconstruction
(Please circle)	ORIF ankle	TURP

Is the note?	Handwritten	Typed
(Please circle)		

I can read all of the patient details	true	false
I can read all of the surgeons details	true	false

1. Legibility
    a. I can read all of the note.
    b. I can read all of the note except 5 words
    c. I can read all of the note except 10 words
    d. I do not understand some of the procedure/post operative instructions due to illegibility?

2. How long would you continue
    a. IV antibiotics?
    b. Po antibiotics?

3. Is there anything that should be monitored overnight?

4. How often should it be monitored?

5. What is the follow up planned for discharge?

9.6 Scoring sheet for intern review of operative notes

Patient details	**1/0**	**(true or false)**
Operator details	**1/0**	**(true or false)**

1.

a. 4- fully legible

b. 3- legible excepting 5 words or fewer

c. 2- legible exception 10 words or fewer

d. 1- illegible

2. Name identified (1)

Patient identifier (MRN) (1)

3. Surgeon identified (1)

Surgeon identifier- medical council number (1)

4. All instructions (4)

Instruction but not time frame (3)

Partial instruction (2)

Limited/ instructions that are not helpful (1)

5. All instructions (4)

Instruction but not time frame (3)

Partial instruction (2)

Limited/ instructions that are not helpful (1)

9.7 Usability study of theatre management system

Candidate	1	2	3	4	5	6	7	8
Log on								
Select procedure								
Coding								
Type procedure								
Printing procedure								
Signing								
Patient chart								
Mental state								

1. Log on

Is the log on simple? Are there difficulties with passwords? Is the surgeon able to log on first time?

2. Select procedure

Is the surgeon able to select the procedure they were involved with? Does this open successfully?

3. Coding

Does the procedure match the code uploaded on the theatre list? Does the surgeon check the code? If the code needs to be changed is this easily done?

4. Typing procedure

Is the surgeon able to type the procedure easily. Is it easy to save the procedure and send it to the printer.

5. Printing

Is there a printer installed? Is it easy to print the completed operative note? Is the printer in close proximity to the computer terminal? Does the surgeon remember to sign the completed surgical note and file in the patient's chart?

6. Mental state

How is the surgeon's mood through out the completion of the electronic surgical record? Do they look hassled/ bothered/ annoyed/ anxious or frustrated? How is their mood at the completion of the record?

9.8 Questionnaire post tutorial and experience of surgical operative note using the theatre management system.

Thank you for completing the following questionnaire relating to your recent experience of the electronic operative record. This is part of an M.Sc. in Health Informatics at Trinity College Dublin. It should take fewer than 3 minutes to complete. If you have any suggestions of questions please contact Katherine Browne at katheribrowne@rcsi.ie. Thank you.

Please circle the answer that best applies to you in each question

1. Are you? *Male* *Female*

2. What age group are you in?

21 – 25 *26 – 30* *31 – 35* *36 – 40* *41 – 45*

3. What level of training are you currently employed?

SpR *Registrar* *SHO*

4. How many procedures did you complete on the theatre management system?

1 *2* *3* *4* *5*

5. I found the programme easy to use

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

6. I am comfortable with coding the procedure

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

7. I am comfortable with the location of the computer and printer

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

8. I am happy with the finished operative note

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

9. It takes much longer to complete the electronic operative note than the handwritten operative note.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

10. I had difficulty typing the operative note.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

11. I found the system easy to use.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

12. I was comfortable that the codes I chose were appropriate for the procedure.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

13. I had difficulty finding appropriate codes.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

14. I was comfortable with the location of the computer and printer.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

15. I was happy that the electronic operative note was an accurate record of the procedure carried out in theatre.

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

16. Writing an electronic operative note takes longer than traditional handwritten note

Strongly disagree *disagree* *neutral* *agree* *strongly agree*

17. Any other comments?

_____

_____

_____

_____

_____

Thank you for taking the time to complete this questionnaire.

9.9 Survey of NCHDs, users of theatre system

Thank you for completing the following questionnaire relating to the electronic operative record. This is part of an M.Sc. in Health Informatics at Trinity College Dublin. It should take fewer than 3 minutes to complete. If you have any suggestions of questions please contact Katherine Browne at katheribrowne@rcsi.ie. Thank you.

Please circle the answer that best applies to you in each question

1. Are you? *Male* *Female*

2. What age group are you in?

21 – 25 *26 – 30* *31 – 35* *36 – 40* *41 – 45*

3. What level of training are you currently employed?

SpR *Registrar* *SHO*

4. Have you ever completed an operative note in the theatre management system?

Yes *No*

5. If yes, how many notes have you completed on the management system? _____

6. Do you find the theatre list easy to upload?

Impossible *difficult* *neutral* *easy* *simple*

7. Are the codes easy to find?

Impossible *difficult* *neutral* *easy* *simple*

8. Do the codes correspond to the expected procedure?

Never *infrequently* *sometimes* *mostly* *always*

9. Are the patient details easy to find?

Impossible *difficult* *neutral* *easy* *simple*

10. Did you receive any training on the programme?

None *Yes, but insufficient* *Yes, sufficient*

11. Who taught you how to use it?

Theatre sister *Theatre superintendent* *IT services* *Colleague/ NCHD*

12. Have you ever contacted IT support for help?

Never ***rarely*** ***sometimes*** ***often*** ***always***

13. Have you ever contacted any of the following people for help?

Theatre sister ***Theatre superintendent*** ***IT services*** ***Colleague/ NCHD***

14. Who would you most likely contact in the even you had difficulties with the system?

Theatre sister ***Theatre superintendent*** ***IT services*** ***Colleague/ NCHD***

15. Would you be prepared to use the theatre management system to complete the operative note?

Never *rarely* *sometimes* *often* *always*

16. Any other comments please_____

Operative note writing: barriers to an electronic record and the possible implications for patient safety

Katherine M. Browne

Abstract

Background

At the conclusion of an operation it is practice for the operating surgeon to complete a note or record of the procedure. Many hospitals now possess electronic theatre management systems. However, moving paper based practice to an electronic work model is a challenge for all health informatics managers. Legibility has previously been shown to affect patient safety with respect to prescriptions, but such research is lacking in operative notes.

Aim

1. To investigate if electronically created operative notes improve patient safety when compared to traditional hand written operative notes.
2. To investigate the reasons why surgeons fail to use an electronic operative note function on existing theatre management systems in two separate institutions.

Methods

1. Four sample surgical procedure notes were created both on the theatre management system and identical records in traditional handwritten format. Pre-registration house officers were asked a range of questions based upon both electronic and handwritten records. Differences in responses were calculated using a chi squared test.
2. Operating surgeons were surveyed regarding their use and potential difficulties with the theatre management system in relation to an operative note creation in the two institutions.

Results

1. There was no statistically significant difference between the two groups of surgical operative notes; however the general trend of results favoured the use of an electronic patient surgical record.
2. The main factors for failure to use the theatre management system for creation of an operative note were related to lack of clinician ownership and leadership of the programme, lack of initial education and an absence of user support for the theatre management system.

Conclusion

The electronic operative record has the potential to improve patient safety. The main reasons for failure of surgeons to complete an electronic record were lack of clinical leaders, lack of technical support and difficulties with coding for procedures.

Operative note writing: barriers to an electronic record and the possible implications for patient safety

Katherine M. Browne

Abstract

Background

At the conclusion of an operation it is practice for the operating surgeon to complete a note or record of the procedure. Many hospitals now possess electronic theatre management systems. However, moving paper based practice to an electronic work model is a challenge for all health informatics managers. Legibility has previously been shown to affect patient safety with respect to prescriptions, but such research is lacking in operative notes.

Aim

1. To investigate if electronically created operative notes improve patient safety when compared to traditional hand written operative notes.
2. To investigate the reasons why surgeons fail to use an electronic operative note function on existing theatre management systems in two separate institutions.

Methods

1. Four sample surgical procedure notes were created both on the theatre management system and identical records in traditional handwritten format. Pre-registration house officers were asked a range of questions based upon both electronic and handwritten records. Differences in responses were calculated using a chi squared test.
2. Operating surgeons were surveyed regarding their use and potential difficulties with the theatre management system in relation to an operative note creation in the two institutions.

Results

1. There was no statistically significant difference between the two groups of surgical operative notes; however the general trend of results favoured the use of an electronic patient surgical record.
2. The main factors for failure to use the theatre management system for creation of an operative note were related to lack of clinician ownership and leadership of the programme, lack of initial education and an absence of user support for the theatre management system.

Conclusion

The electronic operative record has the potential to improve patient safety. The main reasons for failure of surgeons to complete an electronic record were lack of clinical leaders, lack of technical support and difficulties with coding for procedures.