

Expectations and Perceptions of Electronic Health Record Users: A Case Study

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

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university. I further declare that this research has been carried out in full compliance with the ethical research requirements of the School of Computer Science and Statistics.

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4 September 2012

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Summary

Electronic Health Records (EHR) are being touted as the perfect replacement for paper based patient records yet many researches show that adoption and success rate of this information technology is less than satisfactory. Researchers have identified critical success factors for successful EHR implementations. Involvement of users in system specification and evaluation of performance of EHR has been suggested in literature material as one key factor towards successful realisation of EHR benefits.

In the absence of a known one-size-fit-all EHR continuous evaluation method this research attempts to evaluate the performance of a local EHR (Electronic Client Record System (ECRS)) from the point of view of clinical users who provide a service for people with intellectual disabilities. The research compares pre-trained EHR users' level of benefit realisation expectations before they use the system and their subsequent perception level of benefit realisation after a few months of using the EHR system. A pre-usage questionnaire was initially distributed to participants drawn from a sample of convenience. After at least 8 weeks of the EHR usage a follow-up questionnaire was distributed to eligible participants.

Non-parametric statistics, Kruskal Wallis, Friedman, Anova, Wilcoxon and Spearman's rank order correlation were used to determine if there were significant differences and relationships between pre-usage levels of expectations and subsequent levels of perceptions.

The results showed that users maintained a high level of benefit realisation expectations at the end of data collection period. However participants also expressed dissatisfaction with the current level of performance of the EHR. The researcher designed and described a model based on reviewed literature to explain the research results. The model showed that the ECRS was overall rated to be operating just above the midpoint of EHR quality ratings and critical success factors ratings.

Further longitudinal data collection at regular intervals is recommended so that the information collected can be used to improve level of ECRS performance. The interpretation of the results was limited by the low response rate and the short time span between the two data collections.

Table of Contents

EXPECTATIONS AND PERCEPTIONS OF ELECTRONIC HEALTH RECORD USERS: A CASE STUDY	i
DECLARATION.....	ii
PERMISSION TO LEND AND/OR COPY	iii
ACKNOWLEDGEMENTS	iv
SUMMARY.....	v
TABLE OF CONTENTS.....	vi
TABLE OF FIGURES	ix
TABLES	x
ABBREVIATIONS.....	xi
1. INTRODUCTION	1
2 LITERATURE REVIEW.....	3
THE CHANGING PLAYING FIELD	3
ELECTRONIC HEALTH RECORDS (EHR)	5
POTENTIAL EHR BENEFITS AND VALUE.....	11
RISKS AND CRITICAL SUCCESS FACTORS ASSOCIATED WITH IMPLEMENTATION OF IT SYSTEMS....	18
USERS, THEIR EXPECTATIONS AND PERCEIVED BENEFITS	22
EVALUATION OF EHR SYSTEMS.....	25
LITERATURE CONCLUSIONS AND GAPS	31
3 RESEARCH QUESTION	34
3.1 RESEARCH QUESTION	34
4 RESEARCH METHODS.....	35
4.1 INTRODUCTION.....	35
4.2 RESEARCH METHODOLOGY	35
4.3 RESEARCH DESIGN:	35
4.4 THE TARGET POPULATION	36
4.4.1 The Frame Population.....	36
4.5 SAMPLE DESIGN	36
4.5.1 Sample Constructs	36
4.5.2 Sample Frame Inclusion Criteria	36
4.5.3 Exclusion Criteria.....	37
4.5.4 Sample Type.....	37
4.6 DATA COLLECTION INSTRUMENT: SURVEY METHODOLOGY.....	38
4.7 SURVEY DESIGN.....	38

4.7.1	Survey 1.....	38
4.7.2	Survey 2.....	40
4.8	CRITERIA FOR SCORING CATEGORIES OF BENEFITS VARIABLES	42
4.9	RELIABILITY AND VALIDITY OF THE QUESTIONNAIRES	43
4.10	ETHICAL APPROVAL.....	43
4.11	PARTICIPANTS RECRUITMENT PROCESS	43
5	RESULTS	44
5.1	FREQUENCIES OF THE RESPONDENTS	44
5.2	RESULTS FOR PARTICIPANTS' LEVEL OF BENEFIT EXPECTATIONS PRE-ECRS USAGE	48
5.3	RESULTS FOR PARTICIPANTS' LEVEL OF PERCEPTIONS OF BENEFITS DURING ECRS USAGE	54
5.4	COMPARISONS BETWEEN USERS' BENEFIT EXPECTATIONS AND PERCEPTIONS.....	57
5.4.1	Composite Benefit Ranks	61
5.4.2	The Difference between Mean Ranks of Users' Expectations and Perceptions.....	65
5.5	RELATIONSHIP BETWEEN BENEFITS.....	67
5.5.1	Survey 1.....	67
5.5.2	Survey 2.....	68
5.6	PARTICIPANTS' SELF-IDENTIFIED BENEFITS OF USING ECRS.....	70
5.7	PARTICIPANTS' EXPECTATIONS ON ECRS FEATURES	71
5.8	RELATIONSHIP BETWEEN PROFESSIONS AND BENEFIT EXPECTATIONS.....	72
5.9	RELATIONSHIP BETWEEN AGE AND BENEFITS EXPECTATIONS.....	72
5.10	OTHER FINDINGS.....	76
6	ANALYSIS OF RESULTS.....	78
6.1	RESPONSE RATE AND RESPONSE METHODS	78
6.2	USERS' LEVEL OF EXPECTATIONS OF BENEFITS TO ARISE FROM ECRS USAGE (SURVEY 1) ..	78
6.3	USERS PERCEPTIONS ON BENEFITS REALISATION DURING EARLY ECRS USAGE (SURVEY 2) ..	79
6.4	COMPARISON OF USERS' PRE-ECRS USAGE BENEFIT EXPECTATIONS AND PERCEPTIONS...	79
6.5	RELATIONSHIP BETWEEN BENEFITS AND OTHER VARIABLES.....	89
6.6	ECRS STATUS AND RELATIONSHIP ANALYSIS	89
6.6.1	Relationship between pre-implementation factors and pre-usage expectations.....	89
6.6.2	Relationship between Users Perceptions during ECRS Usage and Quality of EHR.....	90
6.6.3	The EHR Implementation Matrix	91
7	CONCLUSION.....	94
	LIMITATIONS	95
	FUTURE RECOMMENDATIONS.....	95

REFERENCES	97
APPENDICES	106
APPENDIX 1: ENTERPRISE SYSTEM BENEFIT NETWORK.....	106
APPENDIX 2: MEASUREMENT FOR PERCEIVED USEFULNESS AND PERCEIVED EASE OF USE.....	109
APPENDIX 3: METHODOLOGIES FOR EVALUATING SOCIOECONOMIC IMPACT OF EHR SYSTEMS.....	110
APPENDIX 4: SURVEY 1.....	112
APPENDIX 5: SURVEY 2	119
APPENDIX 6: INFORMED CONSENT FORM: 2012.....	127
APPENDIX 7	131
ETHICAL APPROVAL LETTER FOR THE RESEARCH	131
APPENDIX 8: STATISTICS DATA TABLES.....	132
8A. SPEARMAN RANK ORDER CORRELATION BETWEEN BENEFITS IN SURVEY 1	133
8B. SPEARMAN’S RANK ORDER CORRELATION BETWEEN BENEFITS IN SURVEY 2.....	135

Table of Figures

FIGURE 1: MAIN HIERARCHY OF CLASSES.....	8
FIGURE 2: AN EXAMPLE OF A BDN.....	13
FIGURE 3: IT BENEFIT MANAGEMENT PROCESS.....	14
FIGURE 4: STAGES OF IT SYSTEM JOURNEY	15
FIGURE 5: NET POTENTIAL SAVINGS OF EHR (USA).....	17
FIGURE 6: INSULATION FACTORS AND RISK FACTORS.....	19
FIGURE 7: THEORY OF COGNITIVE DISSONANCE	24
FIGURE 8: RESPONSE METHODS FREQUENCY SURVEY 1.....	44
FIGURE 9: RESPONSE METHODS FREQUENCY SURVEY 2.....	45
FIGURE 10: RESPONSE METHOD CHOICE VS AGE SURVEY1	46
FIGURE 11: RESPONSE METHOD CHOICE VS AGE SURVEY 2	47
FIGURE 12: BENEFIT EXPECTATIONS MEAN SCORES	50
FIGURE 13: BENEFIT EXPECTATIONS MEDIAN RANKS	51
FIGURE 14: BENEFIT EXPECTATIONS LEVELS SURVEY 1	52
FIGURE 15: MEAN RANKS OF PERCEPTION LEVELS	54
FIGURE 16: MEDIAN RANKS OF PERCEPTIONS LEVELS	55
FIGURE 17: BENEFIT PERCEPTIONS LEVELS.....	56
FIGURE 18: COMPARISON OF EXPECTATION AND PERCEPTION SCORES	58
FIGURE 19: COMPARISON OF MEDIANS OF EXPECTATIONS AND PERCEPTIONS.....	59
FIGURE 20: COMPARISON OF MODES OF EXPECTATIONS AND PERCEPTIONS	60
FIGURE 21: THE COMPOSITE SCORES- EXPECTATIONS.....	63
FIGURE 22: THE COMPOSITE SCORES- PERCEPTIONS.....	64
FIGURE 23: EXPECTATIONS VS PERCEPTIONS	65
FIGURE 24: BENEFIT RELATIONSHIP SURVEY 2	69
FIGURE 25: THE SCATTER PLOT BENEFIT RELATIONSHIP	70
FIGURE 26: THE EHR FEATURES	72
FIGURE 27: AGE DISTRIBUTION CURVE	73
FIGURE 28: SCATTER PLOT FOR RELATIONSHIPS	74
FIGURE 29: PRIVACY CONCERNS.....	76
FIGURE 30: RATINGS ON POTENTIAL ECRS BENEFITS.....	81
FIGURE 31: LEVEL OF CONFIDENCE.....	82
FIGURE 32: PARTICIPANTS' COMMENTS	83
FIGURE 33: PERFORMANCE RATING OF THE ECRS	84
FIGURE 34: SATISFACTION LEVELS.....	85
FIGURE 35: QUALITY OF CARE IMPACT	86
FIGURE 36: IMPACT ON RELATIONSHIP WITH CLIENTS	87
FIGURE 37: ECRS USAGE FREQUENCY.....	88
FIGURE 38: GRAPH- EXPECTATIONS AND PRE-USAGE FACTORS COMPLIANCE	90
FIGURE 39: GRAPH- PERCEPTIONS AND EHR QUALITY.....	91
FIGURE 40: THE ECRS STATUS MODEL.....	92

Tables

TABLE 1: ECRS CLOUD COMPUTING CAPABILITIES	9
TABLE 2: THE RESEARCH DESIGN	35
TABLE 3: CATEGORIES AND SCORING CRITERIA.....	42
TABLE 4: AGE VS PREFERRED METHOD OF SURVEY 1 RESPONSE.....	47
TABLE 5: AGE VS PREFERRED METHOD OD SURVEY 2 RESPONSE	48
TABLE 6: FREQUENCY- BENEFIT EXPECTATIONS.....	49
TABLE 7: FRIEDMAN TEST RESULT 1	52
TABLE 8: FRIEDMAN TEST RESULTS 2	53
TABLE 9: WILCOXON TEST.....	53
TABLE 10: FRIEDMAN TEST RESULT 3	56
TABLE 11: FRIEDMAN TEST RESULTS 4	57
TABLE 12: COMPARISON BETWEEN EXPECTATIONS AND PERCEPTIONS	61
TABLE 13: INTERNAL CONSISTENCY RELIABILITY- EXPECTATIONS.....	61
TABLE 14: INTERNAL CONSISTENCY RELIABILITY- PERCEPTIONS.....	62
TABLE 15: THE KRUSKAL-WALLIS TEST 1.....	66
TABLE 16: COMPOSITE SCORES- EXPECTATIONS AGAINST PERCEPTIONS	67
TABLE 17: THE KRUSKAL WALLIST TEST 2	67
TABLE 18: P VALUES FOR BENEFIT RELATIONSHIPS.....	75
TABLE 19: AGE VE EASE OF ECRS USAGE AND USER CONFIDENCE LEVEL	76
TABLE 20: EXPECTATIONS VS ECRS USAGE FREQUENCY	88

Abbreviations

BDN	Benefit Dependency Network
CSF	Critical Success Factors
ECRS	Electronic Client Record System
EHR	Electronic Health Records
EMR-S	Electronic Medical Record System
ERP	Enterprise Resource Planning (system)
EU	European Union
HIS	Health Information System
HSE	Health Service Executive
HIQA	Health Information and Quality Authority
IT	Information Technology
MHR	Medical Health Records
MIS	Management Information System
IS	Information System
ISO	International Standards Organisation
WHO	World Health Organisation

1. INTRODUCTION

There currently appears to be concerted efforts at national (HSE) Regional (EU) and international (WHO) level to promote the replacement of paper-based record systems with electronic health record systems (EHR) for management of patient's health records for supposedly improved efficiency and effectiveness of management of patients' records.

In line with this modernisation drive, in 2010, Daughters of Charity, a provider of health care services to people with intellectual disabilities in parts of Dublin and Limerick began rolling out a new EHR named Electronic Client Record System (ECRS). The goal of this new Health Information System (HIS) was to initially augment the existing paper based record keeping system and then ultimately replace.

Many researches claim that Information Systems are notorious for failing to bring about expected benefits. Many critical success factors of Information Systems (IS) have been identified in various studies and chief among them is the deficiencies of the implementation processes. The ability to launch the evaluation process of information systems at the outset has been suggested by other researchers as hugely beneficial and could lead to better outcomes.

In order for benefits of EHR to be realised in the long run many researchers have argued through various case studies that critical success factors (CSF) ought to be strictly adhered to. These factors include among other things involving the clinicians in identifying specifications, training the users, and implementation of benefit management and evaluation processes of the implemented IT project.

In the absence of an early evaluation process of the ECRS project this research attempts to provide some early evaluative information on the effectiveness of the new EHR through the eyes of the users. The study compares the trained users' pre-usage level of benefit realisation expectations and their subsequent perceptions levels of the same benefit realisation during the early stages of EHR usage. It is hoped that this information will give project managers vital information which can help correct, improve or maintain a high quality product and service to the clinician who is the end user.

This study reviews the state of art on this subject and identified gaps that exist in the literature. Following on from that the study outlines the methods and justification thereof methods that were used to collect the ECRS evaluative information. The results and analysis sections of the study present the findings from the data collected and the interpretation of the data in the context of what was discussed in the literature. The study describes and presents a model of data interpretation which was drawn up using reviewed literature and the researcher's own viewpoint.

The study finishes off with conclusions drawn about the performance and status of the ECRS during the period under review and the recommendations for project managers and prospects of further studies. The research also highlights some limitations of the study which potential future studies can hopefully improve on.

2 LITERATURE REVIEW

The Changing Playing Field

The current sluggish economic climate in Ireland is having an major impact on all spheres of people's lives and is likely to continue if not worsen in the immediate future according to Irish Fiscal Advisory Council (2012). There is huge pressure on the public purse and as a consequence, the Irish government has options to take advice from its consultants to scale down public sector operations (McCarthy et al. 2009). Health Service, being one of the biggest spenders of national budget, has not been spared and government is drastically reducing money spend on healthcare services (HSE 2010). Annual budgets to service providers have been drastically cut and this will most certainly result in a direct impact on the quantity and quality of service provision.

The HSE National Service Plan is effectively asking Health service providers to improve efficiency of service delivery through maximising the ever dwindling financial resources (HSE 2010) .

Coupled with the reduction in available funds for health services the Department of Health and Children has embarked on a mission to rationalise and modernise the service provision for people with disabilities. Through the HSE National Service Plan, the government published reports such as the 'Time to Move on from Congregated Settings', 'New directions' and 'Value for Money' which effectively demand Health service providers in the disability services to shift their model of service provision from institution based services to community and primary care model where service users 'exercise choice' (HSE 2010).

'Report on National Reference Group on Multidisciplinary Disability Services for Children aged 5-18 (2009), the EPSEN Act (Government of Ireland 2004) and the Disability Act (Government of Ireland 2005) recommend that services to children have to be provided in an equitable manner and preferably closer to homes.

Meanwhile there is increase demand on Disability health service providers to remain efficient and effective in the service provision despite the reduction in funding. It is against this backdrop that Daughters of Charity is implementing a HIS which has been billed as the panacea of efficient and effective patient record management by many Health Informatics practitioners. While the initial costs of setup are high the long term benefits to patient care are supposedly insurmountable.

Daughters of Charity delivers residential, day-care and specialist services for people with intellectual disabilities within its catchment areas. These services are delivered by multi-disciplinary teams which

entail medical, nursing, occupational therapy, speech and language, physiotherapy, social work, social and psychological services Social Care Leaders and many other subspecialties.

Some multidisciplinary team members have caseloads that transcends more than one service centre within each of the two regions. Some of the service-users live in community group houses within local communities. Daughters of Charity has some advanced plans to relocate and integrate some of the centre based services into the community in line with the recommendations contained in the Government of Ireland's National Disability Strategy, (HSE, 2010). This paradigm shift in service provision requires an even more spread-out service provision than currently is the case. Collection, storage and access of service user information will continue to be an integral part of service provision. The file management system will have to adapt to the changes in methodology of service provision. While this period of paradigm shift is perhaps the best time to introduce a new state of art management system to meet the clinical challenges, the state of the financing poses a huge challenge to the success of the project.

Computers have been available to some clinicians for some time but they have been used hitherto, as tools to generate paper based records rather than as service-user electronic record format repositories. Some clinical professions notably the nursing and medical professions use a lot of paper generated service user records, of which a substantial amount is hand written. The introduction of ECRS directly demands clinical staff to change their work practises and adopt new record keeping practises. As of November 2011 most multidisciplinary teams have been trained by the vendor of the ECRS and they were using the system at the time of completion of this research.

Prior to the implementation of ECRS in 2010 a process was set up to identify objectives and subsequently identify an appropriate EHR system. The general objectives could be summarised thus; *the need to improve efficiency and effectiveness of service delivery while increasing the security of documentation.* A steering committee team was set up to investigate further, best practise within similar service providers and the feedback thereof. Shortlisted vendors were invited to showcase their EHR products. The process resulted in identification of Epiccare as the most suitable EHR product available to meet the EHR needs within the constraints of the available budget. Different professionals and departments were invited to submit their specifications for inclusion into the final build. Only specifications which could be accommodated within the capacity of the existing ECRS archetype and the constraints of the budget were accommodated.

In this climate of the ever changing playing field and dwindling resources one assumes that a successful implementation of a good information system for service users' record can leverage the

service provider as one of the more efficient and effective providers of care for people with intellectual disabilities going by the evidence from the literature.

Electronic Health Records

(Kalra 2006, p. 136) encapsulated the general trend and direction of access to patient records when he pointed out that *'clinical care increasingly requires healthcare professionals to access patient record information that may be distributed across multiple sites, held in a variety of paper and electronic formats, and represented as mixtures of narrative, structured, coded and multi-media entries'*. This statement seems to be pointing out the need for efficient and effective access and use of patients' healthcare records with a view to improve clinical care.

Perhaps in response to such demands and trends a drive seems to be underway at International Level (Alvarez 2005) European Level (European Commission 2004) and local level (HSE 2010) in Ireland to encourage health service providers to shift toward EHR from paper based record systems with a view to improve efficiency and effectiveness of patient care. An EHR which focuses on meeting the needs of patients is a potential answer to bringing good quality clinical patient care (Kalra 2006).

Despite the unified drive, literature shows substantial problems with adoption and successful implementation of EHR systems worldwide (Dobrev et al. 2008). Despite 4 decades of research investment in EHR the penetration rate of EHR is rather disappointing (Grimson 2001). EHR systems have been at the forefront of negative reputation of IT systems in healthcare (DesRoches et al. 2010). In their research, DesRoches et al. (2010) attributed low success rate of EHR in the US to lack of organisational and process changes, an observation which was earlier noted by Eason (1988) as quoted by Ashurst and Doherty (2003).

The general field of IT has a bad reputation in many organizations because it is often seen as failing to deliver value (Carty and Lansford 2002, Tiernan and Peppard 2004, Peppard et al. 2007).

Sometimes the pre-investment appraisal is seen as a 'ritual' which has to happen and often the measure of project success is the technical deliverables such as timely launch and within budget constraints, without evaluating whether the benefits have been realized, (Peppard et al. 2007).

Failure to plan for benefits especially during implementation phase has been attributed as one of the main causes of IT systems failure (Clegg 2000, Sedera et al. 2001), as cited by Ashurst and Doherty (2003). An estimate of between 30% and 70% of failure of IT systems is attributed to failure of organisations to effect workflow changes necessary for IT systems to realise benefits (Ashurst and Doherty 2003).

EHR, which is a subdivision of HIS has many definitions. It is defined by the International Standard Organisation (ISO) in a research paper by Häyrinen et al. (2008) as a repository of a patient's medical information stored in digital format where it is accessed by authorised personnel. The record typically contains historical, present and '*prospective*' information of patients. Its main purpose is to enable quality and integrate patient care (Häyrinen et al. 2008). Some other definitions of EHR include such other clinical functions as Decision Support systems like the Computerised Order Entries. However not all EHRs have embedded Decision Support Systems. In their study which focused on systematic review of literature for definitions of EHRs (among other purposes), Häyrinen et al. (2008) identified 16 variants of EHR systems. This underscores the fact that there many EHR variants in use. The variants had some differences but there were more similarities than differences. The differences were mainly around the scope and level of access of the patient records.

EHR is a widely researched topic. Häyrinen et al. (2008) carried out a wide ranging systematic literature review research to establish the general scope of EHRs and how they have been defined and used both clinically and academically. Their results showed that EHRs are used in all levels of patient care such as primary, secondary and tertiary patient care. They also noted that the users of EHR transcended across the spectrum of medical professions. Information collected included '*daily charting, medication administration, physical assessment, admission nursing note, nursing care plan, referral, present, complaint (e.g. symptoms), past medical history, life style, physical examination, diagnoses, tests, procedures, treatment, medication, discharge, history, diaries, problems, findings and immunization*' (Häyrinen et al. 2008, p. 296)

(Brusco 2011) noted that EHR and Medical Health Record (MHR) are similar terms, often used interchangeably but they are different. Both are '*automated systems that allows Healthcare providers to document pertinent health related information*' for individual patients, (the former National Alliance for Health Information Technology as cited by Brusco (2011, p. 371). The difference is that EHRs are typically created and accessed by authorised staff from one health care organisation while MHR can be created, accessed and edited by more than one authorised Healthcare organisation personnel due to the systems' interoperability capabilities, (Brusco, 2011).

Most existing EHR and MHR have mainly consisted of amorphous and descriptive text, together with some coded data (Häyrinen et al. 2008). The authors made a distinction between older EHRs and newer ones. Newer EHRs now combine three architectural designs into one. These design components are;

- i) problem orientated
- ii) time oriented medical

iii) source oriented

The authors argued that the architecture of the newer systems is dynamic enough to present information in either a chronological manner; by origin of the record (e.g. radiology or laboratory departments) or by identifying and listing the patient problems. Such dynamism in structure should help the EHR to present appropriate information for appropriate purposes. In contrast, earlier EHRs were mainly custom-made software programmes, which were designed to suit one specific customer. Adopters of earlier EHRs probably experienced steep learning curves because there was little or no precedence. Adopters of recent and current EHRs tend to buy their EHR applications from commercial vendors and they benefit from more refined and easily customisable EHR programmes (Edwards et al. 2008) and cheaper products (Shang and Seddon 2002). It is cheaper for Health Service providers to buy Information Systems from commercial vendors than invent and customise their own systems (Shang and Seddon 2002).

Recent trends in healthcare delivery in Ireland show a paradigm shift where health delivery is shifting from centres of excellence to primary care centres in community settings (HSE, 2010). Such a shift naturally demands efficient method of sharing patient information between teams of health care providers (Kalra, 2006). There is an on-going concerted effort to develop EHR standards which would allow efficient and effective communication of patient care management between healthcare providers (Eichelberg et al. 2005). The main standards organisations which aim to address interoperability problems include Health Level 7 (HL7), European Committee for Standardisation (CEN EN), openEHR and International Standards Organisation (ISO) (Eichelberg et al. 2005, Kalra 2006). The other purpose served by EHR standards include;

- the '*medico-legal*' status of health records;
- to '*preserve the clinical meaning intended by the original author*', and;
- the need to ensure system backward compatibility thus ensuring seamless system upgrade and updating with less fear of data loss, (Kalra 2006, p. 138).

There is therefore increased commercial pressure on vendors and developers to produce EHR systems which align themselves to one or more of these international EHR architectural standards (Kalra 2006).

Figure 1 shows an example of a draft format of a generic hierarchy and properties of an EHR which could form the basis of a CEN standard.

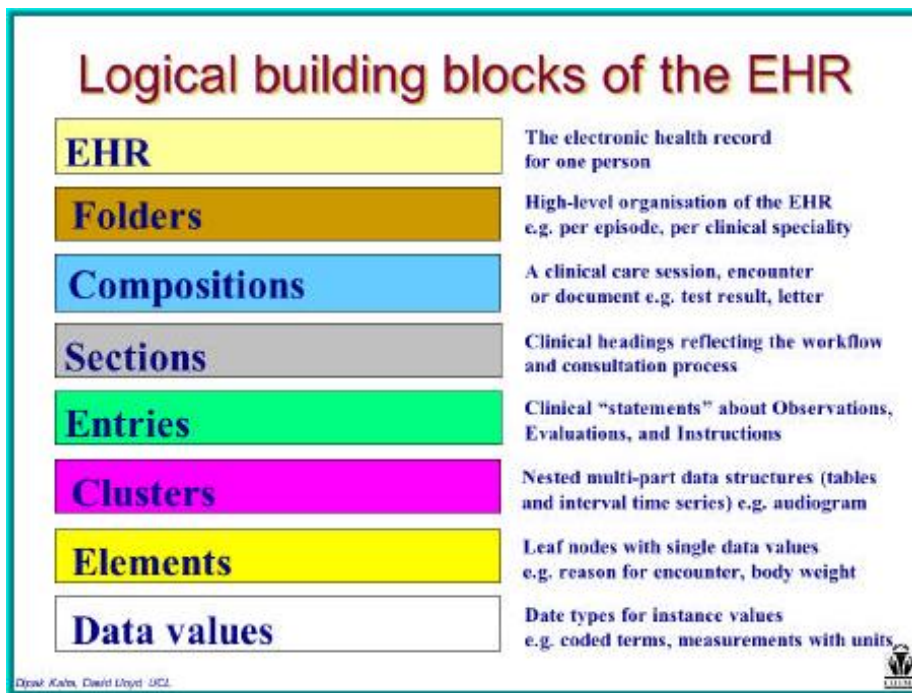


Figure 1: Main Hierarchy of classes of EHR within CEN 13606 (draft) standard (Kalra 2006)

The hierarchy shows categories of data sections which are grouped from very broad general umbrella sections such as Folders at the top of the diagram to very specific items such as data values at the bottom.

One would presume that vendors have a vested interest in ensuring that their products meet international standards in order to maintain commercial relevancy and a competitive advantage.

Epic Solutions is the vendor who licenses the new EHR (EHR) which is being implemented at Daughters of Charity, the site for this research. One of the products of Epic Solution is EpicCare which is a web based application that utilises cloud computing thus allowing its customers to access Electronic patient records from any authorised computer regardless of its location. Cloud computing is defined by Mell and Grance (2009) as '*a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*'. This definition appears to insinuate a business model which is aimed at reducing costs for cloud computing customers through leasing software applications on demand. The customers will supposedly concentrate their operations on core business once they outsource the IT functions to cloud computing services providers.

EpicCare offers on-demand access for Daughters of Charity clinical and medical staff via workstation computers at any time and place where access is enabled. Access is via a virtualisation platform

where users access, add and edit records on demand at their desktops and the records in turn are stored at a remote server.

Table 1 shows the mapping of the EpicCare EHR product based on the characteristics of cloud computing identified by Mell and Grance (2009). These characteristics were observed by this researcher through his 1 year experience of using the EpicCare ECRS system. The table content is therefore limited to observable characteristics from the point of view of this researcher.

Subjective Observations of Cloud Computing Characteristics of the ECRS

EpicCare Characteristics as observed by researcher	Observed capabilities	Comment
On demand self service	Yes	
Broad network access	Currently Limited to desktops and laptops	Currently no access via portable hand-held devices.
Resource pooling	Yes according to Epic Solutions website. (Epic Solutions 2009). Epic solutions supply a community cloud.	Community cloud is a cloud service provision which is accessed by a specific community of vendors with shared concerns. (Mell and Grance 2009). (In this case Nursing homes and intellectual disabilities services)
Rapid Elasticity	Not observed	Researcher has not observed ECRS's dynamic capabilities where the ECRS adapts to increased or decreased levels of demand. Effect may not be observable from a user's point of view
Measured Service	Not observed	Researcher is unacquainted with measurement methods employed by Epic Solutions

Table 1: Observed ECRS cloud computing capabilities using Mell & Grance (2009) list of cloud computing capabilities

On their website Epic Solutions, market themselves as a supplier of '*Health Information Management Systems*' for Nursing Homes, Care Homes, Intellectual Disability Services and Hospitals, (Epic Solutions 2009). They assert that their Information Systems comply with the standards of Health Information and Quality Authority (HIQA), a regulatory statutory board which is tasked with policing standards of health care provision in the Republic of Ireland (HIQA 2011). At the time of completion of this research Epic Solutions however did not provide readily available information on the website about their compliance with any one of the international standards such as those mentioned in previous paragraphs (at least up to the time of submission of this thesis).

Epic Solutions (2009) state that they '*consolidate multidisciplinary services*'. Epic Solutions makes some other affirmation on product benefits. They state that epicCare® (EHR product) results in '*better care*', '*reduced risk*', is '*simple to use*', it is quick to learn and it offers management solutions to its customers (Epic Solutions 2009). Epic Solutions offer training to its customers and on their website they state that they self-audit to ensure high levels of standards and compliance. Permission to use screenshots or readily available vendor materials was sought but no response was received by the time of completion of this research. Therefore screenshots from ECRS were not used in this study.

Most HIS vendors such as BlueWare®, Socrates Healthcare Informatics, System C and Connected Healthcare Information System; who showcased their EHR products on the 16th Annual Health Informatics Society of Ireland (HISI) Conference (2011) claim to be compliant with at least one of the international standards.

While marketing information is an essential part of customers' product selection criteria, it is worth noting that vendors generally portray their products in a positive light; are less likely to point out failures and in some cases they overstate the benefits of their IS (Shang and Seddon 2002). Ward et al. (1996) as cited by Ashurst and Doherty (2003) noted that benefits of IT generally arise as a result of '*organisational changes*' introduced by the organisations to enable benefits to be realised '*rather than from the functionality*' of the IT systems. Some researchers go even further and highlight that there appears to be no strong evidence to suggest that EHRs improve patient care or clinical outcome (Hillestad et al. 2005). In fact some EHR proved to be more costly than originally anticipated (Häyrynen et al. 2008, DesRoches et al. 2010).

Richard, H. (2006) described '*The Design- Reality Gap Model*' which highlights the gap which exists between the design of HIS on one hand and the reality of the end user's experience. The typical HIS design is usually based on the designers' perceptions of the needs of the clients while the experience and expectations of users and stakeholders vary widely from one to the other. In an earlier research

Swan et al. (1999) appeared to concur when they concluded that the gap arises when IT end-users demand specific functions to suit their organisation's needs on one hand and on the other hand vendors prefer to standardise IT solutions to make them useable by a larger market. Bancroft (1996 p. 274) as cited by Hong and Kim (2002) identified IT agencies and consultants as major drivers of standardisation of IT solutions.

The literature at hand shows that despite EHRs having been in use for a while they are still far from perfect and uniform. There are concerted effort from Regional Groupings, local health providers, EHR product developers, vendors and International standard organisations to come up with a better experience for users and attain promised outcomes. At the moment there is a lot of EHR product fragmentation and lack of standardisation which is making it difficult to achieve goals. Some of the promised benefits of EHRs have not been forthcoming as promised. The next session explores the nature of these potential EHR benefits with more focus on end users.

Potential EHR Benefits and Value

There are many documented potential benefits of EHR over paper-based record keeping systems. Potential EHR benefits range from health benefits to financial savings some of which potentially arise from the efficiencies resulting from usage of EHR systems (Miller et al. 2005). Some of the benefits of EHR arise from attributes of the EHR architecture (Ilias 1998).

Some direct benefits to EHR users include record **consistency, completeness, accuracy, legibility, better communication and collaboration between health care workers** (Miller et al. 2005 ,Häyrynen et al. 2008). In order for such benefits to arise the EHR systems must have such attributes as easy **accessibility and availability; user friendliness** (user interaction) and **flexibility** (multiple user views). It should also provide record **confidentiality, auditability** (digital audit trail) and **integration** (allowing management and clinical integration (Ilias 1998). Interoperability is another feature of EHR which gives rise to the potential benefit of better interagency communication which in turn improves continued patient care (Kalra, 2006). At the forefront of realising IT systems' success from a human-computer-interaction point of view, is the notion of good system design which facilitate users to execute their intended tasks (Dix et al. 2004, p319).

Appendix 1 shows a comprehensive list of potential benefits of generic IT systems across the layers of organisational management structures (Shang and Seddon 2002). This list was prepared from systematic review of case studies of companies which collectively achieved these benefits. The key theme thus far is the fact that these benefits remain a potential until a time when they are actually realised.

Tiernan & Peppard (2004) noted that users of HIS tend to invest a lot of time and effort in the implementation of HIS but very little in the actual process of benefit realisation. While lists of potential benefits of HIS are known and readily available from various researches worldwide, and appear regularly on vendors' brochures and product promotional materials, Tiernan & Peppard (2004) pointed out that there is a notable gap between having a fully operational IS and actually realising those benefits. They believe that this alone is one of the main reasons why so many IT projects result in failure.

Benefit Realisation from IS projects will not materialise if proper planning during implementation phase is not done (Sedera et al. 2001). According to these researchers some of the main reasons for IT failure which results from limited planning are summarised thus;

- a) Ignoring critical success factors,
- b) Largely concentrating on technical aspects of the system while ignoring other aspects,
- c) Lack of interest from stakeholders,
- d) Band wagon effect in the initial stages,
- e) Poor project scope definition,
- f) Design weakness approach, and,
- g) The life cycle stage of the IT system, (Sedera et al. 2001).

Peppard et al (2007) even go further to suggest that, not only should the benefit plan be implemented but that it should be put in place prior to the implementation of an EHR. Edwards et al. (2008) appear to concur when they concluded in their research that for benefits to be realised it is important to evaluate usability of commercial EHR systems before they are fully launched.

There are many forms of Benefit Realisation programs which are available to practitioners of Informatics. A benefit realisation programme was defined by Ward and Elvin (1999) as *'the process of organising and managing, such that the potential benefits arising from the use of IT are actually realised'*. One of these programs was proposed by Peppard et al. (2007), and they named it the 'Benefit Dependency Network (BDN)' which is a tool used by managers and stakeholders in business IT projects. The BDN is essentially a tool which is used to link business objectives with appropriate IT systems to achieve these business objectives. This is prepared through a process of identifying business benefits and the changes which are necessary to realise those benefits and hence meeting the organisation objectives. The authors tried and tested the BDN tool in various case studies and they found the tool to be useful in helping organisations to have a planned benefit realisation

strategy, (Peppard et al. 2007a). Figure 2 shows an example of a BDN used in one of successful implementations of an IT system which the researchers were involved.

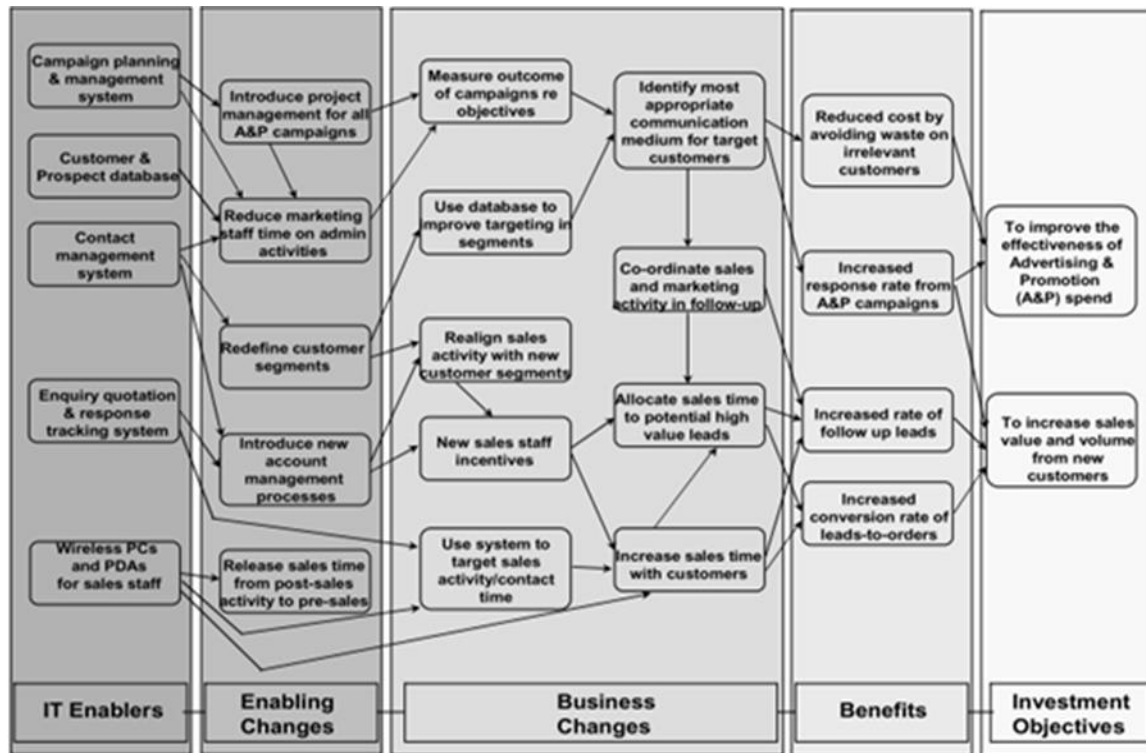


Figure 2: An example of a partial BDN for a new customer relationship management system (CRM) (Peppard et al., 2007)

The diagram shows a systematic process which started off with identification of the organisation's objectives on the right. The process flowed leftwards with the addition of the details of how the achievement of the identified objectives and the benefits thereof are linked to individual workflow changes which the management and employees needed to implement. The BDN ended with the identification and specification of suitable IT systems (IT enablers) which resulted in realisation of benefits and subsequent achievement of organisation objectives.

Peppard et al. (2007) make a distinction between new IT innovations and those IT systems which are new to an organisation but not new to the wider industry. If the IT system to be implemented is not a new innovation to the industry as is the case with ERCS, according to Peppard et al. (2007), the BDN tool is implemented **from right to left** meaning that objectives of the project have to be identified first then followed by identifying the business benefits and the work practises which would be required to realise those benefits. Subsequent to this, the enabling changes or once-off changes are identified, followed by identifying and specifying the IT system which needs to be set up in order that benefits are realised and hence objective achievement.

Peppard et al, (2007) argue that the right to left approach is done to ensure that the stakeholders can be able to evaluate worthiness of the investment before its implementation. They however point out that '*innovation based investments*' often require that the IT is set up first before benefits and objectives can be established. In this case the benefit management process is implemented from the left part of the diagram going towards the left side.

Only when a service provider's objectives and benefits have been realised can the **value** of the IT system be accomplished (Tiernan and Peppard 2004). It therefore appears that it is possible for an IT project to realise benefits but later fail to release value. Value is only released when an IT system meets its set objectives. Benefit realisation is therefore only a milestone along the journey of releasing an IT value. It can be deduced from the above literature that while EHRs have the potential to achieve the benefits listed by EHR vendors it is worth noting that the actual realisation of the benefits and value of the EHRs depends on how the end users and stakeholders are willing to implement and invest in the usage of the system in a manner which makes them achieve their organisational objectives.

The BDN appears to be just one cog on the wheel of 'IT Benefit Management Process'. Tiernan and Peppard (2004) described five 'interdependent stages' of IT Benefit Management Process. Figure 3 shows a diagram depicting the interdependency of the five stages. As highlighted in previous section the stages of **benefits planning** and **execution** are the ones which receive the least attention from implementers of IS.

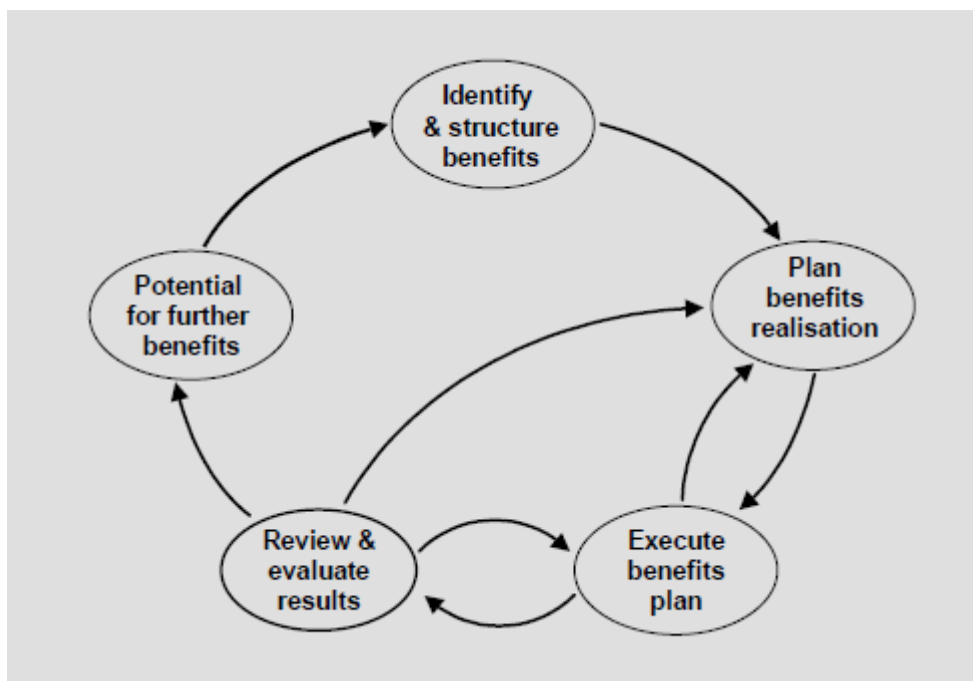


Figure 3: IT Benefit Management Process, (Tiernan & Peppard, 2004)

When and if these early stages have been undertaken, the process of benefit management then moves on to the later steps which involve reviewing and evaluation of IT implementation.

This process is somewhat similar to one suggested by Ross (1999) and it is illustrated in figure 4. Ross identified six stages of IT system life cycle, namely, Selection, Design, Implementation, Stabilization, Continuous Improvements and Transformation (Ross 1999).

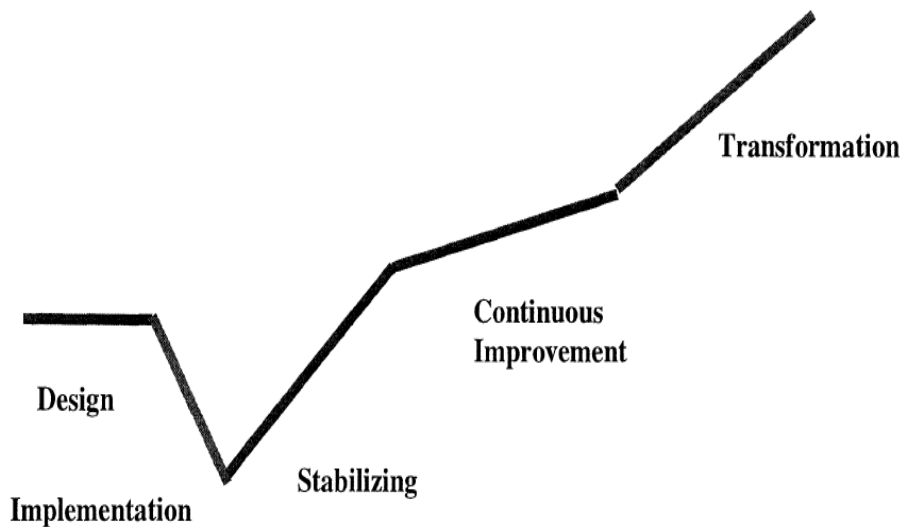


Figure 4: Stages of IT System Journey (Ross, 1999)

These stages which are self-explanatory show a linear metamorphosis of IT system from the point of its inception to the period when the IT system becomes mature. It is important to note that most organisations according to Ross (1999), go through a downward trend of productivity during the implementation stage. These two models of IT life cycles appear therefore to suggest that evaluation of an implemented IT system should be undertaken in the middle to later stages of the life cycle or at least after the stabilization stages according to Ross (1999) or after execution of the Benefit plans according to Tiernan & Peppard (2004).

While IT systems such as ERPs have clear and unambiguous life cycles, reviews of IT system benefits is the least easy part to deal with. In fact IS benefits are difficult to quantify and measure (Remenyi et al. 2007). A number of authors such as Tiernan and Peppard (2004) and Carty and Lansford (2002) have suggested some metric formulas which tend to express business benefits in financial terms. Many researchers including those who proposed financial metrics for measuring IT systems agree that not all benefits can be expressed or represented accurately using only financial metric formulas (Carty and Lansford 2002, Shang and Seddon 2002, Remenyi et al. 2007).

Despite the existence of substantial material written about the advantages of benefit management programs, according to Bradley (2010) *'benefit realisation management is common sense but not common practice'*. There are few but compelling articles which challenge the effectiveness of benefit management processes. Richard (2012) chronicles his experiences in United Kingdom government projects in which he was involved in regeneration projects of disadvantaged communities during the 1990s. He pointed out that the benefit realisation management process was endorsed for use in these projects. His experience and later review of the projects led him to conclude that, often benefit realisation programs are too prescriptive and too scientific to the extent that outcome measures do not match the practicalities on the ground. He summed up by arguing that this imposed scientific management approach of *"modern paradigm" reflected failure of the real world to match the assumptions of the scientific method'* Richard (2012 p 348). Conflict and ambiguity is likely to result because of differing stakeholder priorities and interests (Richard 2012). Other authors, notably Remenyi et al. (2007) argue that it is difficult to identify and plan for benefits before the actual IT project is implemented.

If and when benefits are realised they should ultimately lead to savings in money spend on health thus releasing value of the IT system as suggested earlier by Tiernan and Peppard (2004). In a study designed to understand the impact of EHRs on healthcare and cost reduction, Girosi et al. (2005) demonstrated the net potential savings of adopting EHR or Electronic Medical Record Systems (EMR-S) in the USA for hospitals and physicians over a 15 year adoption period. Figure 5 illustrates the trend of this adoption rate as it relates to outpatients and inpatients.

Net Benefits (Savings – Costs) for Inpatient EMR-S and Outpatient EMR-S

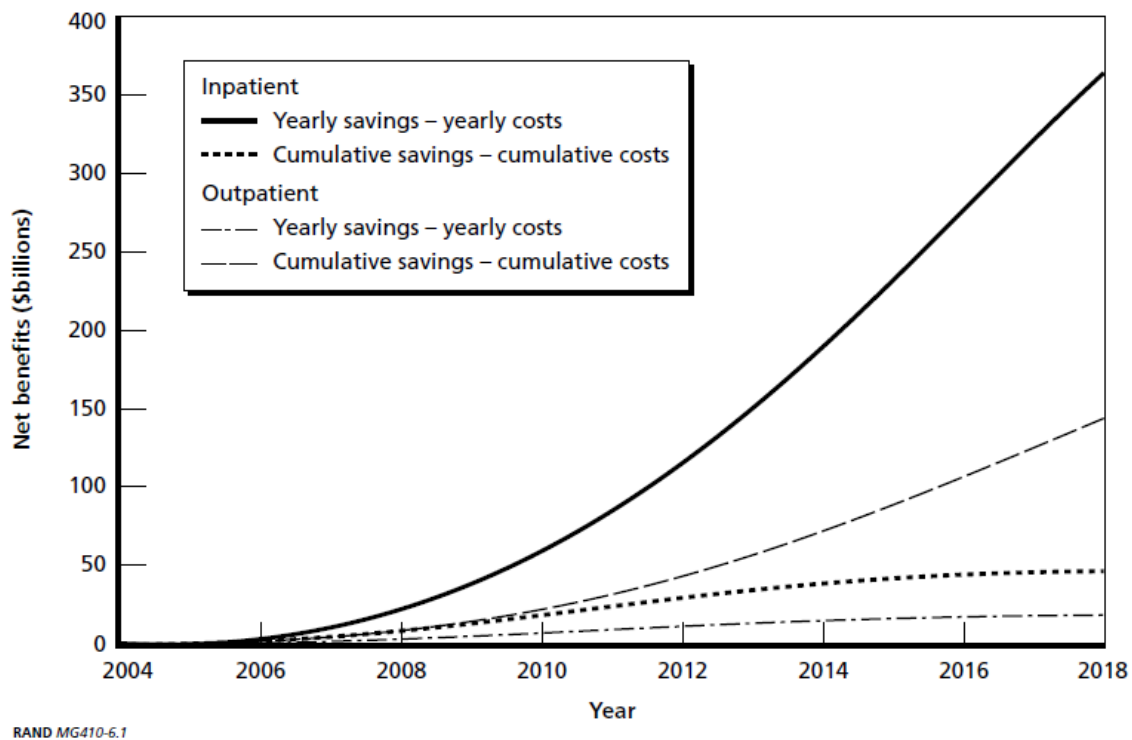


Figure 5: Net Potential Savings (Efficiencies vs. Costs of adoption) Girosi et al. (2005)

The graph shows that net benefits in the first few years of implementation are quite low, a potential source of frustrations for the funding stakeholders. The graph illustrates that projection of benefits rises exponentially (particularly for inpatients) as the adoption process matures, thereby confirming that EHRs take a while to realise their full potential. The savings for outpatients EHRs seem to be very low over the 12 year period under review.

Literature therefore shows that EHRs have many benefits which have been described in various studies. Most researchers argue that these benefits which range from financial savings, better health outcomes and improved work efficiencies, remain potential benefits unless proper benefit management strategies are put in place to improve likelihood of benefit realisation. This section has also presented counterarguments of a small number of researchers who believe that benefit management strategies are overrated. While implementation of Benefit realisation management strategy is arguably one of the critical success factors to EHR implementation there are many other important critical success factors. The next section review these critical success factors.

Risks and Critical Success Factors associated with Implementation of IT Systems

Daigrepont and McGrath (2011) defined critical success factors (CSF) as *'the elements necessary to accomplish a specified goal'*. They suggested that a successful implementation of an EHR involves definition of goals, selection of vendors who meets the requirements of the organisation and planning for the *'implementation, on-going management and development of the EHR'*.

Daigrepont and McGrath (2011) identified the following CSF of EHR:

- a) Change management
- b) Completion of readiness assessment
- c) Contribution from stakeholders including users
- d) Training before, during and after EHR implementation
- e) Reliable maintenance and technical support
- f) Efficient governance structure
- g) Reliable network infrastructure
- h) Good design with useful features that support workflow
- i) On-going management to ensure optimum use of the system
- j) Standardized workflow

Szajna and Scamell (1993 p. 494) identified what they termed *'pre-Implementation factors'*. They defined pre-implementation factors as those *'variables which have an impact on the realism of users' expectations'*. These factors have an influence on the end- users of IT systems and may therefore determine the magnitude of the relationship between user's expectations from the system and the actual performance of the system. Some of the pre-implementation factors include *'management support, user involvement and user training'*.

For successful implementation of an EHR Leslie et al.(2009) argued that it is important to involve clinicians in *'authoring and reviewing clinical content'*. The authors acknowledge how difficult it is for clinicians to come to some consensus on some homogeneous structure but they point out that reducing barriers to participate will often help. Some of the barriers to clinicians' participation according to the authors are;

- a) The process of EHR development which has largely excluded clinicians to date
- b) The models of EHR content which have been too technical.

An earlier journal editorial by Harvey and Gershefski (1970) suggested a long held view that dissatisfaction with the capacity of the IT system was a contributory factor to systems failure. A

systematic literature review by Ludwick and Doucette (2009) which reviewed literature from a wide range of sources concluded that the main determinants of the outcome of a HIS implementation was such things as the quality of the systems' graphical user interface, *'feature functionality, project management, procurement and users' previous experience'*.

They also found out there are considerable risk factors which can affect the success of HIS implementations. These include *quality of care, liability, efficiency, patients' safety, previous experience, time, financial and staff anxiety*.

Figure 6 shows Ludwick and Doucette (2009)' s illustration of how an implementation of a HIS can be *'insulated'* against failure. The outer ring represents risk factors such as quality of care and staff anxiety. The IT system can successfully be insulated from the green outer ring risks by implementation of measures in the inner pink ring which include proper project management and training. The blue ring represents technical aspects of the IT system which interact with the social working environment to help achieve the innermost goal (yellow circle) of successful implementation of HIS.

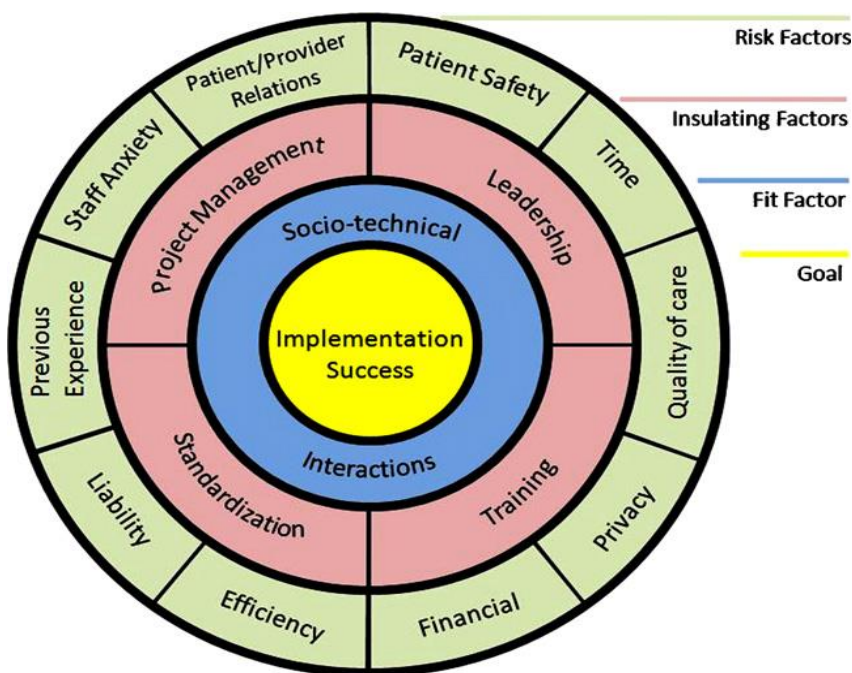


Figure 6: Insulation Factors and Risk Factors (Ludwick & Doucette 2009)

Ludwick and Doucette (2009) concluded that an implementation process which identifies the determinant success and risk factors and puts in place measures to insulate the IT project against the identified risks, is likely to result in success of implementation process.

The importance of having IT system specifications which suits the clinical setting onto which the system will operate should not be underestimated. In a study which investigated the impact of the relationship between IT solutions and how they inherently fit into the business models which they are applied, Hong and Kim (2002) concluded that IT solutions which are not in tandem with the business models in which they are applied are bound to fail. In practice, despite this grim finding it appears to be particularly difficult to come up with the a right combination of specifications of HIS such as EHRs judging by the documented high failure rate of EHR implementation due to such things as difficulties with unsuitable data entry.

McDonald (1997) concede in his article, that constructing EHR is very difficult because the data sources such as laboratory and X-ray records entries often resides on different '*isolated islands*' with varying degrees of coding and detail. Presumably each medical profession has its own preferred way of managing information and it is not necessarily compatible or complementary to the other profession. Such difference in preferences and model of operation among health professionals potentially presents a huge challenge for managing change in work practises.

Arguably, one of the biggest challenges in any implementation of new IT systems is the management of work process change. Many clinicians are probably comfortable with the tried and tested paper based record management systems which they use in their own '*isolated islands*' to borrow a phrase from McDonald (1997). While there are well documented advantages of EHR there are some advantages of paper based records EHR. Walsh (2004) noted that relatively smooth patient management frequently does not match the inflexibility of most EHRs. In another study in which needs of physicians in terms of the '*design and implementation prototype of EMR*', Tange (1999) discovered that physicians expressed satisfaction with paper based record management systems because they liked the '*flexibility of data entry*' something which cannot totally be achieved with EMRs. Coiera (1997 p. 64) as quoted by Walsh (2004) also argued that it is feasible for a properly designed paper based patient record system to perform much better than a poorly designed and implemented EHR.

Berg (1998) argues that collection of medical records is a sociological process rather than a cognitive one. The researcher went on further to suggest that clinicians transform the '*narrative*' information gathered from the patient into material which they understand. According to Kay and Purves (1996) loosing this format of information capture often results in dilution of information and change of meaning when coded into EHR systems which have '*limited codes and weakly connected phrases*'. Walsh (2004) pointed out that EHRs should '*compliment and improve clinical care*' not overtax staff who are often already overworked. He concluded that this can be achieved by involving the

clinicians in the system user specification. It is therefore feasible to assume that staff may show some level of intolerance to EHR systems which may appear to increase their workload rather than complement their record management process.

The notion of change management and staff's perceptions of newly implemented projects appears to have an influence on the success, delayed success or indeed failure of the implementation process. Ross (1999), in a study which examined the obstacles that companies face during implementation process of IT systems, discovered that productivity went down on the initial period of implementation. This is because of the new change processes that are introduced which are not familiar to users. Figure 4 from earlier sections depicted the life cycle of an IT system from design to 'transformation' phase. The graph showed a dip in productivity during the implementation process and Ross (1999) suggests that this period of low productivity lasts from about four months upwards.

If the Implementation phase is analysed and evaluated properly and adequate support is given to the system users, then soon enough the IT system graduates into the stabilisation phase where productivity increases. Ross, (1999) found out that the better prepared an organisation is, in dealing with necessary changes and support mechanisms required, the shallower the productivity deep and the earlier the return to productivity.

It appears the mere development of a benefit realisation plan is not enough on its own merit to yield results. IT systems will be able to deliver value if organisations develop what Doherty et al. (2011) called '*benefits delivery competence*' and they defined it as '*the ability to design and execute the programme of organizational change necessary to realize all of the benefits specified in the benefits realization plan*'. The benefit delivery competence according to Doherty et al (2011) are not an event but rather a process which begins from the time the benefit realisation plan is approved right through the period when the system is in active usage.

This section of literature review showed that there is a lot of literature which identifies factors which influence success of IT systems in general and HIS in particular. This wealth of information could potentially be used to form the basis of planning and evaluation of EHR implementations.

Researchers have found out that often managers of IT projects underestimate the extent to which planning for success is required and they also underestimate the impact new IT projects have on users, (Ross 1999). It appears that Implementation success of IT projects is generally determined by project managers rather than end users.

Many researches quoted in this section have demonstrated the importance of understanding the CSF which determines the success or failure of implementation process of IT projects such as EHRs.

Many studies have done this through detailed case studies of implemented IT projects worldwide. Most of these researches set out to establish why implemented IT projects failed. In an inverse methodological approach Umble et al., (2003) reviewed a case study of a success story with a goal to find out why the IT project was a success. The factors which the author identified could be summarised as **good implementation strategies** and **correct selection process of IT systems**.

Perhaps one of the most important and probably underestimated CSF is the involvement of EHR users from the outset and all the way through the life cycle of the EHR. The next section is devoted to analysing the importance of EHR system users.

Users, their Expectations and Perceived Benefits

Clearly judging by the level of high degree of IT's failure to realise potential benefits, many researchers are concentrating their research efforts on how best to plan and evaluate IT implementation processes so as to avoid failure.

First of all it is important to acknowledge the scepticism of some clinicians on how useful such technologies as EHR are to the advancement of patient care. One physician blogger Reece (2011) in a blog appropriately titled *'Why doctors don't like electronic health records'* put it in a nutshell when he argued that *'the computer is oversold as a tool to improve health care, implement reform, cut costs, and empower patients'*. He went on to point out that physicians seek clues, signs and symptoms and should not be reduced to *'data entry clerks sorting through undigested computer bytes'*. Leslie et al. (2009) pointed out that some equate the idea of getting a consensus on EHR make-up from clinicians to *'herding cats through a waterfall'*.

Despite the scepticism the involvement of users of EHR systems has been identified by many researches as one of the important critical success factors (Curtis 1992, Szajna and Scamell 1993, Leslie et al. 2009). Based on these researches it would therefore appear that users' opinions are vital for a successful implementation process of EHRs. Prelaunch expectations have been suggested as one possible component of measure of subsequent success of Information Systems, (Ginzberg 1981, Szajna and Scamell 1993). Szajna and Scamell (1993 p. 494) defined user expectations as *'a set of beliefs held by the targeted users of an information system associated with the eventual performance of the IS and with their performance using the system.'* It is important to involve users in the set up and even design process of IS systems because they have important knowledge and will soon find problems if not included (Dix et al. 2004 p7).

Despite this seemingly logical reasoning, some major EHR national projects have gone on to be implemented with a top-down approach. According to Robertson et al. (2010) England's NHS Care

Records Service, was launched with a top-down approach for the management of patients records for national and local secondary health care facilities. One of the findings from evaluations of this NHS Care Records Service according to Robertson et al. (2010) showed that a significant number of users of the EHR system felt that the top-down implementation approach was less responsive and less adapted for local needs.

On the other level, Staples et al. (2002) demonstrated in their study that unrealistically high expectations of IT before implementation lead to low perceived benefits after system is implemented. They sampled views of users of an information system before and after implementation of the system. Ginzberg (1981) undertook a study to establish if expectations of Management Information Systems (MIS) could be used to predict success or failure of the system. The results of the study suggested that users with more realistic expectations were more likely to use the system than those with unrealistic '*pre-implementation expectations*'. This therefore suggests that an IT system where users have more realistic pre-implementation expectations has a higher chance of success than an IT systems whose users have unrealistic expectations simply because the later are not going to use the system that much.

Szajna and Scamell (1993) undertook a study to determine the '*effect of user expectations of Information System on their perceptions and performance*'. They used the Cognitive Dissonance Theory to hypothesize the behaviour and attitudes of IT users. They used a longitudinal experiment in which they manipulated the experimental subjects so as to commence the study with 3 respective participant categories with realistically high, low and medium expectations. The results suggested that there is an association between realism of users' expectations and their perceptions but with no association with their actual performance.

As cited by Szajna and Scamell (1993), Cognitive Dissonance Theory was first described by Festinger (1957). According to this theory individuals yearn to have a state of '*cognitive consistency*'. A '*psychological state of dissonance*' arises when an individual maintains two cognitive ideas that are at odds with each other. The individual will attempt to rectify the dissonance by changing one of the conflicting ideas to approximate the other idea.

Szajna and Scamell (1993) explained the theory using a graph reproduced in figure 7.

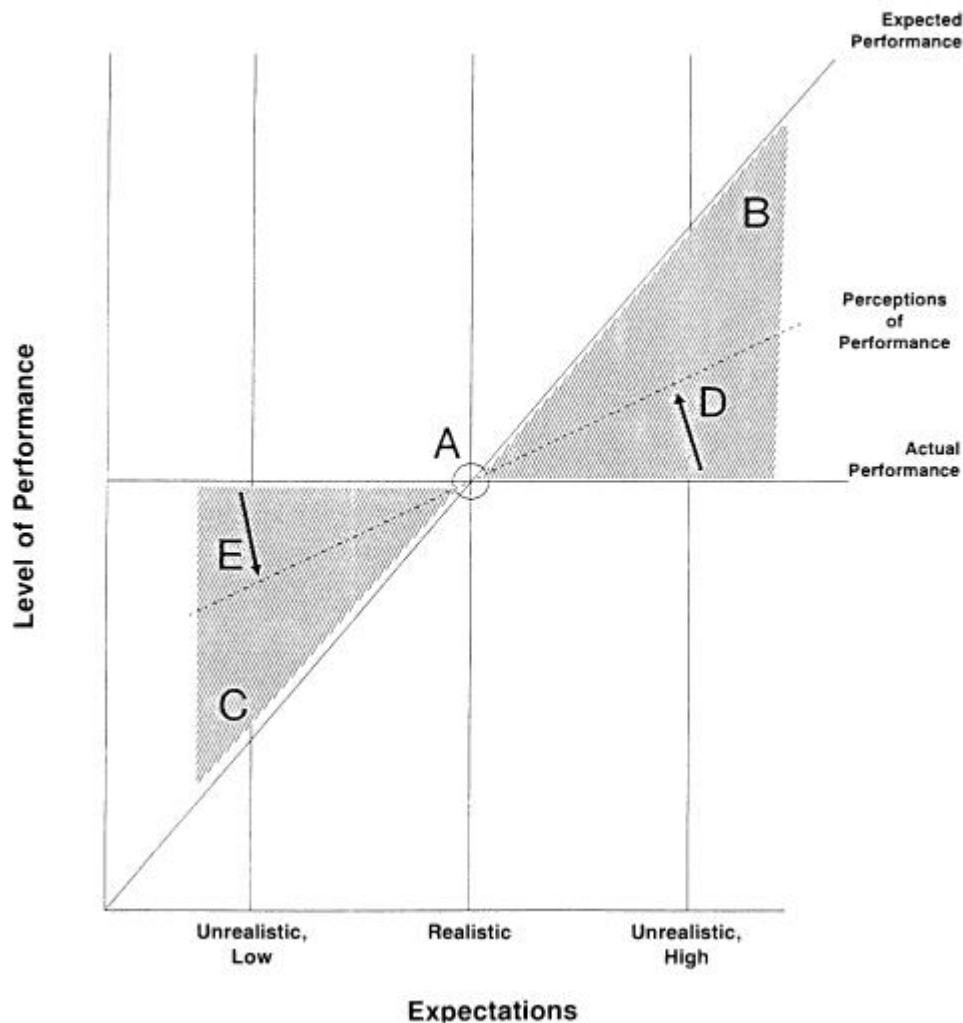


Figure 7: Festing (1957)'s Theory of Cognitive Dissonance as illustrated by Szajna & Scamell (1993)

The diagram shows a horizontal line labelled as 'Actual performance' which represents the actual observed or measured performance. Point A represents a point where realistic expectations and actual performance intersect thus representing 'a confirmation of expectations'. When expected performance and actual performance are different the state is called 'disconfirmation'. 'Negative disconfirmation' occurs when expected performance (B) is higher than actual performance and 'positive disconfirmation' occurs when expected performance (C) is lower than actual performance.

According to the Cognitive Dissonance Theory, as cited from Festing (1957) by Szajna and Scamell (1993), when a state of 'psychological dissonance' arises an individual response by 'assimilating perceptions' towards expected performance. In the case of negative dissonance when an individual 'assimilates', the resultant perceptions of performance (dotted line on graph) will still exceed actual performance (area D). Conversely, in the case of positive dissonance when an individual

‘assimilates’, the resultant perception of performance will still remain less than actual performance, (Area E).

The theory of cognitive Dissonance is therefore suggesting that users’ perceptions of performance have to be interpreted with a certain adjustment of error because of the inherent need of the humans to attain a state of ‘*cognitive consistency*’.

Szajna and Scamell (1993) employed a laboratory style of methodology. It is well documented that laboratory studies have the disadvantage of lacking context and therefore are subject to lower reliability because they are not necessarily reproducible in the real world (Dix et al. 2004 p 328).

Bhattacharjee (2001) delved into the study of cognitive beliefs and emotions which influence users’ continued usage of IS systems. He demonstrated that continued usage of IT systems is influenced by the user’s perception of usefulness of continued usage. Satisfaction is in turn influenced by conformation of prior pre-implementation expectations.

Wakefield et al (2007), report that they are developing a measurement tool of EHR impact on clinical outcomes and work process through users’ expectations and experiences. The preliminary results suggest that this tool called the I-SEE (Information System Expectations and Experiences) is a reliable and valid method for this kind of measurement. The researchers acknowledge that their sample size was too small to make conclusive claims. Secondly they only sampled one category of professionals i.e. the Registered Nurses.

These theories and researches suggest some kind of influence of user’s pre-implementation expectations on either outcome or usage of information systems. They all make different detailed findings under varying research conditions within the umbrella field of IT user’s expectations and IT benefits. Each one of the cited researches appears to have concentrated on niche investigations which cannot be generalised to every question of the relationship between users’ pre-implementation expectations and their subsequent perception of IT implementation success.

It seems one of the main ways the management can know whether an IT project is heading towards success is to do a system evaluation from the onset. The next section discusses the various state-of-art EHR evaluations methods.

Evaluation of EHR Systems

Literature shows that there are many ways of evaluating EHR Systems. As mentioned in previous section, many researchers approach the evaluation process by way of analysing specific case studies of health centres which are involved in implementation of EHR systems

One prominent method was employed by Robertson et al. (2010) who evaluated the implementation and adoption of EHR in secondary health care in England's national rollout of NHS Care Record Service. The method entailed the use of multi-site longitudinal case studies which employed the traditional before-and-after evaluation design. The evaluation consisted of interviews of multidisciplinary participants and the research team revisited the study sites again to collect subsequent sets of data.

Most such researches use the experience and insight of system users to evaluate the impact of EHR systems on their work. Hong and Kim (2002) in another study, measured implementation success by evaluating the perceived variation from 'expected goals' which included items like over-expenditure, failure to achieve set time targets, system poor performance and failure to realise benefits. Robertson et al. (2010) on the other hand interviewed users of NHS Record Service to establish the experiences of the early adopters of the national EHR system.

The functionality and features of EHR are probably the most conspicuous factors which have the potential to capture the immediate attention and interest of system users. A whole subject namely the Human Computer Interaction (HCI) is devoted to the design and evaluation of IT system functionality and features to improve ease of use. HCI has many established evaluation techniques for usability of electronic devices. Some of the common techniques used by expert users and developers are cognitive walkthrough and heuristic evaluation.

Cognitive Walkthrough is an evaluative process where expert users step through the action sequence of system prototypes to critique the system and review its usability, (Dix et al. 2004 p321). On the other hand *'Heuristic is a guideline..... that can guide a design decision or be used to critique a decision that has already been made'*, Dix et al. (2004 p 324). Heuristic Evaluation, according to Dix et al. (2004 p 324), is an inexpensive approach which could be used to evaluate early system designs.

Heuristic Evaluation consists of a group of expert users who independently evaluate the functionality of a system. The key point is that it can be used as an evaluative tool for decisions that have already been made. Elements of this approach could potentially be adapted for user driven assessment of an EHR which has been already been implemented.

Usability Testing, a HCI technique used to establish how real users experience software applications, is touted as yielding more accurate results than the use of interviews and focus groups. Foraker Labs (2012) argue that while interviews and focus groups 'attempt' to get users to report accurately their behaviours and preferences using self-report, Usability Testing measures actual performance. It

appears however that this requires the set-up of a field experiment which means dealing with logistics of observing and recording users while they perform their tasks. The researchers would need to deal with issues of confidentiality if the research involves sensitive issues such as patients' medical records.

Evaluative techniques such as laboratory and field studies involve real users. Field studies have the advantage that systems are evaluated in their natural environment, unlike laboratory studies where conditions are manipulated to mimic the ideal status. Robertson et al. (2010) in their research study, which was designed to assess the implementation and adoption of a national Electronic Health Record system for secondary care in England, collected useful data which related to how users rated the performance and perceived usefulness of the EHR systems. This was done through structured interviews to participants.

Evaluations which focus on achieved benefits tend to happen in the later stages of IT life cycle because benefits themselves take a long time to materialise, (Ross 1999). Such evaluations focus less on the implementation process of IT systems but rather on the wider IT project. Longitudinal research designs also tend to be used for long term research projects and the findings tend to be iterative and are likely to give an insight into the overall value of the whole project as exemplified by the research study by Robertson et al. (2010).

Intel Corporation introduced a program called IT Business Value (ITBV) in 2002 as an investment management solution to its customers. In a white paper entitled 'Using IT Business Value to Measure Benefits to Enterprise', the authors explained how the ITBV program provided a framework for *'measuring and evaluating IT products, services and support in terms that reflect business benefit'* (Carty and Lansford 2002). This is one example of an evaluation process which stretches over a significant period of an IT implementation and usage. It appears that ITBV uses metrics and methodologies which measure the financial impact of IT investment. It also appears to be limited to Intel customers.

Shang and Seddon (2002) argue in their article that the problem of restricting measurement of performance of IT systems on financial indices such as Return on Investment (ROI) is that, a lot of benefits are intangible, hence difficult to quantify. Carty & Lansford (2002) acknowledged that it is important to measure other benefits such as productivity, despite the fact that they are difficult to measure. The same authors found it valuable to work with their customers in a collaborative way so that both sides understand each other, during the ITBV programs. ITBV has Human Factor Engineers (HFE) whose role is to measure the impact of intangible benefits termed *'soft benefits'*. These

benefits relate to the human technology interfaces which impacts on human productivity. These appear to be the same as HCI factors. The HFE measures these benefits through **surveys, interviews and observation**.

Tiernan and Peppard (2004) proposed a financial formula for measuring Value of Information Systems. The formula measures value rather than benefit of IT system. As pointed out in previous section Benefits of IT system is a pathway to realising value. Remenyi et al. (2007), defined value as *'the ability of ICT (Information and Communication Technology) to enhance the business performance of the enterprise'*. Because this formula in its format cannot account for non-quantifiable benefits Tiernan and Peppard (2004) proposed that the formula can be modified to accommodate non-quantifiable benefits.

The mathematical formula is potentially useful in evaluation processes that occur towards the middle to the end of the IT Life Cycle. Given that benefits take a long time to accrue and moreover this formula evaluates value rather than IT System Benefits; it is therefore not feasible to use this formula to evaluate the implementation process of ECRS.

Kaplan and Norton (2007) described a method which is used to measure benefits of IT systems. This method, called the Balanced Scorecard combines the financial metrics with *'company's relationship with its customers, its key internal processes and the learning and growth'* (Kaplan and Norton 2007). However this process appears to encompass wider elements of an organisation and does not focus on one particular aspect such as one IT system within the organisation. It appears that it quantifies performance in all aspects of the organisation to generate one ultimate score. It is therefore difficult to isolate success which accrues from IT on its own merit.

There are many critics of using econometrics to measure value or benefit of IT Investments. Boyle (2001) was quoted by Remenyi et al. (2007 p.45) indicating that econometrics fail to quantify the *'complexity of human life'*. There is ongoing debate about definitions of IT benefits and value and no method of measurement has been universally adopted by IT practitioners (Remenyi et al. 2007).

In another article entitled *'The impossibility of an Ideal Metric for Health Service Benefit Measurement'*, Richardson and Mckie (2009) sought to discredit any attempt to establish standard benefit measurement methodologies. Instead they suggest that it should be acceptable to postulate a descriptive formula which explains what is known in a specific domain and then use this knowledge to make practical predictions. The authors therefore are suggesting that there is no specific universal metric to measure Health benefits; rather a selection of metrics should be based on the context of the issues which need to be analysed. While Richardson and Mckie (2009)'s article is generally

addressing benefits as they relates to health services it could potentially be extrapolated into the field of human computer interaction and IS success measurement where similar conclusions on benefit measurement metrics could potentially be made.

Cameron and Whetten (1983) developed a seven question strategy for use when attempting to measure organisational performance. The seventh question asks; *'against which referent is effectiveness to be judged?'* Shang and Seddon (2002) argued that this question can be answered in three ways depending on the circumstances.

- i) The first way is to use the stated goal of the Information system if the system were to be evaluated years after implementation.
- ii) The second way is to compare performance with industry benchmark
- iii) The third way is to compare actual performance of system with *'some ideal level of performance'*.

The ECRS is still in its infancy; therefore the first way could not possibly be used on its own.

There is not much literature on Ireland or other countries where a proper benchmark for measuring performance or benefits of HIS for Health Service providers for People with Intellectual Disabilities. In a report commissioned for the European Commission, Dobrev et al. (2008) aggregated a number of methodologies which have been used in various case studies to evaluate socioeconomic impact of EHR systems. The methods were all different and specific to the purposes which they were formulated. Most of the Methods are not applicable to a specific stand-alone system like the ECRS. Appendix 3 shows a list of Assessment methodologies compiled by Dobrev et al. (2008)

Perhaps a combination of the second and third way methods of organisational performance could potentially be adapted for evaluating the effectiveness of the ECRS given the suggestion by Richardson and Mckie (2009) **who found merit in designing specific methodologies which suited the local purpose**. Ideal level of performance is well documented and as shown earlier there is a lot of literature which identifies benefits and ideal features of EHR systems. The actual performance of the EHR can then be compared with this ideal level of performance.

Remenyi et al. (2007) grouped approaches of IT measurement into three categories namely fundamental measures (standardized metrics); composite approach (combining several metrics to come up with weighted metrics) and **Meta approaches which are based on the context of what is to be measured**. Meta approaches cannot be generalized because they refer to the local context which is being measured. They could be used to compare present and future project.

The authors suggested that the choice and focus of measurement of IT benefits is dependent upon the perspective of the person asking the questions. A company marketing manager, accountant and operational managers will focus on different aspects of benefits, (Remenyi et al. 2007). Shang and Seddon (2002) suggested that when evaluating Information Systems it is important to take the perspective of middle level managers because these managers understand the likely benefits to come out of the IT in line with the objectives of the organisation. Senior level managers according to Shang and Seddon (2002) tend to focus on financial benefits which are always difficult to attribute to the effects of the IS system on its own. Lower level managers and end users tend to focus of IT system attributes and usability and may not always focus on realising the benefits which will lead to meeting the objectives of the organisation, (Shang & Seddon, 2002).

Häyrynen et al. (2008) noted in their study that many organisations used interviews, structured and semi structured questionnaires, in-depth and open ended interviews and videotaping as method for data collection to determine the impact of the EHR systems to organisations. 'System quality was assessed by means of observation and time use by means of self-report, by computer or observation'.

Literature is awash with articles chronicling the success and failures of IT systems in the health Sector. Many different methodologies have been used to evaluate IT systems. van der Meijden et al. (2003) carried out a systematic literature review to establish the various methods used by researchers to evaluate HIS. They discovered that descriptive and correlational methods were the most frequently used methods. Chart reviews, questionnaires and interviews were the most popular data collection methods. Not every researcher used multiple attributes but the user satisfaction attribute was most frequently measured using questionnaires.

The researchers conclude that there is need for development of methods which evaluate 'wide range of factors' (van der Meijden et al. 2003). This suggests that evaluation methods which encompass wide ranging factors may have a better chance of evaluating success or failure of a system.

'*Focused Performance Measures*' have been identified as one of the critical success factors to the implementation of IT (Umble et al. 2003). This suggests that a selection of a proper method of EHR evaluation is essential.

(Davis, 1989) developed a '*measurement Scale for perceived usefulness and perceived ease of use*' of IT systems. His research developed and validated a psychometric test for perceived usefulness and perceived ease of use of IT systems, two variables which were found by other researchers to be

important determinants of successful adoption of IT. The scale validated for content validity and the reliability and construct validity in two field studies. Appendix 2 shows a sample of this scale. The format and structure of the survey questionnaire is a potential useful tool for formulating survey questions to determine users' ECRS pre-usage level of benefit expectations and their subsequent perception levels.

Recently Wakefield et al. (2007) also published preliminary results of a research which validated a psychometric scale which is designed for measuring HIS users' expectations and subsequent experiences of using same systems as a determinant of the system outcomes. They developed the scale called the Information Systems Expectations and Experiences (I-SEE). Since the research paper is only a preliminary publication it did not make available the actual I-SEE scale but the research paper describes how the survey questions were formulated.

Both Wakefield et al. (2007) and Davis (1989) used Likert type of questions. Wakefield et al. 2007, used a 6 point scale while Davis, 1989 used a 7 point scale, highlighting difference in opinion as it relates to inclusion of neutral questions in the scales.

Literature Conclusions and Gaps

There is increased demand on Health Services Providers in Ireland, Europe and the rest of the world to improve health service provision (European Commission 2004, HSE 2010). One of the solutions being touted is the usage of EHR to replace the traditional paper-based patient record systems. Some of the benefits identified include reduction of medical errors, easy, secure, safe and efficient access to patient health records.

Yet in spite of all this concerted effort, the adoption and success of EHR worldwide has been less than satisfactory (Dobrev et al. 2008). There is a lot of research which has gone into documenting reasons for IT system failure and identifying CSF of same. Many reasons for failure have been identified and they can be summarised into 3 categories, namely; effects of **product quality, effects of product implementation process and setting up of concurrent evaluation.**

Vendors and developers of HIS are ever trying to make the best possible software in order to **improve quality** of EHR products. Health Informatics practitioners are very much involved in the standardisation of HIS to make them interoperable and make them fit for purpose (Kalra 2006). Available evidence suggests that the success of such IT is as much a responsibility of the users and its implementers as it is of the vendors and its developers.

Literature suggest that many health Informatics practitioners see very little chance of HIS and IT in general realising benefits if no serious attention is paid to the implementation processes. Adequate support to users and usage of such strategies as benefit realisation programs have been argued to be of value (Ward and Elvin 1999, Sedera et al. 2001, Peppard et al. 2007). Despite the evidence and argument, very few implemented systems tend to pay adequate attention to the implementation process of EHR system, which probably explains part of the high failure rate.

Perhaps majority of EHR systems are initiated without concurrent implementation of benefit management programs. Yet there is very little research which has been done to help salvage EHR systems implemented without benefit realisation programs. Some of these systems are relatively new and on face value appear to be salvageable if proper evaluation strategies are implemented. Given the fact that EHRs have poor success rate especially when executed without benefit realisation plans it appears to be a good idea to investigate best ways of maximising performance of such EHRs systems which inadvertently find themselves in this situation.

Involvement of users has been identified in researches as an important part of EHR product development, implementation and evaluation. Curtis (1992) as cited by Grimson (2001) asserts that part of IT failure has been the fact that there is inadequate involvement of clinicians or end users in setting up of these systems. Clinicians or users of the EHR systems have been demonstrated to offer very useful information during the planning and implementation of benefit realisation management processes (Peppard et al. 2007). Clinicians are the people who have to deal with the changes in work practises which are brought about by the implementation of new EHR systems and therefore their involvement ought to be vital.

Once EHR systems have been implemented, on-going evaluation has been identified in researches to be very vital to the success of the implemented EHR system. Many forms of evaluation have been suggested and some have been used in different EHR and IT projects with varying degrees of success. One remarkable observation is that there are no one-size-fit-all evaluation methods. In fact some notable authors Richardson and Mckie (2009) are not in favour of attempts by some, to standardize evaluation of IT systems. Remenyi et al (2007) and Richardson and Mckie (2009) advance the argument that system evaluators should design local evaluation methods which suits local scenarios.

Users or clinicians have been shown to provide useful information which can be used to evaluate the effectiveness and success of IT systems, such as EHR, (Ginzberg 1981, Szajna and Scamell 1993, Wakefield et al. 2007). Users' expectations before they use IT systems have been compared with

their perceptions of success as well as actual performance to evaluate the effectiveness of IT systems. While the use of one component or indices of IT to evaluate its effectiveness and success is not adequate, the information collected, can be one important piece of a jig saw puzzle.

Wakefield et al. (2007) have demonstrated through their I-SEE tool that usage of expectations and experiences of users is a valid and reliable method of measuring EHR outcome and workflow impact. However they do admit to methodological shortfalls such as small sample size and they sampled one profession. They do suggest further studies which address these issues.

Perhaps it is worth establishing a local based partial evaluation process of implementation of the ECRS system, utilising the clinicians who will be using this EHR system. Literature review has demonstrated that users are a vital component of the implementation process of EHR systems and some researchers have used varying instruments to harness vital user information to suit their own local and specific needs. Similarly this research aims to investigate the ECRS users' early evolving expectations and perceptions of benefits arising from usage of ECRS. The researcher hopes the analysed information will help inform the planners on the way forward as the ECRS further develops into a mature product.

3 RESEARCH QUESTION

3.1 Research Question

The background information and the gap identified in the literature led to the following research questions:

What is the impact of initial usage of ECRS on the users' expectations of benefit realisation?

This research question is divided into the following sections:

- 1. What is the users' level of benefit expectations prior to using ECRS?**
- 2. What is the users' perception level of benefit realisation during early stages of ECRS usage?**
- 3. Is there a difference between ECRS users' pre-usage benefit expectations level and subsequent perceptions level of the same benefits after the initial ECRS usage?**

Null Hypothesis: There is no significant difference between ECRS users' pre-ECRS usage benefit expectations and subsequent perception level of the same benefits during early ECRS usage

- 4. What conclusions can be drawn from the observed patterns of relationships and the levels of expectations and perceptions?**

4 RESEARCH METHODS

4.1 Introduction

This chapter outlines the methods and instruments used to collect the data required to answer the research question. It also describes the population of the study and the sample thereof.

4.2 Research Methodology

This study is an evaluative study with mixed quantitative and qualitative designs. Participants were required to participate in 2 data collection timelines in which they were required to express their level of benefit expectations before and during early usage of the ECRS respectively.

Through the research questions, this study evaluated the impact of usage of ECRS on users' opinions of benefits realisation.

4.3 Research Design:

This study is a 'One-Group Before and After' in which data is collected from a panel of participants (Leedy and Ormrod 2009)

- a) Before they start using the ECRS
- b) During early usage of the ECRS

The Design is illustrated in table 2.

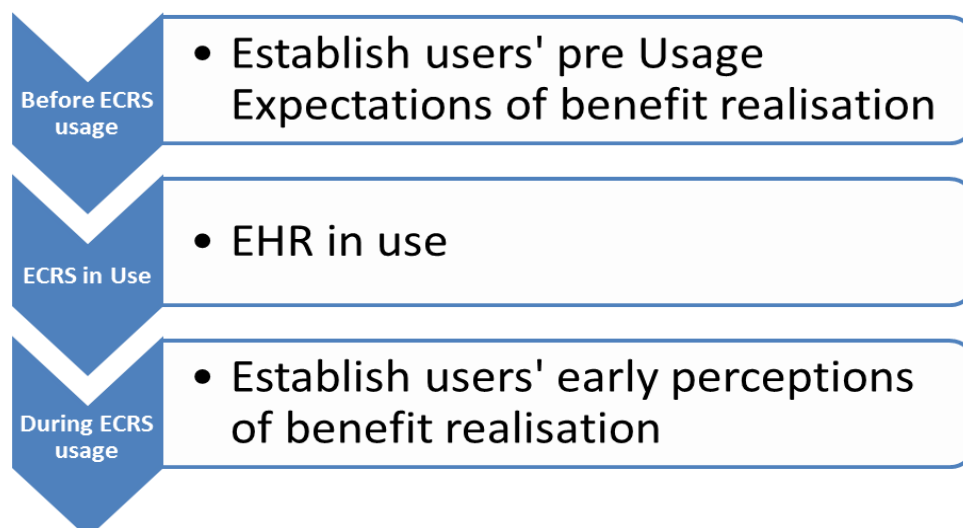


Table 2: The Research Design adapted from (Leedy and Ormrod pg 230; 2009)

The one group before and after is a design which was preferred by many of the reviewed researches for such types of study. The case in point is the study by Wakefield et al (2010). This study is also partly a 'within-subject-design' in which 2 repeated measures were applied to some participants (Aron et al. 2010 p. 424). In addition participants who had already commenced using ECRS (hence ineligible to participate in first part of research) were also included in the second part of the study.

4.4 The Target Population

The target population of the study was defined as all current and potential users of the ECRS who worked for the specific Health Service Provider which was the subject of this research between the period of 2010 and 2012. Participants of the research were drawn from all clinical areas, which included medical practitioners, allied professionals, nursing staff and administrators who were current and potential users of the ECRS between the specified dates.

The population size was estimated to be between 80 and 100 ECRS users.

4.4.1 The Frame Population

The frame population which was defined by Groves, (2004) as *'the target member of the population who had a chance of being selected into the survey sample'* consisted of ECRS users who started using the ECRS for the first time between January 2012 and June 2012.

The rest of the other population members were assumed to bring a significant error of measurement if included in the survey sample either by virtue of their prolonged prior knowledge of use of ECRS or lack of training as the case may be.

4.5 Sample Design

4.5.1 Sample Constructs

The following elements of ECRS users' information were required;

- ECRS users' pre-usage level of benefit expectations
- ECRS users' perception level of benefit expectations during early ECRS usage.

4.5.2 Sample Frame Inclusion Criteria

Survey One:

- New ECRS users who have been using ECRS for less than 6 weeks or those who have not started to use the system but were due to start within 1 month from the start of data collection i.e. January 2012 to June 2012 inclusive.
- Users who were not due to start using ECRS within the data collection period but would have received training on ECRS usage.

Survey Two:

- Users who were eligible in survey one in addition to those who were already using the ECRS prior to commencement of the data collection.

4.5.3 Exclusion Criteria

Survey One

- All users of ECRS who have already started using the system more than 6 weeks after start of data collection. These users were assumed to be already familiar with the system and as such there was no value to collect their pre-usage expectations because they were no longer categorized as 'pre-system users'.
- Future users who had not received ECRS usage training and were not scheduled to use ECRS by the commencement of data collection.

Survey Two

- Users who had not commenced using ECRS by the start of data collection process

4.5.4 Sample Type

Given the inclusion and exclusion criteria many users from the population were ineligible to participate in the first data and second collection part of the research. The main reasons for exclusion were

- a) The fact that a many of users started using the ECRS outside the period of inclusion defined by the inclusion criteria Some users were not yet set to start using the ECRS during the period demarcated by the inclusion criteria
- b) A small number of users were excluded from participating in the first part of the data collection process because they worked in close proximity to users who had used the system for more than 2 months prior to them using the same system.

The sample was therefore selected on the basis of the inclusion criteria and all eligible users received requests to participate in the research. Everyone eligible was invited to participate because the eligible participants' number was deemed to be small in relation to the population.

The sample type used therefore was a **Sample of Convenience**.

4.6 Data Collection Instrument: Survey Methodology

Survey methodology was used to collect quantitative and qualitative data required to answer the research questions. Questionnaire was the selected instrument of data collection because;

- It offered greater anonymity and it allowed for the researcher to ask sensitive information from colleagues.
 - It was the instrument of choice of most studies of this nature. The design of the survey was strongly influenced by two studies reviewed in literature;
 - a) A study by Wakefield et al. (2007) which described and validated a psychometric questionnaire based measurement scale (I-SEE), demonstrated that survey is a strong instrument useful for comparing EHR users' expectations and experiences EHR usage.
 - b) A study by Davis (1989) described a Likert Scale designed questionnaire which was adjudged to be useful to measure the perceived usefulness and perceived ease of use of IT systems.
- It has to be noted however that surveys suffer a general weakness of low response rate. Baruch (1999) noted from review of 175 studies that the average response rate of surveys is 55.6%.

Disadvantages of Questionnaires such as low response rate and 'self-selecting' bias were noted. Participants provided a set of answers to a self-administered questionnaire at the beginning of the research (pre-ECRS usage expectations). After 8 weeks the participants who met the inclusion criteria were asked similar questions (subsequent perceptions) at the end of the data collection process. In between the 2 data collection periods the participants used ECRS system as normal. The instrument included open ended questions and comments in which participants could expand on their answers in an unstructured way, hence providing some **qualitative data**. Qualitative data was planned to be systematically analysed through dividing responses into emergent category themes then interpreting the overall messages.

4.7 Survey Design

To answer the research question 2 questionnaires (Survey 1 and Survey 2) one at a time were distributed to the participants.

4.7.1 Survey 1

Questionnaire 1 was designed to establish participants' expectations either before or during the very early usage of the ECRS system. The questionnaire consisted of the following sections;

Section 1: Questions 2-3

These were questions which sought to validate if respondents met the inclusion and exclusion criteria.

Section 2: Questions 4-12

This section consisted of a list of questions which required participants to rate their expectations of ECRS as they related to 8 benefits of EHRs which were derived from the Literature review. A 7 point Likert Scale (table 3) whose categories ranged from highly likely to highly unlikely was used for participants to select choices which best described their expectations. Participants were provided with a choice to select 'neither likely nor unlikely' if they were not sure and to select 'not applicable' if they deemed the question not to be applicable.

The questions were presented in future tense to reflect that the information sought related to future expectations.

The expectations of benefits rated by participants in this section are as follows

- **Benefit 1: Improved communication (among clinicians/users)**
- **Benefit 2: Reduced time spend on documentation**
- **Benefit 3: Faster record access**
- **Benefit 4: Improved (record) legibility**
- **Benefit 5: Improved teamwork (and collaboration among clinicians)**
- **Benefit 6: Improved (record) accuracy**
- **Benefit 7: Improved record consistency**
- **Benefit 8: Improved records completeness**

The questions were designed and formatted from the point of view of positive response. Similar line of questioning has been used by (David 1989). The positive presentation of the questions, though it has been recognised as 'leading', the alternative design of mixing positive and negative approaches has also been argued to bring about its own form of bias where varying patterns of responds caused largely by the way the questions are asked (Buckingham and Saunders 2004).

Section 2: Questions 13-15

This section consisted of a list of questions which required participants to identify any other benefits which they considered to be very important in enhancing client care. The participants were required to rate their level of expectations that usage of would result in realisation of those user-identified benefits.

This section was designed to allow users to identify any other benefits which they felt were not included in the previous section. This section also required participants to explain why their ratings were low if they gave low ratings to some or all of their identified benefits.

Section 3: Questions 11-15

This section contained questions which required participants to rate EHR system features which they thought were important in making it easy and meaningful to use the system effectively and efficiently. The last part of the section required participants to identify any other EHR features which they considered to be important in enhancing effective and efficient usage of an EHR for the type of service users which they provide a service for.

Section 4: Questions 16-20

These questions required participants to state their demographic information. This information helped to categorise and analyse responses into relevant categories which gave more qualified meaning to the results. Special care was taken to avoid certain sensitive questions which potentially identified individuals and it was made clear to the participants that the questions were not compulsory.

The full sample of the Questionnaire 1 is shown in Appendix 4.

4.7.2 Survey 2

Questionnaire 2 was designed to establish the participants' perception level of benefit realisation resulting from ECRS usage. The Questionnaire consisted of the following sections:

Section 1: Question 1, 2 and Last 3 Questions

The purpose was to verify, validate and categorise the participants to ensure they meet the inclusion criterion. The last 3 questions of the questionnaire were also part of this section. They sought to establish participants' demographic history. They were placed at the end because they sought information which was potentially sensitive. The questions were placed at the end so that they do not get in the way of participants at the outset thus improving on response rate.

Section 2: Questions 3-19

These questions were designed to capture participants' perception of ECRS implementation process as it related to benefits and features of the system. This section included a follow up to questions 4-12 in Survey 1 in order to allow a comparison of pre-usage expectations and later perceptions. A 7 point Likert scale (table 3) was also used for each of the 8 and other benefits. The score categories ranged from highly agree to highly disagree.

In addition this section included benefits and features which were identified by participants in survey 1. Participants were required to rate the benefits according to the extent to which they agree that they were on course to be realised. They were also required to state whether the features they wanted prior to use were indeed present.

Section 3: Questions 20-29

These set of questions were designed to collect other information which may be relevant for the overall evaluation of the performance of the ECRS and its management so far.

The full questionnaire 2 is shown in Appendix 5.

4.8 Criteria for Scoring Categories of Benefits Variables

Table 3 shows how each of the EHR benefits will be scored for analysis of Surveys 1 and 2.

Categories for Descriptive Statistics		Score/weight rank	Categories for Inferential Statistic's (counts)
Benefit Expectations (Survey 1)	Benefit Perceptions (Survey 2)		
Extremely likely	Highly agree	7	High Expectations/Perceptions
Quite likely	Agree	6	
Slightly likely	Somewhat agree	5	
Neither likely or unlikely	Neither agree nor disagree	4	Middle Level Expectations/Perceptions
Slightly unlikely	Somewhat disagree	3	Low Expectations/Perceptions
Quite unlikely	Disagree	2	
Extremely unlikely	Highly disagree	1	

Table 3: Categories and scoring criteria for each of 8 benefit expectations and perceptions in Survey1 and 2 respectively

The Likert scale categories for each of the 8 benefits were treated as ordinal data because of their rank ordered categorical nature. The criterion shown in table 3 applies to interpretation of measures of central tendencies in the Results Section.

Relationships and rank/mean differences between levels of benefit expectations and perceptions will be determined using inferential statistic in order to answer the research questions.

4.9 Reliability and Validity of the Questionnaires

The questionnaires were designed and based from other questionnaires which have been designed for related information. Prior to administration the questionnaires were tested and reviewed by a colleague who would otherwise have been part of the sample. Corrections adjustments and omissions were made to the final questionnaire.

Following data collection of Questionnaire 1, further adjustments were made to Questionnaire 2 to ensure that information collected was relevant and would answer the research question. Comment spaces were either reduced or omitted from Questionnaire 2 based on the patterns of responses from Questionnaire 1.

4.10 Ethical Approval

Ethical Approval for the Data Collection was sought from Daughters of Charity Services and was subsequently granted in April 2012. Appendix 7 shows a copy of the Ethical Approval letter.

4.11 Participants Recruitment Process

The services of a gatekeeper were sought as specified by the requirements of the Daughters of Charity Ethics Approval Committee. The gatekeeper was tasked as the link person between the participants and the researcher. The gatekeeper was responsible for the recruitment of participants. The gatekeeper was selected on account of the fact that she had natural access to all participants through her own brief.

5 RESULTS

IBM SPSS Statistics 19 and Microsoft Office Excel 2010 were used to process the quantitative data. Themes and categories emerging from qualitative data were manually processed in Excel 2010.

5.1 Frequencies of the Respondents

A total of 30 clinicians were invited to participate in Survey 1 of the study and 45 clinicians in Survey 2. Twelve participants responded to survey 1 (40% response rate) and eleven responded to Survey 2 (24% response rate). Participants were provided with 3 options for completing both surveys.

- a) Paper based fill-in and mail option,
- b) Fill-in and submit online option (www.surveymonkey.com)
- c) Fill-in electronic pdf format then print or email back option.

Figure 8 shows the frequencies by percentage of options selected by participants in Survey 1. 50% of participants selected the paper based response option.

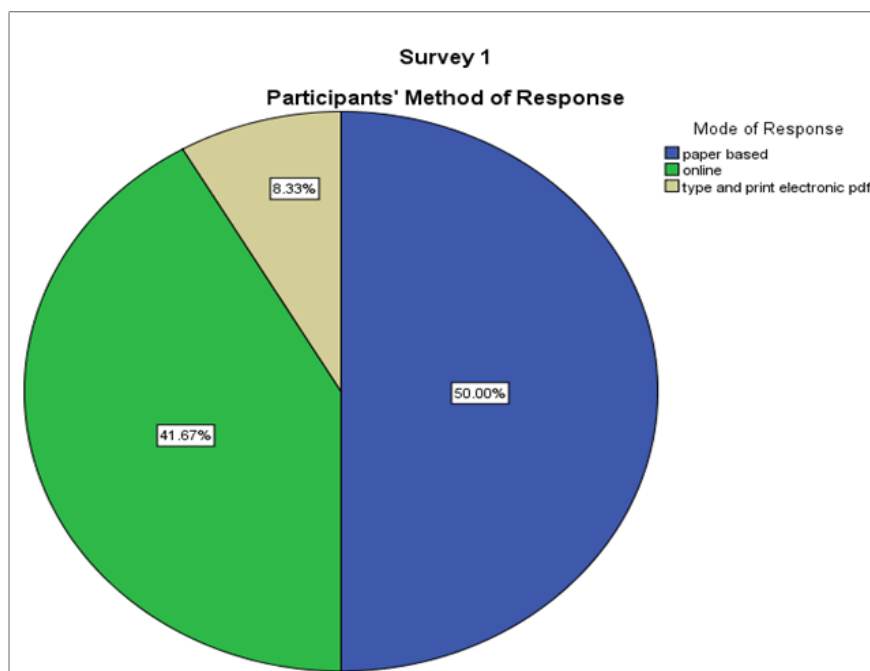


Figure 8: The frequency of Response methods chosen by respondents to Survey 1

41.7% of participants chose to complete and submit survey 1 via electronic online option while only 8% preferred completing an electronic pdf format attachment, printing it off and posting it.

Figure 9 shows a slight increase in the survey 2 online response method to 45.5% when compared with Survey 1 (41.8%).

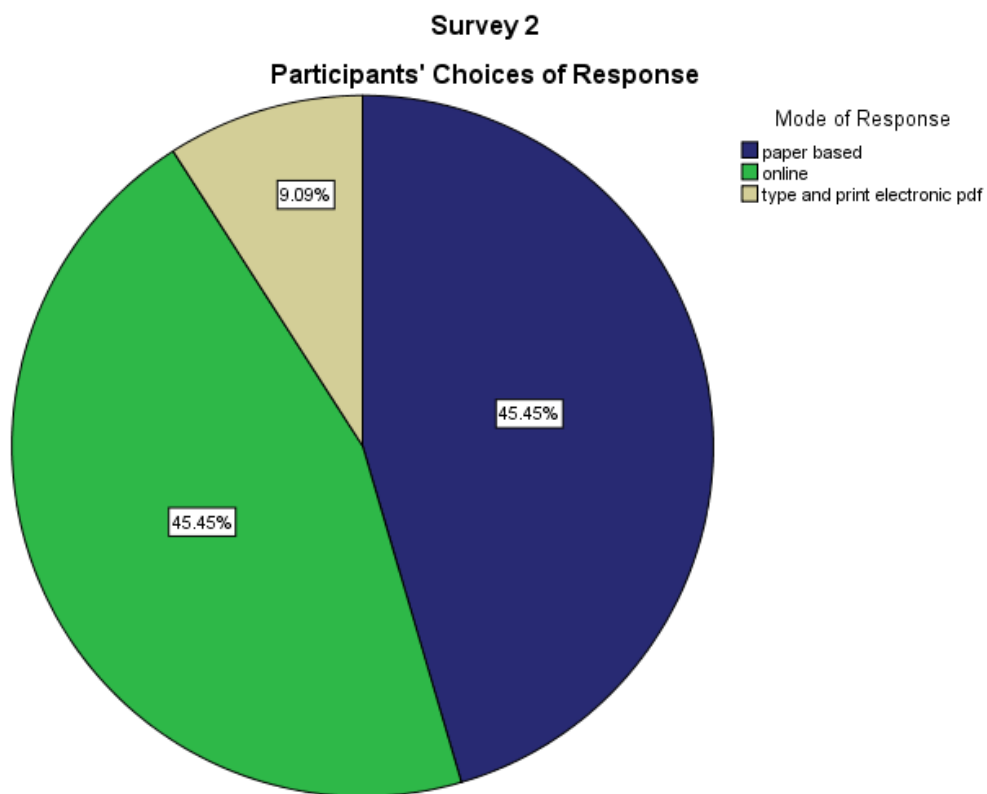


Figure 9: the frequency of Response methods chosen by respondents to Survey 2

Figure 10 and 11 shows the breakdown by age categories, of the participants' response methods in survey 1 and 2 respectively.

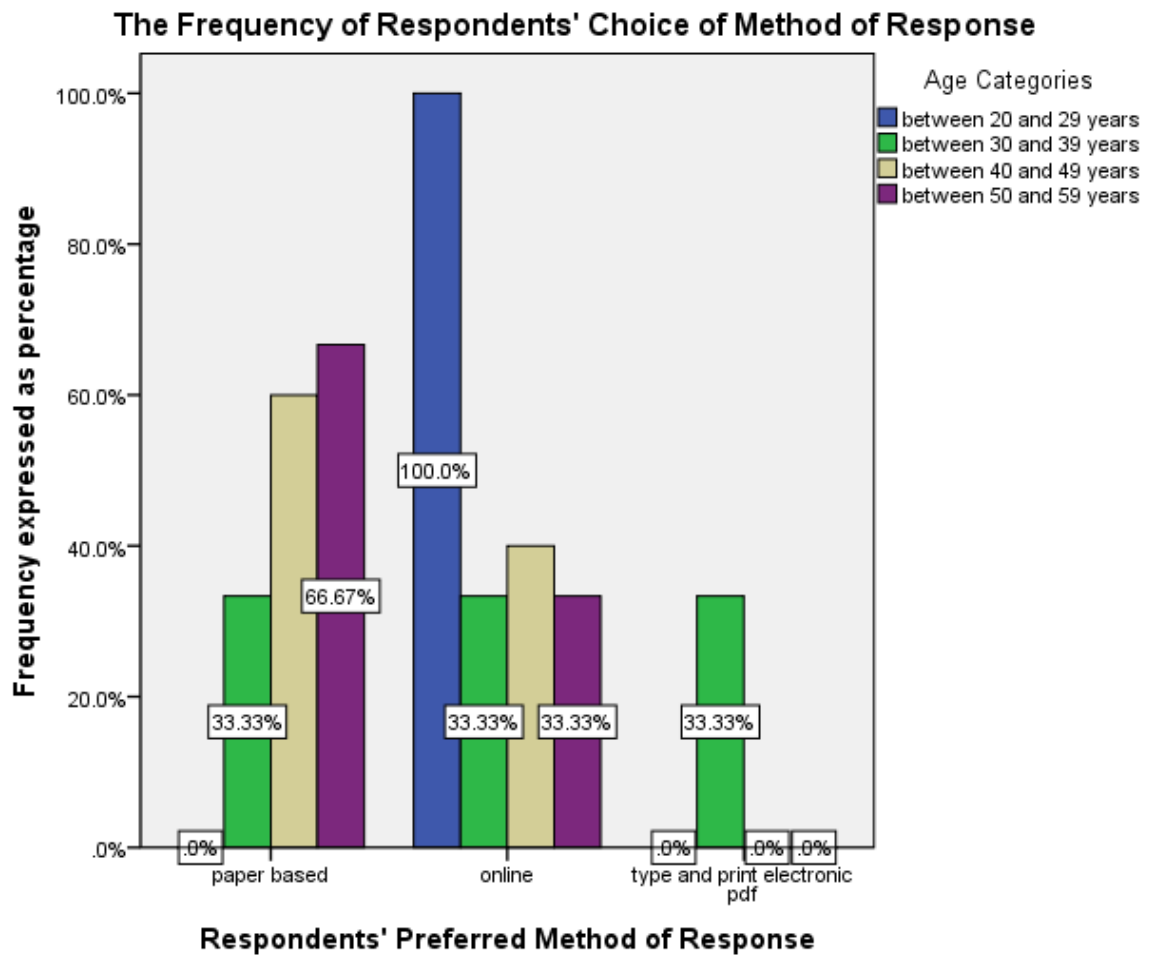


Figure 10: Frequency of Respondents' preferred method of participation to survey 1

The 2 figures show that in survey 1 and 2 all respondents between the 20 to 29 years category preferred to participate via the online survey option.

There were variations in selection of response options by participants in the 30 to 39 category. The type-and-print-pdf method was the least popular among all age groups.

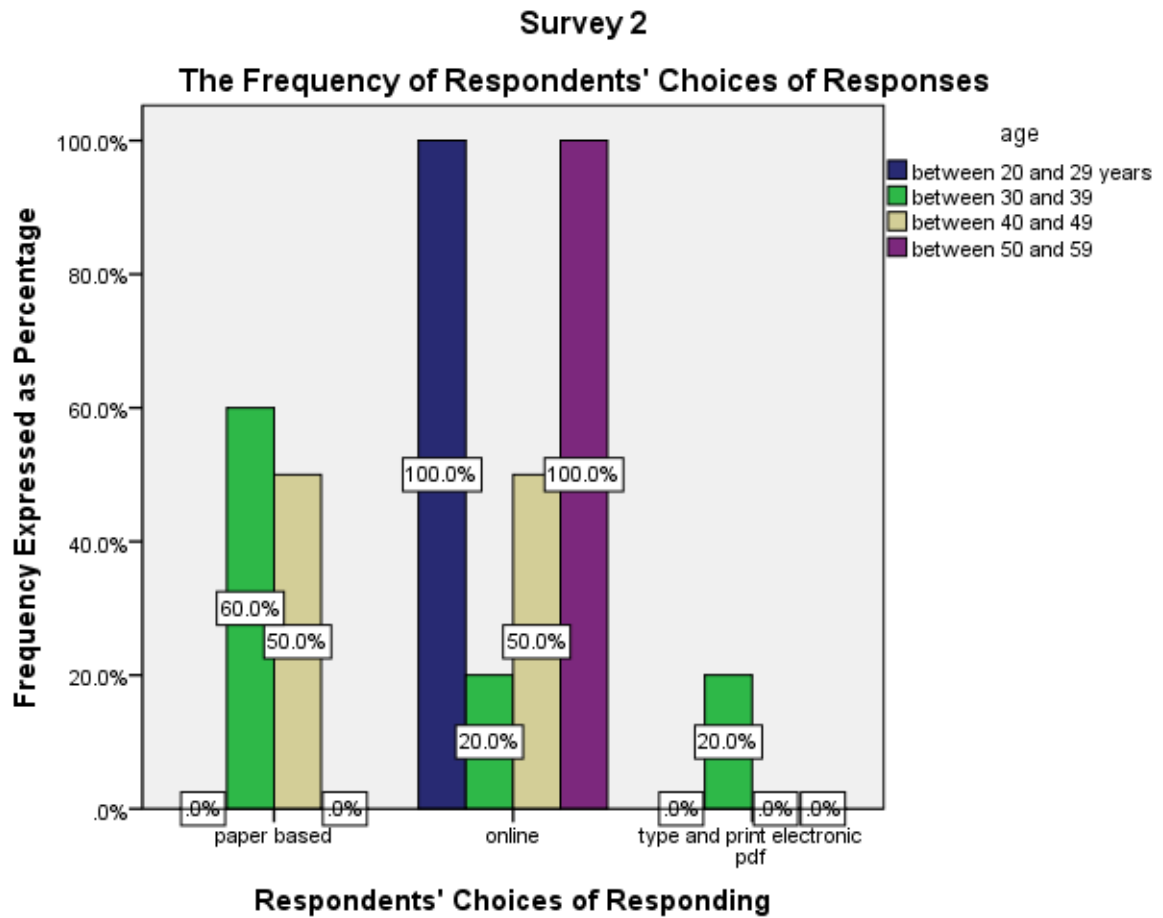


Figure 11: The frequency of participants' preferred method of participation to survey 2

A One-Way ANOVA test was run to see if the relationship between age and preferred method of response was significant. Table 4 shows that the F statistic for survey 1 was 0.724 which was not significant at 95% confidence level.

One Way ANOVA –Survey 1					
Preferred Response Option					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.050	3	.350	.724	.565
Within Groups	3.867	8	.483		
Total	4.917	11			

Table 4: The F statistic for the comparison between age and preferred method of Survey response

Table 5 shows that the Survey 2 statistic of 0.216 was also not significant at 95% confidence.

One Way ANOVA- Survey 2					
Preferred Response Option					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.400	3	.133	.216	.882
Within Groups	3.700	6	.617		
Total	4.100	9			

Table 5: The F statistic for the comparison between age and preferred method of survey response, Survey 2

5.2 The Results for Participants' Level of Benefit Expectations pre-ECRS Usage

Table 6 shows the mean, the median and the mode of each of the 8 benefits scores/ranks in survey 1. All three measure of central tendency show that participants' level of benefit expectations (except for the benefit of '*reduced time spend*') were all above the middle point meaning that on average participants showed a high rather than a low level of expectation.

Benefits → Statistics	Improved Communication	Reduced Time Spend	Quick Record Access	Improved legibility	Improved Team Work	Improved Record Accuracy	Increased Format Consistency	Improved Record Completion
N Valid	12	12	12	12	12	12	12	12
Missing	0	0	0	0	0	0	0	0
Mean	5.50	3.50	5.92	5.33	5.33	4.67	5.17	4.67
Std. Error of Mean	.500	.544	.336	.310	.376	.482	.490	.376
Median	6.00	3.50	6.00	5.50	6.00	5.00	6.00	5.00
Mode	6	4	7	6	6	6	6	6
Std. Deviation	1.732	1.883	1.165	1.073	1.303	1.670	1.697	1.303
Skewness	-1.575	.392	-.640	-.804	-1.634	-.208	-.846	-.735
Std. Error of Skewness	.637	.637	.637	.637	.637	.637	.637	.637
Minimum	2	1	4	3	2	2	2	2
Maximum	7	7	7	7	7	7	7	6

Table 6: The frequency statistics for users' benefit expectations pre- ECRS usage.

The table shows that 7 out of 8 benefits have a negative skew and benefit of '*reduced time- spend on documentation*' had a positive skew. This suggests that the pattern of response was not normally distributed.

Figure 12 and 13 show graphs for the respective mean scores and the median ranks for each of the 8 benefits in survey 1.

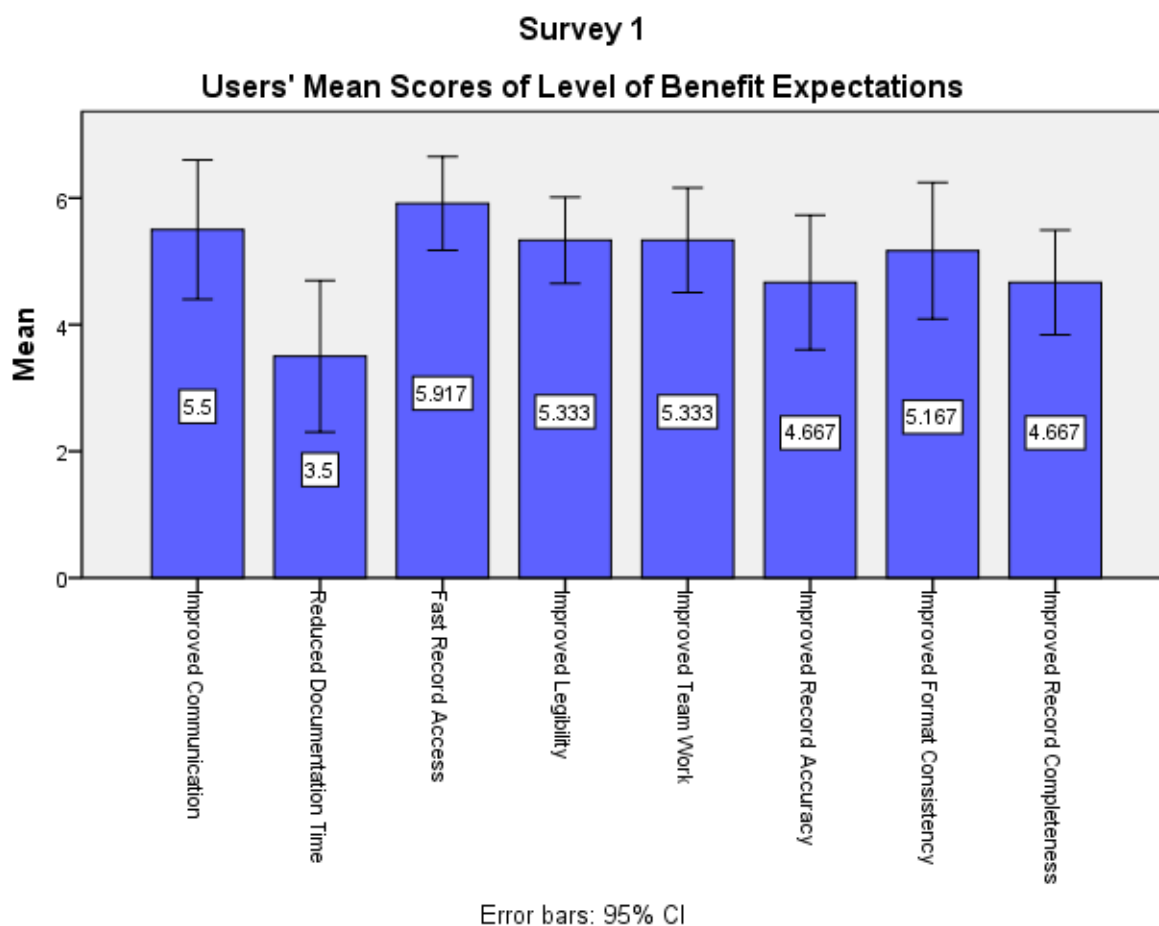


Figure 12: Participants' mean scores for levels of benefit expectations (pre-ECRS usage)

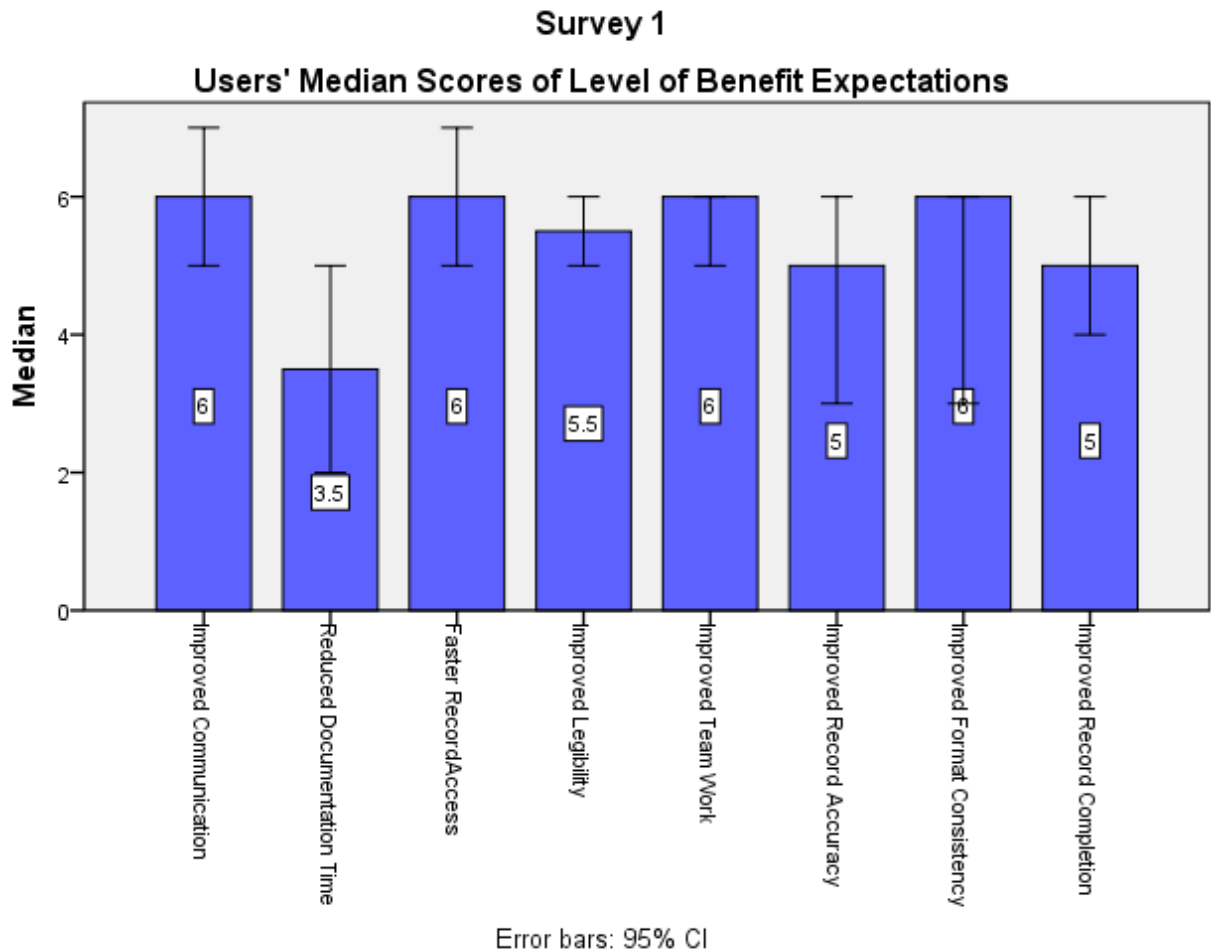


Figure 13: Participants' median ranks of levels of benefit expectations (pre-ECRS Usage)

For 7 out of 8 benefits the graph shows that participants had high levels of expectations before using ECRS.

The mean score, median and mode ranks for the benefit '**reduced documentation time**' was on the halfway mark which corresponded to the neutral rank, '**neither agree nor disagree**'. While the Error bars which represent the standard error of the sample show that there is no significant difference between the median ranks of all of the 8 benefits at 95% confidence level the Friedman test shows a result consistent with a significant difference between at least 2 median ranks of the benefits.

Table 7 shows a p value of 0.02 which is significant at 95% confidence level.

Test Statistics^a

N	12
Chi-Square	22.951
df	7
Asymp. Sig.	.002

a. Friedman Test

Table 7: Friedman test result show that there is a significant difference between at least 2 median ranks of the 8 benefits

The participants' levels of expectations were transformed into 3 categories previously illustrated in column 4 of table 3. Figure 14 shows the proportions of participants' levels of benefit expectations before ECRS usage.

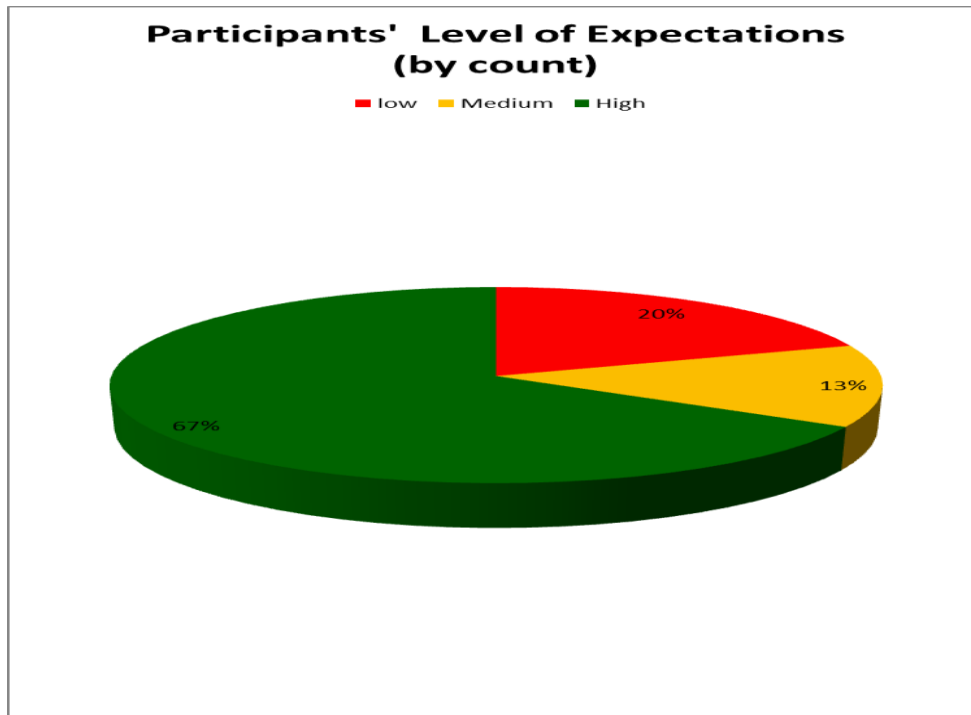


Figure 14: Proportion of participants' level of benefit expectations in survey 1

Overall a big majority (67%) of participants had high pre-ECRS usage expectations. An inferential statistic was required to confirm if the observed differences in the 3 categories is significant.

Given that the benefits variables frequencies did not follow a normal distribution curve Friedman test, a non-parametric test was used to determine if difference between the means/medians of the 3 computed categories of expectations for Survey 1 was statistically significant.

Ranks Survey 1 (Benefit Expectations)

	Mean Rank
Low Expectations	1.71
Middle Level Expectations	1.54
High Expectations	2.75

(a)

Test Statistics^a

N	12
Chi-Square	10.511
df	2
Asymp. Sig.	.005

a. Friedman Test

(b)

Table 8: Friedman test results which tested for significant difference between 3 levels of benefit expectations

Table 8 results show that the p value= 0.005 is significant at 0.01 significant level. These results therefore suggest that there is a significant difference between Low expectations, Middle/neutral level expectations and High expectations.

A post hoc Wilcoxon test (Table 9) was done to determine which of the 3 categories were significantly different.

Test Statistics^c

	Middle Level Expectations- Low Expectations	High Expectations – Middle Level	High Expectations - Low Expectations
Z	-.408 ^a	-2.795 ^b	-2.294 ^b
Asymp. Sig. (2-tailed)	.683	.005	.022

a. Based on positive ranks.

b. Based on negative ranks.

c. Wilcoxon Signed Ranks Test

Table 9: Wilcoxon test to check which 2 of the 3 categories had a significant difference.

The results show that High expectations and middle level expectations were significantly different at 99% confidence level. Also significant at 95% confidence level was the difference between the

categories of high expectations and low expectations. The results confirm the differences observed in figure 14.

5.3 The Results for Participants' Level of Perceptions of Benefits Realisation during ECRS usage

A similar analysis of the 8 benefits was performed for survey 2 using categories' weighting shown in table 3.

Figure 15 and 16 show the mean scores and the median ranks for the users' perceptions of benefit realisation during ECRS usage.

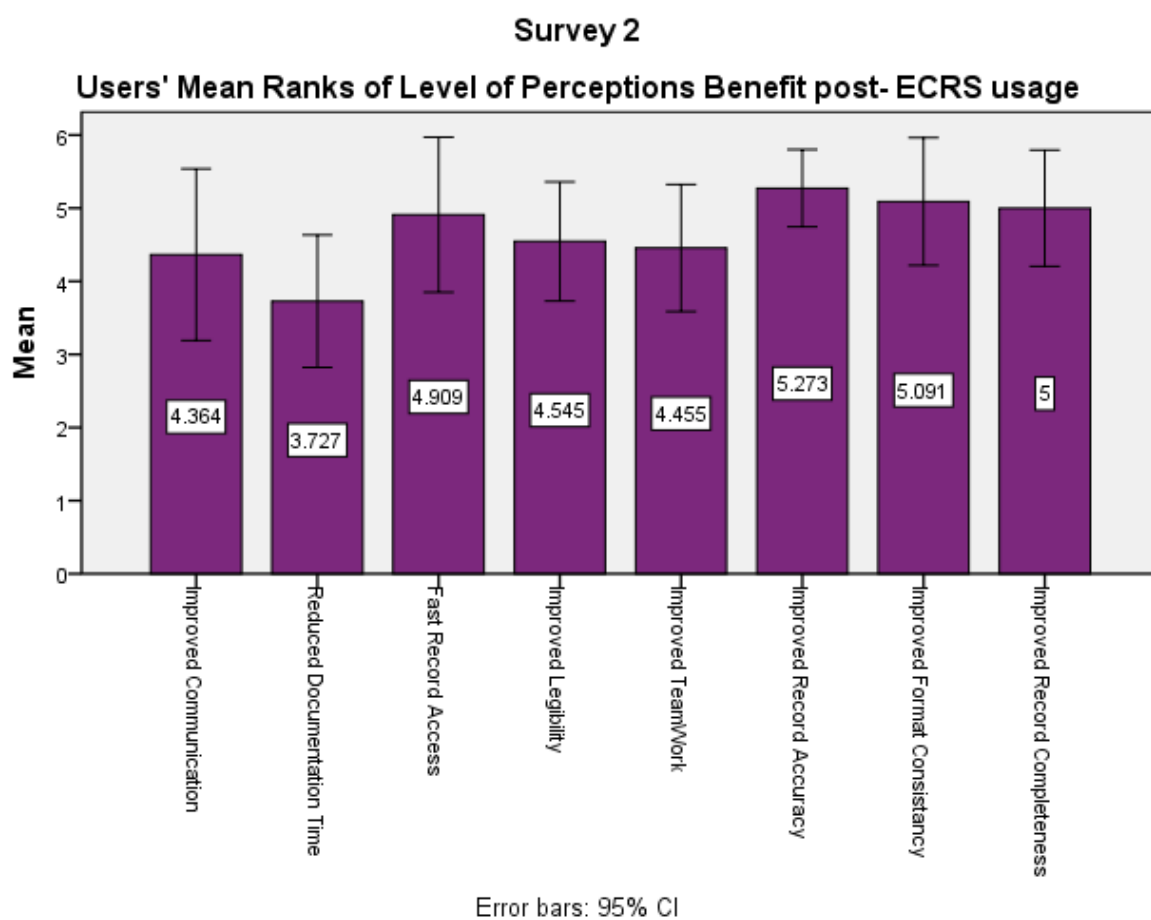


Figure 15: Participants' mean ranks of levels of perception of benefit (during ECRS usage)

All the mean scores are higher than 3.5 which suggest a higher level of perception.

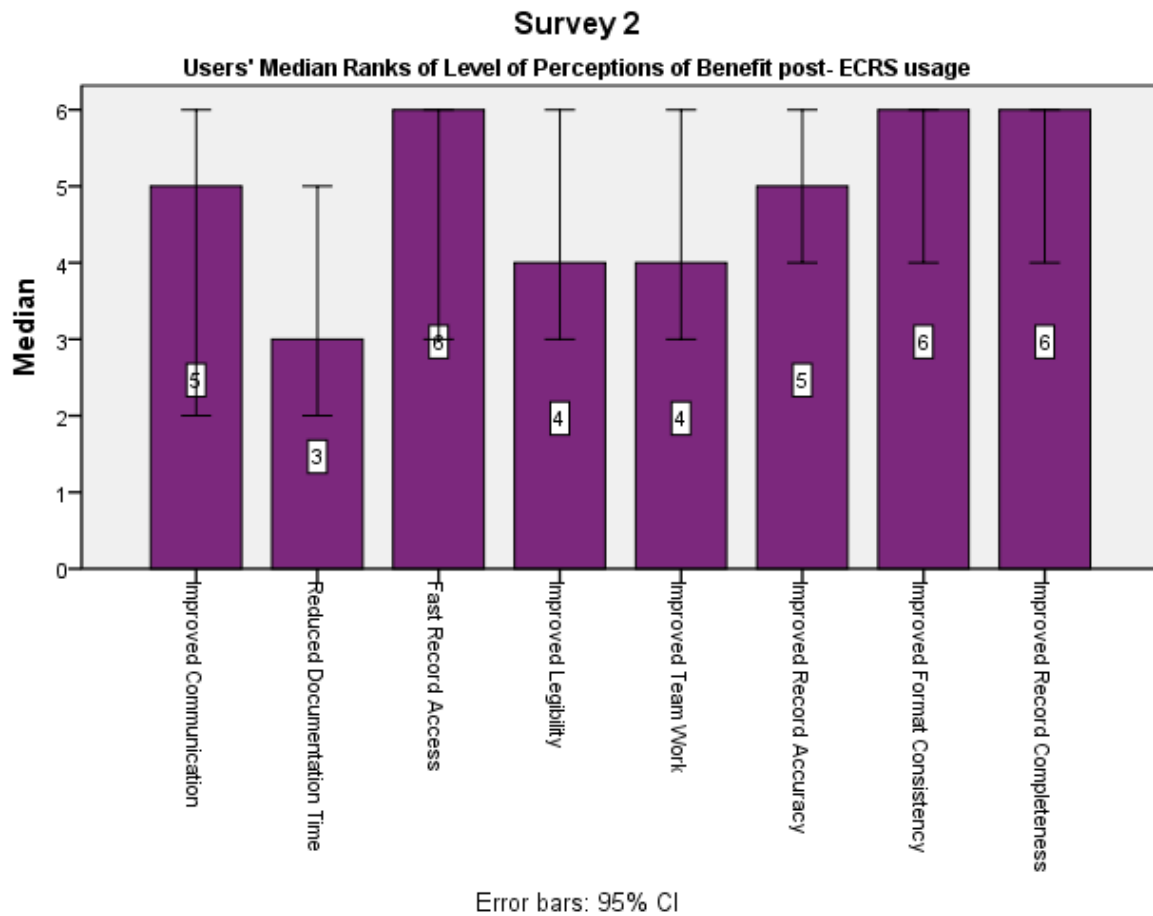


Figure 16: The participants' median ranks of level of perceptions of Benefits (during ECRS usage)

6 out of 8 median ranks of benefits have a score of at least 5 which shows a high level of participants' perception of benefit realisation.

The benefits of '**Improved Teamwork**' and '**Improved legibility**' had a median score which corresponded to the neutral category '**neither agree nor disagree**'. The benefit '**Reduced documentation time**' had a median rank of less than 4 which represented a low level of perception of benefit realisation.

While the error bars for the median ranks and the mean scores showed that there is no significant difference among the median scores of the 8 benefits at 95% confidence the non-parametric Friedman test show that there is at least two benefits whose level of perception was significantly different at 95% confidence level.

Table 9 shows Friedman test result which is significant at 95% confidence level.

Test Statistics^a

N	11
Chi-Square	16.678
df	7
Asymp. Sig.	.020

a. Friedman Test

Table 10: Results of Friedman Test to test the significant difference between benefit perceptions during early ECRS usage

The participants' level of benefit expectations were similarly transformed into 3 categories and figure 17 shows the proportions of participants' level of perceptions of benefit realisation in survey 2.

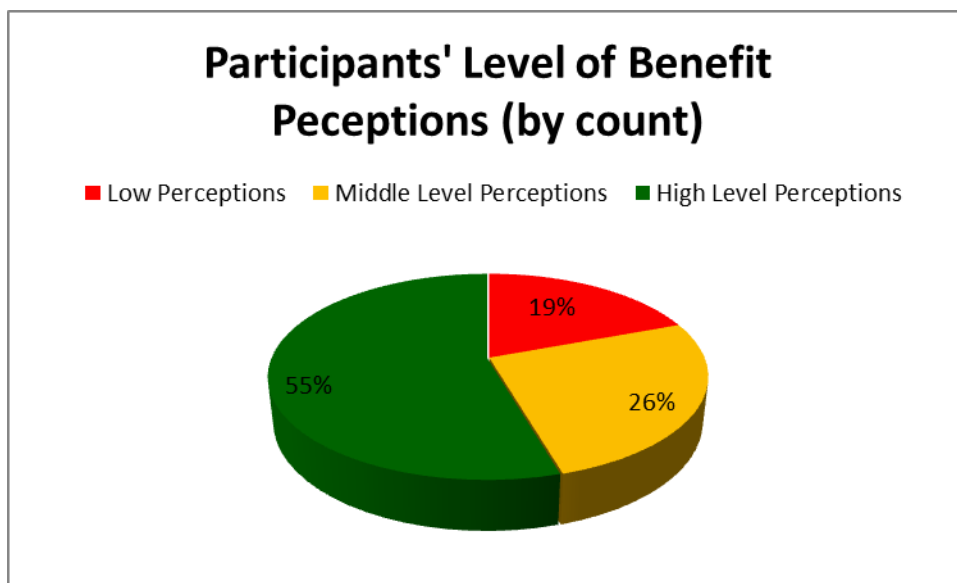


Figure 17: Participants' percentage of level of benefit perceptions during ECRS usage

Given that the benefits variables did not follow a normal distribution curve Friedman test, a non-parametric test was used to compare the difference between the 3 computed benefit perception level categories for Survey 2.

Table 11 shows the results of the Friedman Test

Ranks

	Mean Rank
Low Perceptions	1.77
Middle Level (Neither nor Agree)	1.73
High Perceptions	2.50

Test Statistics^a

N	11
Chi-Square	4.333
df	2
Asymp. Sig.	.115

a. Friedman Test

Table 11: Friedman test results

The results show the difference between the categories is not significant at 0.05 confidence level. Wilcoxon test was used to determine if any pairs of these categories were significantly different in their own right. Table 12 shows that there is a significant difference at 95% confidence level between the low benefit perception category and the high benefit category (p value=0.026).

Test Statistics^b

	Middle Level Perceptions- Low Perceptions	High Perceptions – Middle Level Perceptions	High Perceptions - Low Perceptions
Z	-.720 ^a	-1.891 ^a	-2.229 ^a
Asymp. Sig. (2-tailed)	.472	.059	.026

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

5.4 Comparisons between Users' Benefit Expectations and Subsequent Perceptions

The 3 measures of central tendencies were computed for the comparison of the Likert items which related to users' benefits expectations (pre-ECRS usage) and perceptions (during early ECRS usage). When the seven point Likert scale was treated as interval data the sample mean scores of each

benefit for both the expectations (pre-ECRS usage) and subsequent perceptions thereof during ECRS usage were compared. Figure 18 shows this graphical comparison.

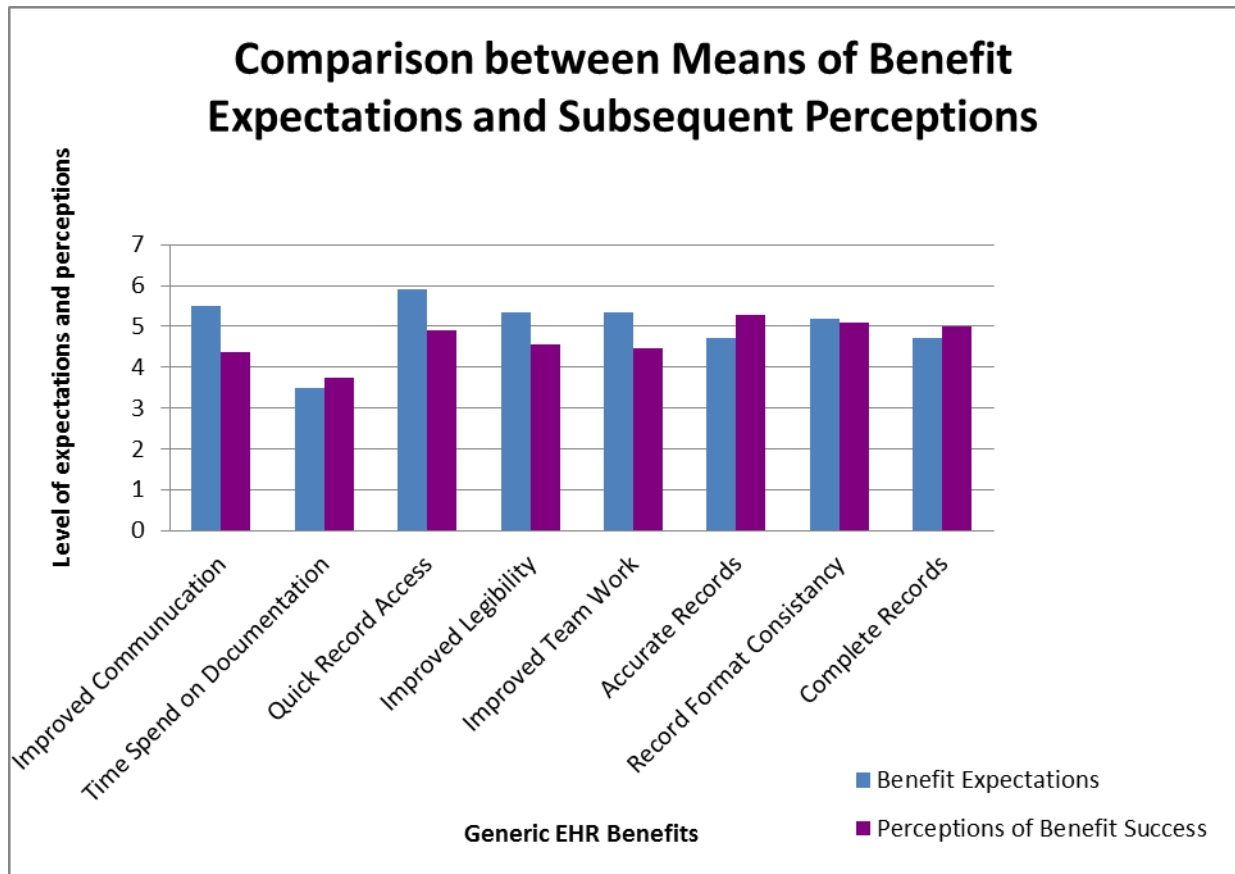


Figure 18: Comparison of means of benefit expectation and subsequent perception scores

When the Likert scales were treated as categorical data, comparison of the mode and medians of the rank categories of the benefit expectations and subsequent perceptions were calculated. Figure 19 and 20 show these comparisons.

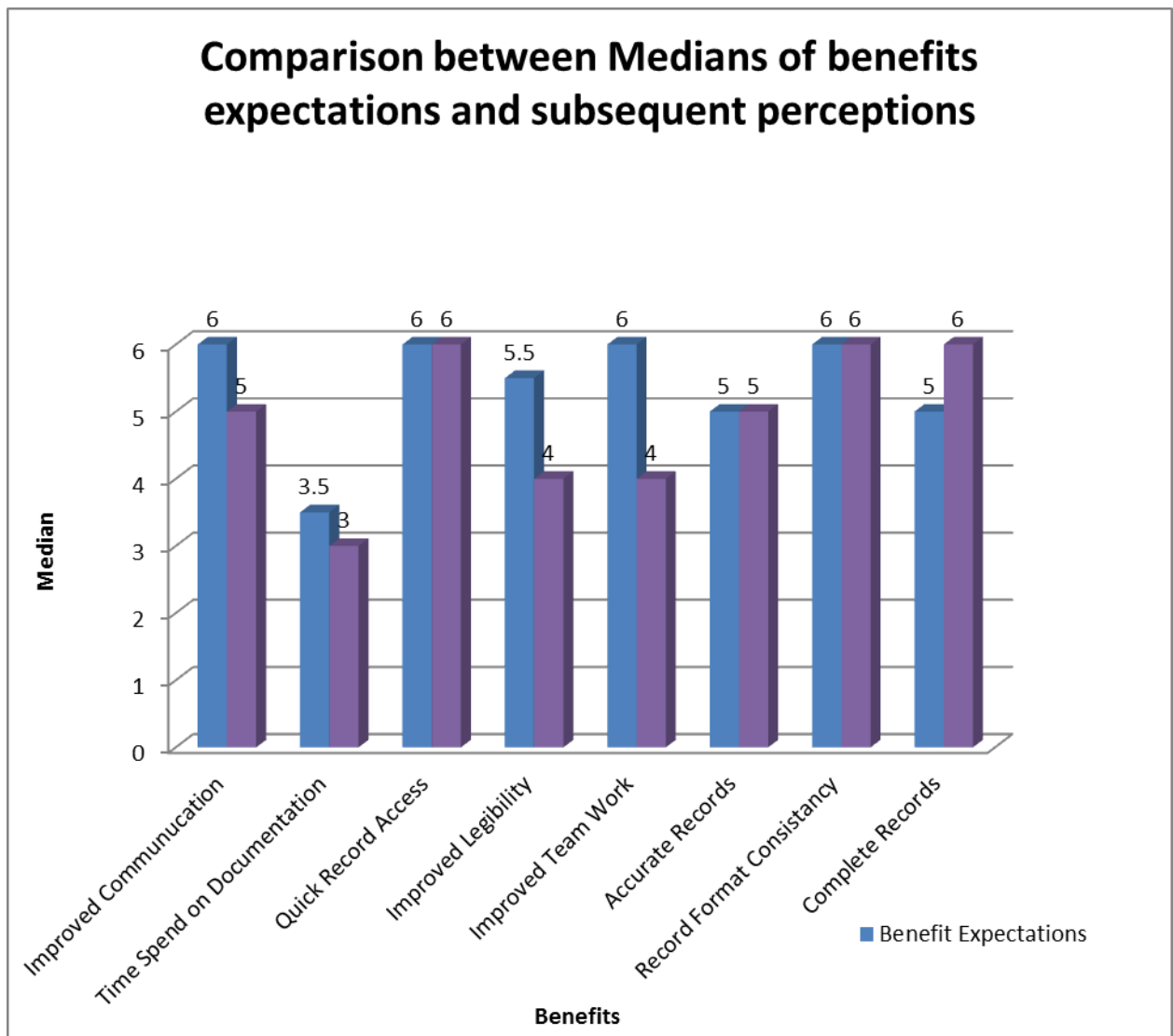


Figure 19: Comparison between the medians of the categories of benefit expectations and subsequent perceptions

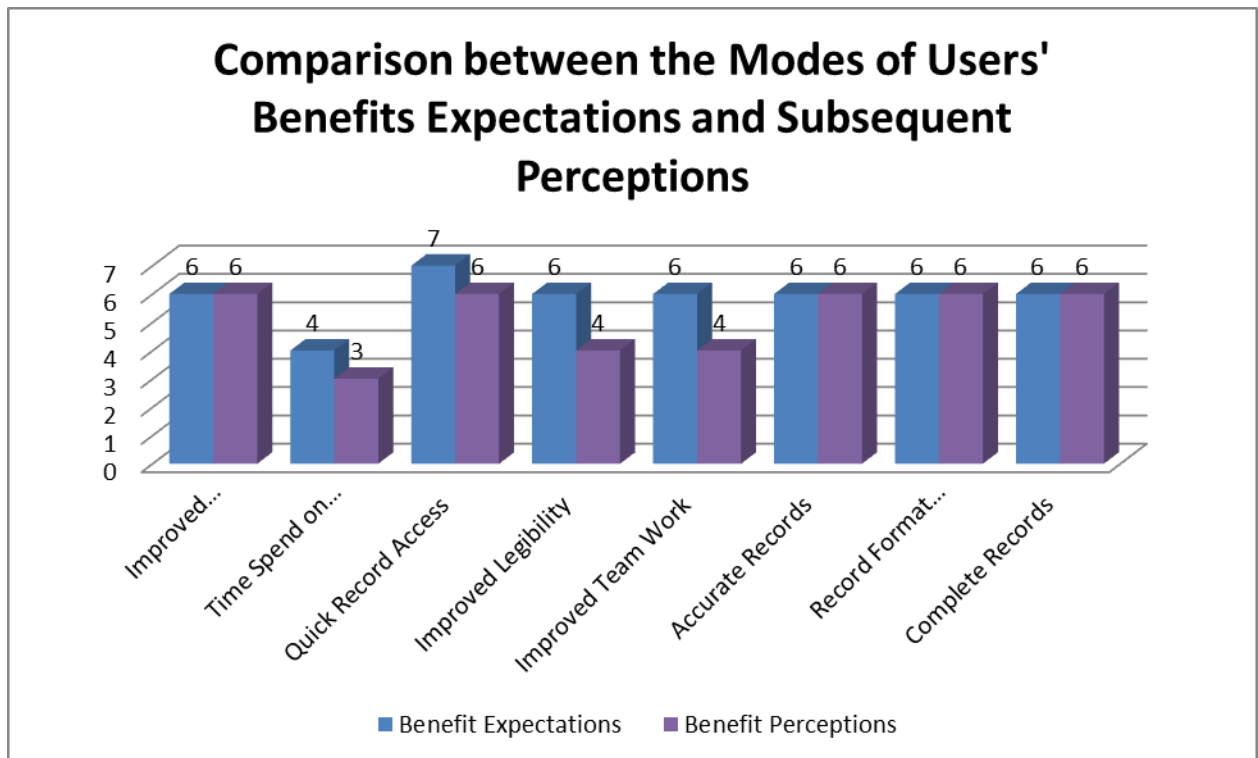


Figure 20: Comparison between the modes of the categories of users' benefit expectations (pre-ECRS usage) and subsequent perceptions (during ECRS usage)

These 3 measures of central tendencies were compared between each corresponding pair of benefit expectations and subsequent benefit perceptions to see if similar patterns emerge. Table 12 shows that the 3 measures of central tendencies show similar levels of relationships for the following benefits;

- 1) Faster record access
- 2) Improved legibility
- 3) Improved teamwork

	Communication		Fast Access		Documentation speed		Legibility		Teamwork		Accurate Records		Format consistency		Complete Records	
Benefits	Expectations	Perceptions	Expectations	Perceptions	Expectations	Perceptions	Expectations	Perceptions	Expectations	Perceptions	Expectations	Perceptions	Expectations	Perceptions	Expectations	Perceptions
Mean	H	L	H	L	L	H	H	L	H	L	L	H	H	L	L	H
Median	H	L	H	L	S	S	H	L	H	L	S	S	S	S	L	H
Mode	S	S	H	L	H	L	H	L	H	L	S	S	S	S	S	S

Table 12: Comparison between 3 measures of central tendencies as they relate to participants benefit expectations and perceptions

H=Higher: L=Lower: S=Same. H and L are mutually exclusive between expectations and perceptions of each benefit

5.4.1 Composite Benefit Ranks

Each participant's category score on each benefit was summated to create an individual sum of score which could take a minimum value of 8 (weight 1 X 8 benefits) to a maximum value of 56 (weight 7 X 8 benefits). The summated 8 variables for Benefits Expectations in Survey 1 had a Cronbach's Alpha of 0.863 which is above the value of 0.70, hence confirming the **internal consistency reliability** required for such multiple scale according to Leech et al. p50, (2008).

Table 13 shows the Cronbach's Alpha score.

Reliability Statistics for Benefits Expectation Scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.836	.863	8

Table 13: Internal Consistency reliability for Summated Benefits as they relate to participants' expectations

The Cronbach Alpha (table 14) for the Summated values of level of Perception of benefits realisation (Survey 2) was 0.642 which is close enough to 0.70 thus confirming a high enough internal consistency reliability of the summated scale.

Reliability Statistics for perceptions of benefit

Realisation

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.642	.656	8

Table 14: Internal Consistency reliability for Summated Benefits as they relate to participants perceptions

Values of the Summated Benefits Score which lie below the halfway point (a score below 28) indicated low level and values above 28 indicated a high level of benefits expectations and benefit perceptions for survey 1 and 2 respectively.

Figure 21 shows a scatter graph which depicts the participants' summated benefits scores for Survey 1. The graph shows that 11 out of 12 participants had a score of more than half (28) which suggest a high level of expectations.

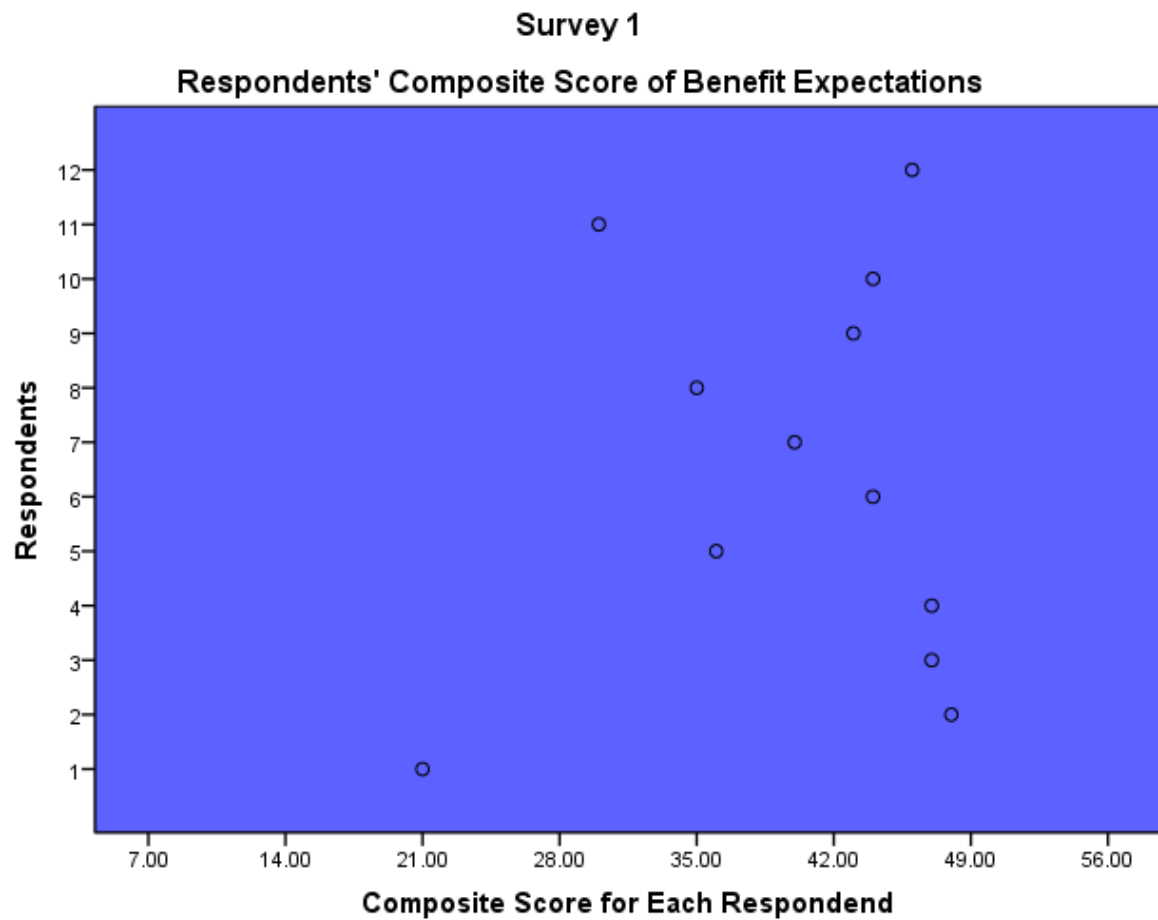


Figure 21: The composite scores of participants' benefit realisation expectations (pre-ECRS usage)

Figure 22 shows a scatter diagram for a similar analysis of Survey 2 data. The graph shows that composite scores for all participants were above the halfway mark of 28.00 which suggest a high level of perceptions.

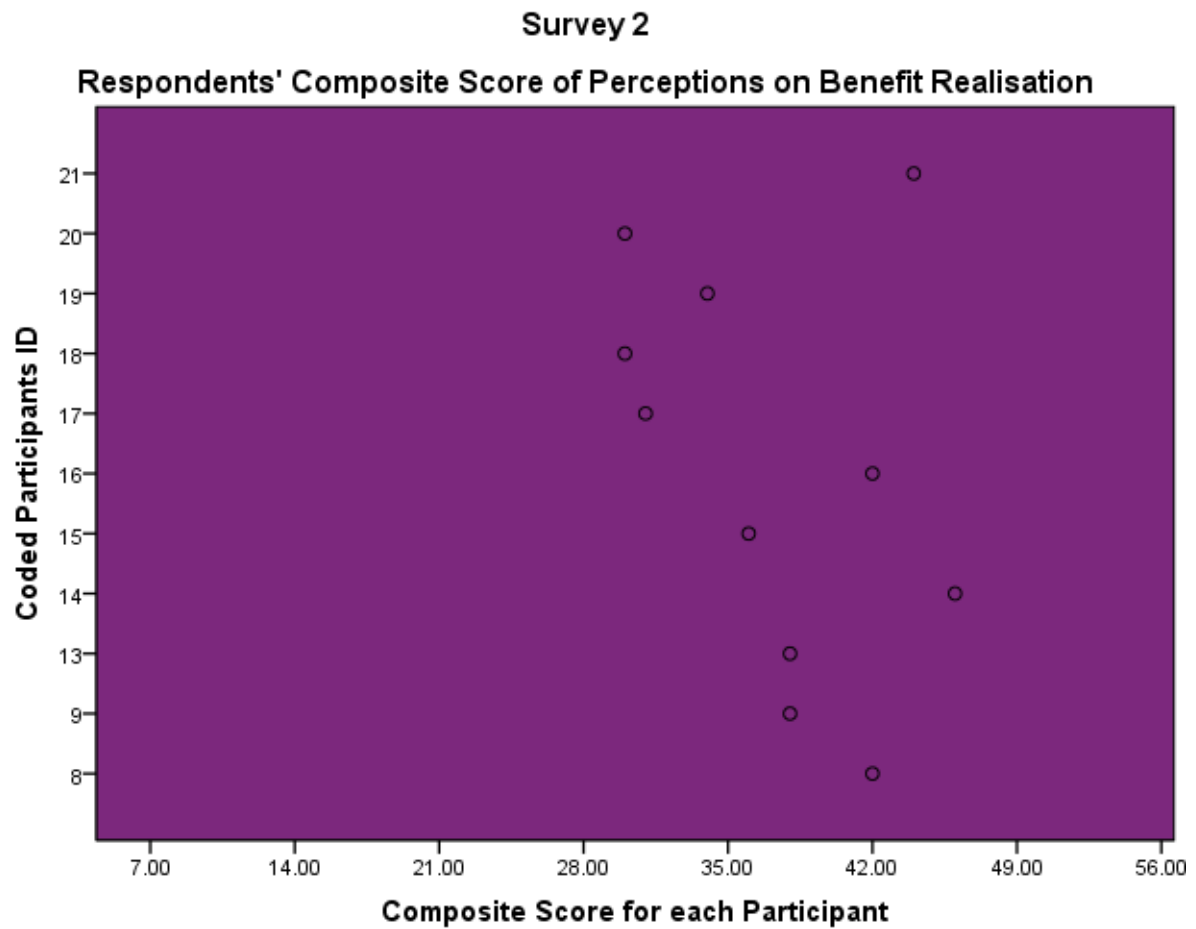


Figure 22: The composite scores of participants' perceptions of benefits (during ECRS usage)

Data from figure 14 and 17 was combined to allow a comparison of the 3 computed levels of benefit expectation and benefit perceptions. Figure 23 depicts this comparison.

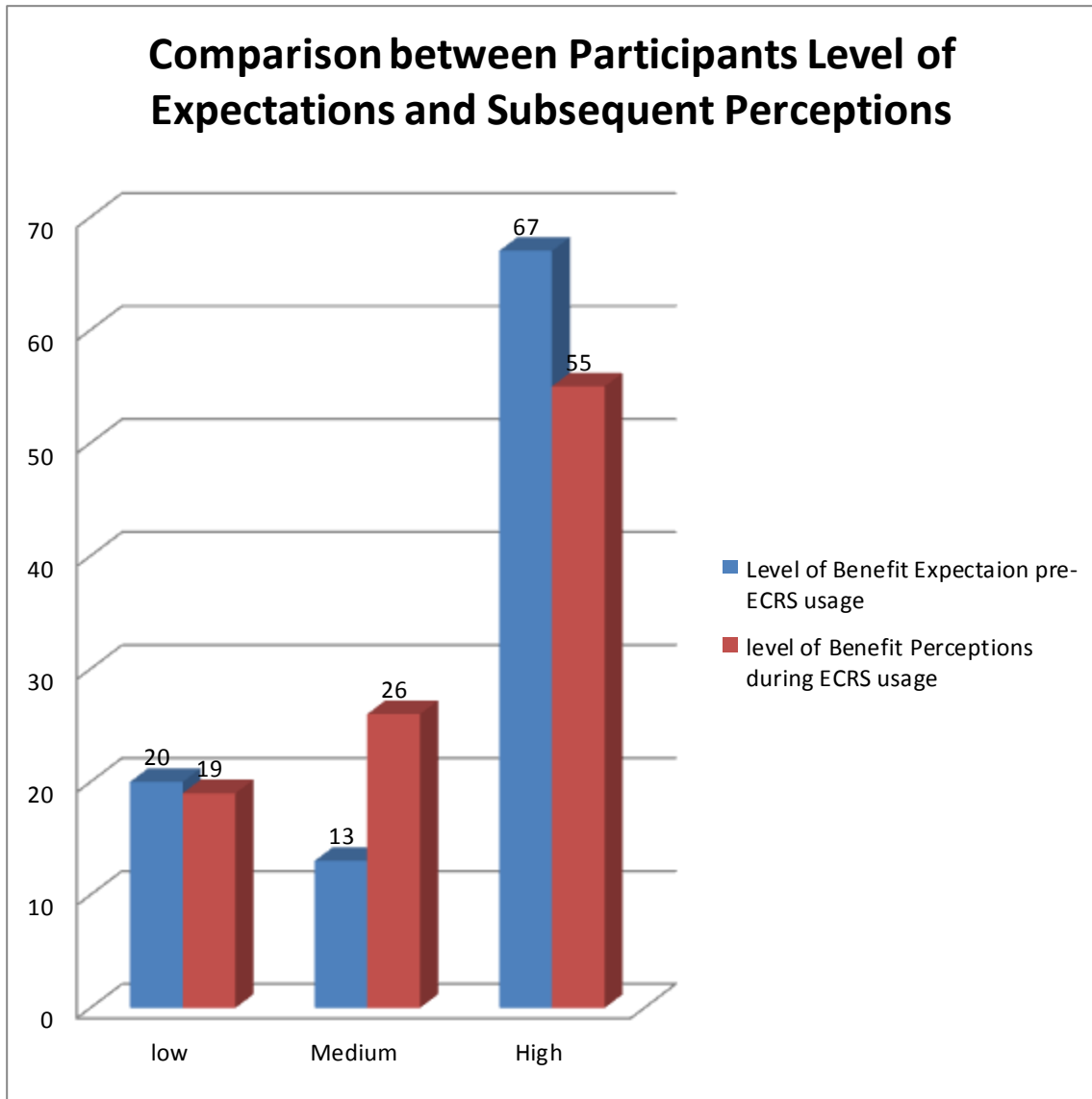


Figure 23: Comparison of participants' percentage expectations vs subsequent perceptions across 3 level categories

The graph shows that 1% less benefit perceptions fell in the low level category when compared with benefit expectations. In the high level category participants also had 15% higher expectations than perceptions. However 13% more of participants' responses fell in the neutral category in survey 2

5.4.2 The Difference between the Mean Ranks of Users' Expectations before ECRS use and their subsequent Perceptions during ECRS usage

Data collected on EHR users' Benefit expectations in survey 1 and subsequent perceptions in survey 2 were categorical hence ordinal. In order to answer the following research question:

Is there a difference between ECRS users' pre-usage benefit expectations level and subsequent perceptions level of the same benefits after the initial ECRS usage?

The Kruskal-Wallis H Test was used to test the hypothesis;

Null Hypothesis: There is no significant difference between ECRS users' pre- usage benefit expectation level and subsequent perception level of the same benefits during early ECRS usage

The test was used to determine if there was a significant difference between the mean ranks of ECRS users' benefit expectations and their subsequent perceptions.

Table 16 confirms that there is no significant difference between all the mean ranks of pairs of users benefit expectations in survey 1 and the subsequent perceptions in survey 2. All the p values of each pair are not significant at 0.05 levels.

Test Statistics^{a,b}

	Improved Communication	Improved Time spend	Faster Access	Improved Legibility	Improved Teamwork	Improved Record Accuracy	Improved Format Consistency	Improved Record Completion
Chi-Square	.067	.166	2.751	2.282	3.112	.461	.320	.385
df	1	1	1	1	1	1	1	1
Asymp. Sig.	.796	.684	.097	.131	.078	.497	.571	.535

a. Kruskal Wallis Test

b. Grouping Variable: Survey 1 and/or 2

Table 15: The Kruskal-Wallis Test to compare mean ranks of 8 benefit expectations and subsequent perceptions

The Composite Scores of both the benefit expectations in survey 1 and perceptions in survey 2 were also compared similarly using the Kruskal-Wallis Test as a form of **triangulation**. Table 16 and 17 also confirm that there is no significant difference at 0.05 level between the two scores.

Ranks			
Surveys		N	Mean Rank
Computed Scores for Benefits Expectations and Perceptions	survey 1	12	13.83
	survey 2	11	10.00
	Total	23	

Table 16: Mean ranks of composite scores of benefit expectations against subsequent benefit perceptions

Test Statistics ^{a,b}	
	Computed Scores for Benefits Expectations and perceptions
Chi-Square	1.845
df	1
Asymp. Sig.	.174

a. Kruskal Wallis Test

b. Grouping Variable: ComPartic

Table 17: The Kruskal Wallist Test to compare mean scores of the composite scale of the 8 benefit expectations (Survey 1) and subsequent perceptions (Survey 2)

The researcher therefore failed to reject the null hypothesis.

5.5 Relationship between Benefits

5.5.1 Survey 1

The relationship between individual benefits was determined using the Spearman's Rank Order Correlation (ρ) for two reasons

- The benefits variables were all rank ordered.
- Fewer assumptions have been made in relation to the normality of distribution of the sample.

Before the correlation values were computed bivariate scatter plots were plotted to confirm that the relationships were linear thus validating the use of the linear correlation coefficients.

Table in appendix 8a shows positive correlation at 99% confidence level between the following benefits:

- a. **Improved communication and teamwork**
- b. Improved communication and improved record accuracy
- c. **Improved legibility and improved record accuracy**
- d. Improved accuracy and improved team work
- e. Improved record legibility and improved teamwork

The other benefits relationships which are significant at 95% confidence interval are as follows:

- f. Improved communication and faster record access
- g. Faster record access and improved record accuracy
- h. Improved communication and improved legibility
- i. Improved legibility and improved record completeness
- j. Improved record completeness and Improved record accuracy

5.5.2 Survey 2

In Survey 2 improved **legibility and improved record accuracy** had a positive correlation which was significant at 99% confidence level same as it was in Survey 1. This relationship is shown in figure 25

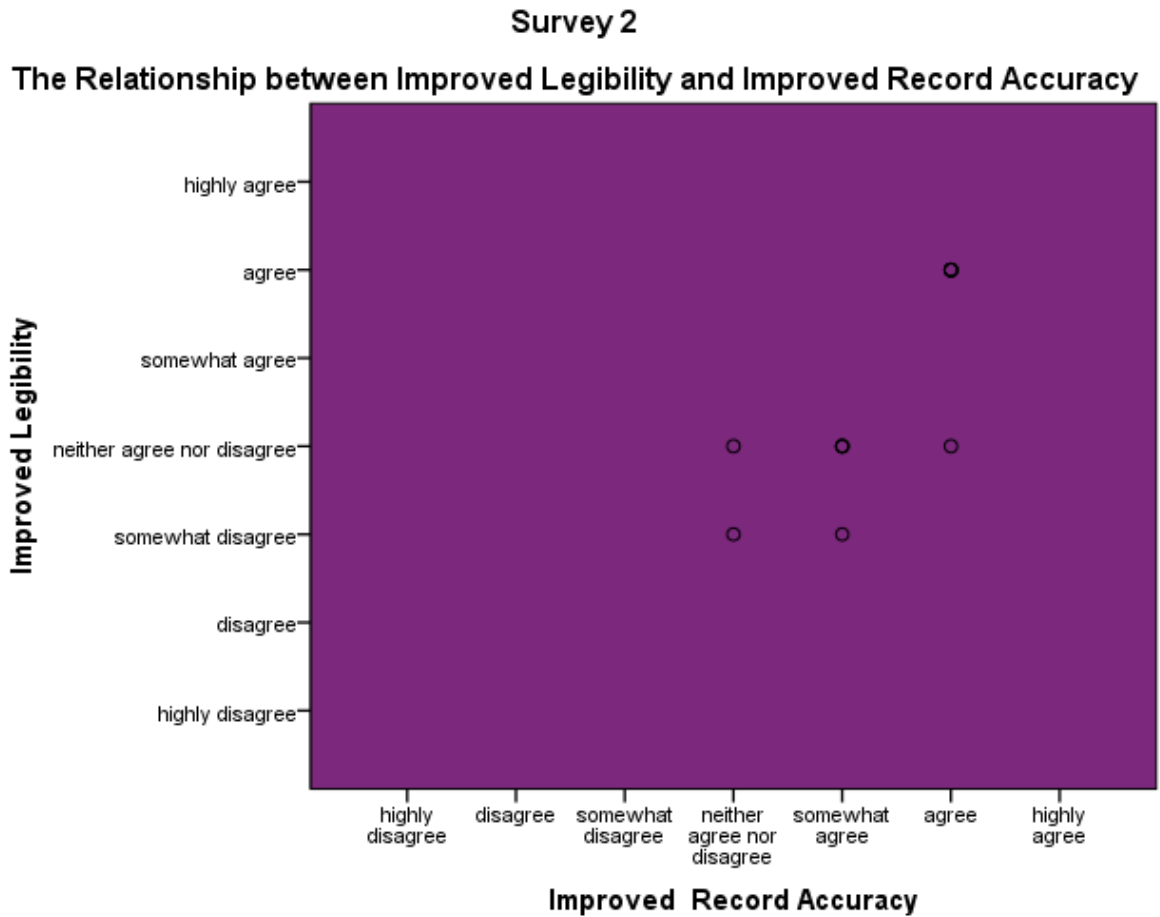


Figure 24: Linear positive relationship between improved legibility and improved record accuracy. Survey 2

At 95% confidence interval '**Improved communication**' and '**improved teamwork**' benefits maintained a linear positive relationship.

A new significant linear positive relationship was observed between the benefits '**faster record access**' and '**improved legibility**'. The rho value was 0.733.

The relationship between '**improved legibility**' and '**improved record accuracy**' showed a linear positive relationship with a rho of 0.794 which was significant at 99% confidence level. Figure 25 shows the scatter plot for this relationship.

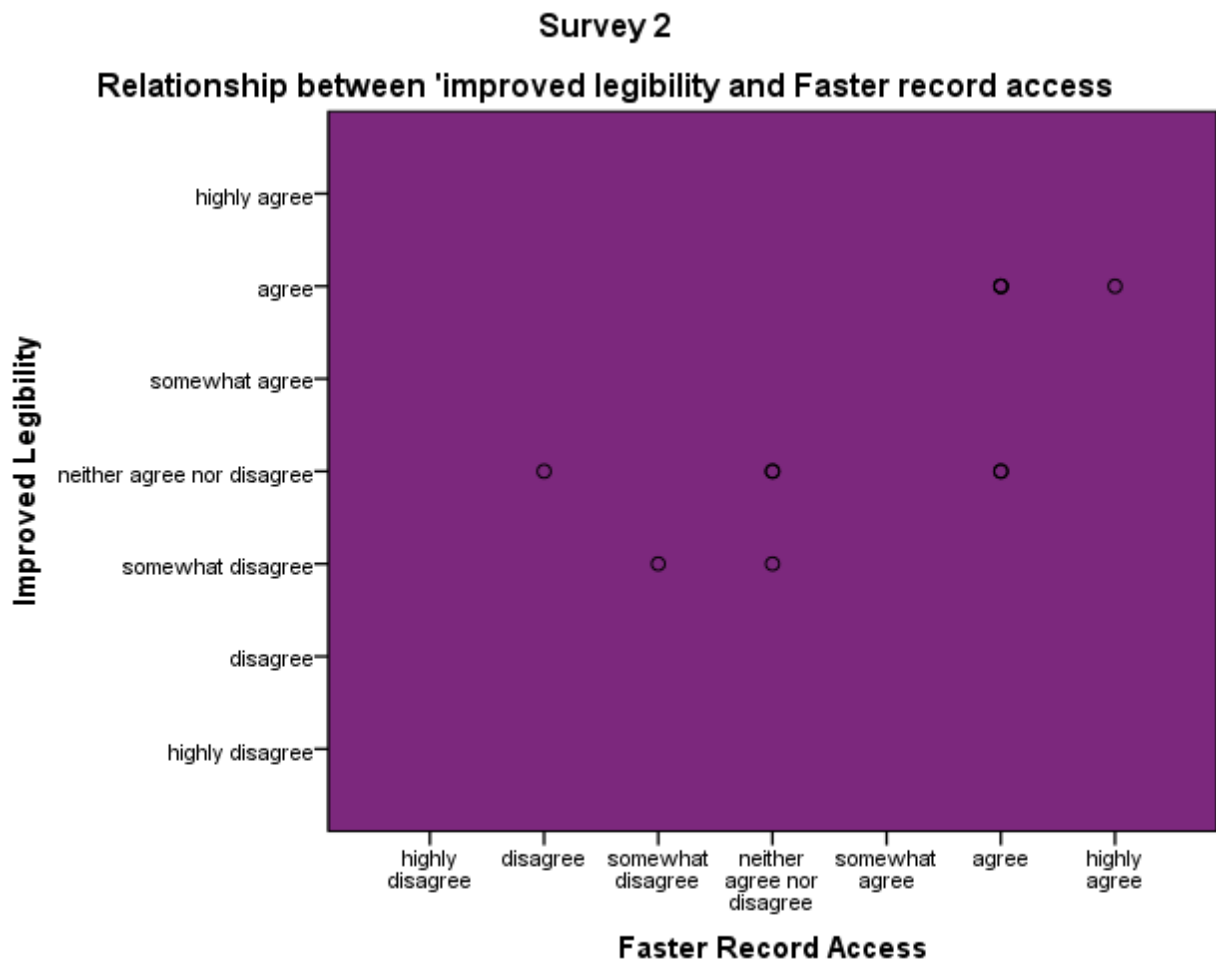


Figure 25: The scatter plot showing a linear positive correlation between the perceptions on the two benefits

Relationship between Gender and the level of benefit expectations could not be established because of the heavy gender bias. Although the gender balance reflected the population of the study i.e. more females than male clinicians the number of male participants was too low for any inferential statistics to be used.

5.6 Participants' Self-identified Benefits of Using ECRS

Participants were asked to self-identify any other benefits of using EHRs which they thought were important in enhancing service users' care.

The questions were only answered by 41% of the respondents. They identified the following benefits over the paper based record system.

- Improved service user progress tracking
- Easier record access

- Better record storage
- High record Quality
- Better record Security
- Lower Overheads Costs
- Improved Record transferability between local centres within the service area

Participants had a high level of expectations that ECRS will fulfil these benefits with a mean score of 5.4 on a scale from 1 to 7 where 1 represented the least level of expectation while 7 represented the highest level of expectation.

None of the participants who had low expectations indicated why their rating was low. It is worth noting however that the response rate to each of these two questions was 41% which is a very low figure to generalise these findings.

5.7 Participants' Expectations on ECRS Features

Ten important features of an EHR were identified from the literature. Participants were asked to state if each of these features were either important or not important for an EHR system which is designed for keeping and maintaining records for the type of clinical work they were involved with. Participants were also given an option to state if they were not sure.

Figure 26 shows the respondents' ratings of the importance of each feature they were asked to comment on.

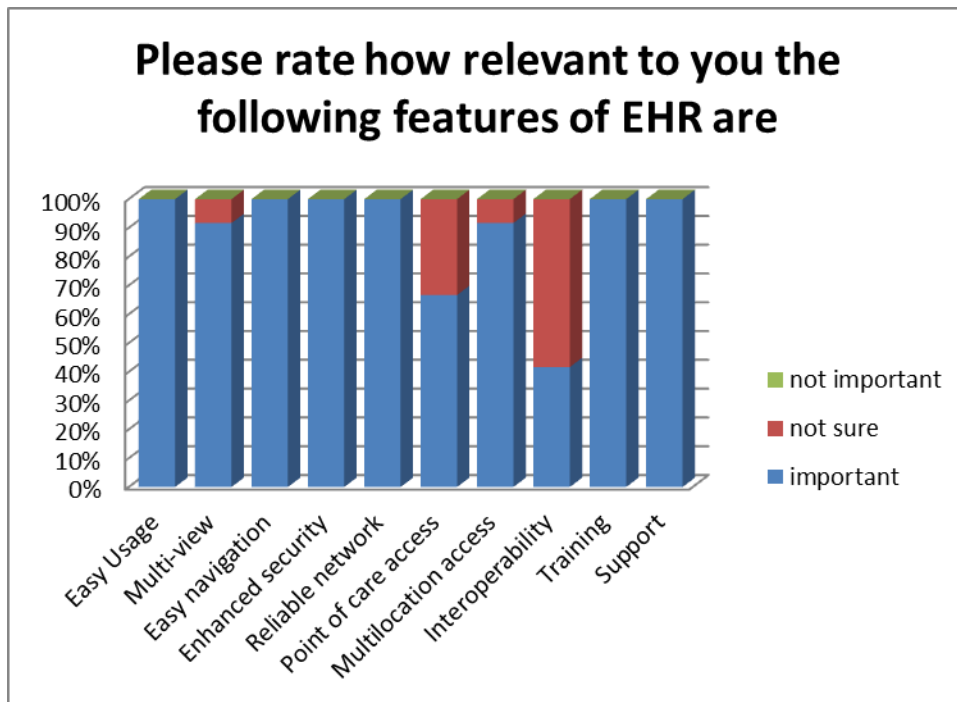


Figure 26: Participants ratings on how relevant literature based EHR features are to them

All respondents identified that 6 out of the 10 features were important for their needs. 40% of respondents answered that they were not sure if the function of EHR interoperability was either important or not important while the remainder believed this feature was important.

5.8 Relationship between Professions and Benefit Expectations

There was not sufficient number of respondents from all professionals to carry out an inferential analysis of the relationship between benefits expectations and individual multi-disciplinary professionals.

5.9 Relationship between Age and Benefits Expectations

The ages of the participants did not follow a perfect normal distribution curve as shown in figure 27.

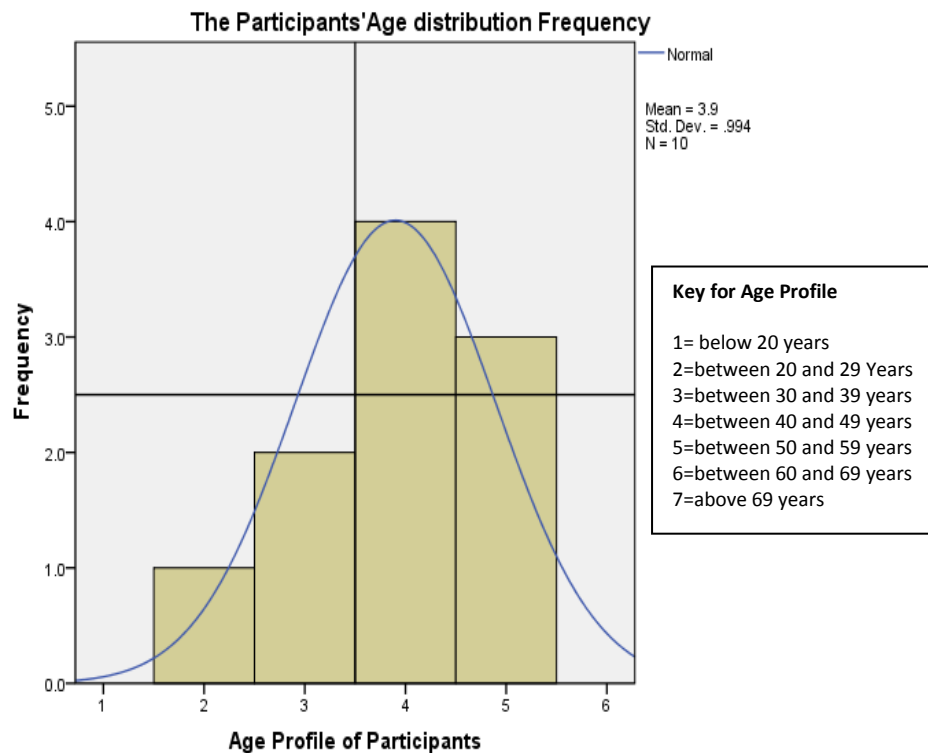


Figure 27: Participants' age shows negative skew to the right

The non-parametric tests were therefore used to test if there were significant relationships between ECRS users' ages and the level of expectations/perceptions of individual benefits for both survey 1 and 2. Non-parametric tests were chosen over the parametric because of the samples were not normally distributed. Both the Spearman's rank order correlation and the Kendall's tau_b were used for purposes of triangulation.

Table 18 shows that the relationship between these two variables was not significant at 0.05 or 0.01 significant levels with the exception of the relationship between users' age and perception level of the benefit **'improved communication'** in survey 2. The relationship was positive but weak as shown in figure 28.

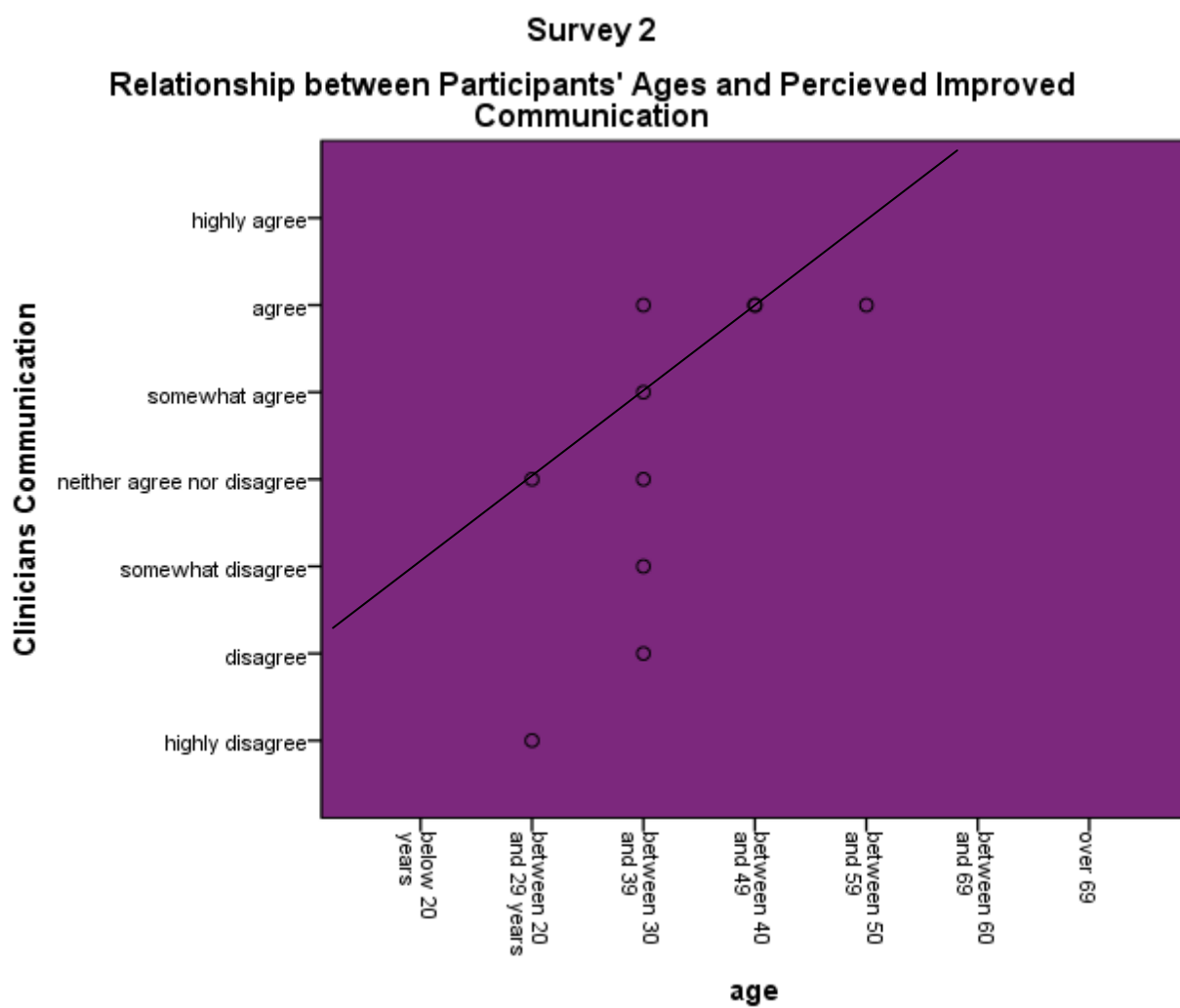


Figure 28: Scatter plot for relationship between improved communication benefit and age of participants

Relationship between Level of Benefit Expectation/Perceptions and Age

	Test	p- value for Survey 1	Significance	p-value for survey 2	Significance
Communication	Kendall's tau_b	0.636	x	0.021	Sig @ 0.05. Positive correlation. Value 0.649
	Spearman's rho		x	0.013	Sig @ 0.05 Positive correlation. Value 0.745
Time Spend on Documentation	Kendall's tau_b	0.184	x	0.614	x
	Spearman's rho	0.153	x	0.620	x
Quick Document Access	Kendall's tau_b	0.878	x	1	x
	Spearman's rho	0.905	x	0.963	x
Improved Legibility	Kendall's tau_b	0.817	x	0.672	x
	Spearman's rho	0.848	x	0.654	x
Better Team Work	Kendall's tau_b	0.875	x	0.157	x
	Spearman's rho	0.864	x	0.164	x
More accurate Record	Kendall's tau_b	0.760	x	0.754	x
	Spearman's rho	0.757	x	0.730	x
Increased Format Consistency	Kendall's tau_b	0.754	x	0.376	x
	Spearman's rho	0.696	x	0.407	x
More Complete Records	Kendall's tau_b	1	x	0.236	x
	Spearman's rho	0.981	x	0.244	x

Table 18: p values for the relationship between benefit expectations/perceptions with ECRS users' age categories

Spearman rho and the Kendal tau_b were computed to determine if there was a relationship between the age of users and ease of ECRS usage and level of user confidence. The results in table 19 show that the linear relationships between age and each of these two variables were not significant at 95% confidence level.

Variables	Statistic	Correlation co-efficient	P value
Age vs ease of ECRS usage	Kendall's tau_b	0.147	0.610
	Spearma's rho	0.171	0.637
Age vs level of user confidence	Kendall's tau_b	-369	0.220
	Spearma's rho	-.421	0.226

Table 19: relationship between age and ease of ECRS usage and level of user confidence

5.10 Other Findings

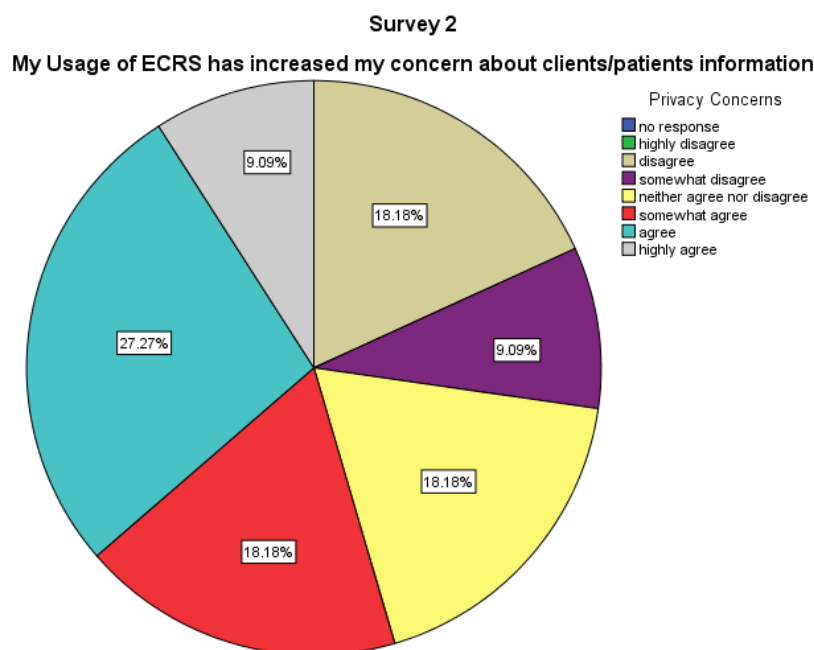


Figure 29: Users' Levels of anxiety with privacy concerns

Respondents largely agreed with varying degrees of agreement with the statement in figure 29.

The response rate to open ended questions was low. After survey 1 data collection, survey 2 was redesigned with fewer amounts of open ended questions as a response to the low response rate on

survey 1. While overall response rate to open ended questions were low the response to Question 28 and 29 in Survey 2 was 82%. The questions asked participants to explain why they may not be using the ECRS fully and how the ECRS can be improved. The general theme to emerge was that users felt the ECRS was less than satisfactory in its current status and they urged better consultation with users and suggested implementation of identified features.

6 ANALYSIS OF RESULTS

6.1 Response rate and Response methods

The response rates to both survey 1 and 2 were low. The rates were below the average response rate of 55.6% suggested by Baruch (1999). There are therefore some significant possibilities of committing type 1 error where the null hypotheses in this research may have been rejected when in fact they may have been true particularly at 95% confidence level

Online surveys were most popular amongst the youngest group of respondents. Despite this observation the one way –ANOVA test for both survey 1 and 2 showed that the participants' observed age related patterns of response were both not significant at 95% confidence level. This implies that the observed pattern is not necessarily true for the ECRS population of users. The implied suggestion is that age of ECRS users does not influence their choices of responds.

In future similar studies with the same population, inclusion of an option to respond using electronic pdf may not be necessary given the low rate of selection of this option. All age groups should be targeted equally with the same choices of responds.

6.2 Users' Level of Expectations of Benefits to arise from ECRS Usage (Survey 1)

The answer to the Research Question 3.1.1: What is the users' level of benefit expectations prior to using ECRS?

The results from analysis of the 3 measures of central tendency showed that participants had a higher level of expectation that usage of ECRS was going to lead to realisation of at least 7 benefits. Participants showed a relatively low expectation level that the usage of ECRS will result in **reduction of time spend on documentation**.

Friedman test and the post hoc Wilcoxon test confirmed that there is a significant difference between the high (67% of responses), the middle (13%) and the low level (20%) categories of benefit expectations at least at 95% confidence level.

High level expectation category being the biggest this suggests that a clear majority of users had pre-usage high level of expectations of benefit realisation.

The high level of benefit expectations could have resulted from users' enthusiasm with adapting a new technology given that 72.7% of respondents to survey 2 had no prior experience of using EHR systems. This is potentially what Sedera et al. (2001) referred to as 'band wagon effect'. The band

wagon effect may have influenced newer participants to conform purely because it is believed to be the right thing.

6.3 Users Perceptions on Benefits Realisation during early ECRS Usage (Survey 2)

The Answer to the Research Question 3.1.2: What is the users' perception level of benefit realisation during early stages of ECRS usage?

The results from analysis of 3 measures of central tendency showed that participants only had a low perception score on the benefit of '**reduced documentation time**'. Participants had neutral to high level of perception on the other 7 benefits of ECRS usage. Just as with their prior expectations, participants, continued to believe that ECRS usage will not result in substantial **reduction in documentation time**.

Friedman test and the post hoc Wilcoxon tests confirmed that there was a significant difference between the high (55% of responses) and low level (19%) of perceptions of benefit realisation at 95% confidence level.

The suggested inference is that the observed difference between low perception and high perception may not have occurred by chance. This evidence suggests therefore that during early ECRS usage majority of users had an overall high level of subsequent view that usage of ECRS would result in benefit realisation. The belief holds true at least up to the period of the end of data collection.

Given that users' experience is evolving their perceptions of benefit realisation may change with time.

These results also show that more users were uncertain about the success of the ECRS after a few months of using the ECRS than they were before usage. This may suggest that there was subsequent reduction in optimism on the part of these users after experiencing ECRS for themselves.

6.4 Comparison of Users' Pre-ECRS Usage Benefit Expectations and their Subsequent Perceptions during Early ECRS Usage

The answer to the question 3.1.3: Is there a difference between ECRS users' pre-usage benefit expectations level and subsequent perceptions level of the same benefits after the initial ECRS usage?

Null Hypothesis: There is no significant difference between ECRS users' pre-ECRS usage benefit expectations and subsequent perception level of the same benefits during early ECRS usage

Comparison of participants' pre-usage level of benefit expectations and subsequent perceptions during early usage show that in both cases users had high levels of expectations that benefits will be realised.

This observation was confirmed by the analysis of participants' responses when those responses were divided into 3 categories i.e. high level, neutral level and low level. The results showed that 13% more of participants' responses fell in the neutral category in survey 2 than in survey 1. This may suggest that users were not as optimistic with their subsequent perceptions as they were with their pre-ECRS usage expectations.

However results showed that this observed difference was not significant at 95% confidence level. The differences observed may have occurred by chance. The visual inspection of the corresponding mean ranks also shows that the difference is small.

The researcher therefore fails to reject the null hypothesis. However there is a possibility of having failed to reject the null hypothesis when it could be false (Type 2 error) because the sample size was small.

According to these results users maintained the high level of benefit perceptions as they did on expectations of benefit realisations although more users in survey 2 became unsure of this than they were in survey 1. It could be interpreted that most users were satisfied with their usage and performance of the ECRS during this early phase.

It can also be argued that the lack of difference between the levels of expectations and perceptions could be a result of **negative disconfirmation** according to the Cognitive Dissonance theory. The possible interpretation is that participants who participated in survey 1 realised after using ECRS that they had high unrealistic expectations but instead of correcting this they could have subconsciously rated their perceptions to a higher level in order to attempt to match earlier high ratings. This argument is similar to the '*regression effect*' (Kumar 2011) whereby it is possible that users who participated in the first survey may have gravitated towards the mean if they felt their levels of expectations were extreme.

The participants were also quite optimistic that the other user identified benefits were on course to being realised. Figure 30 shows the breakdown of participants' levels of perceptions. A mean score of more than 3.5 indicated a high level of perception that these benefits were on course to be realised. All 6 means are well above 3.5.

Survey 2

Rate these benefits according to the extend to which you agree that they are on course to be fulfilled

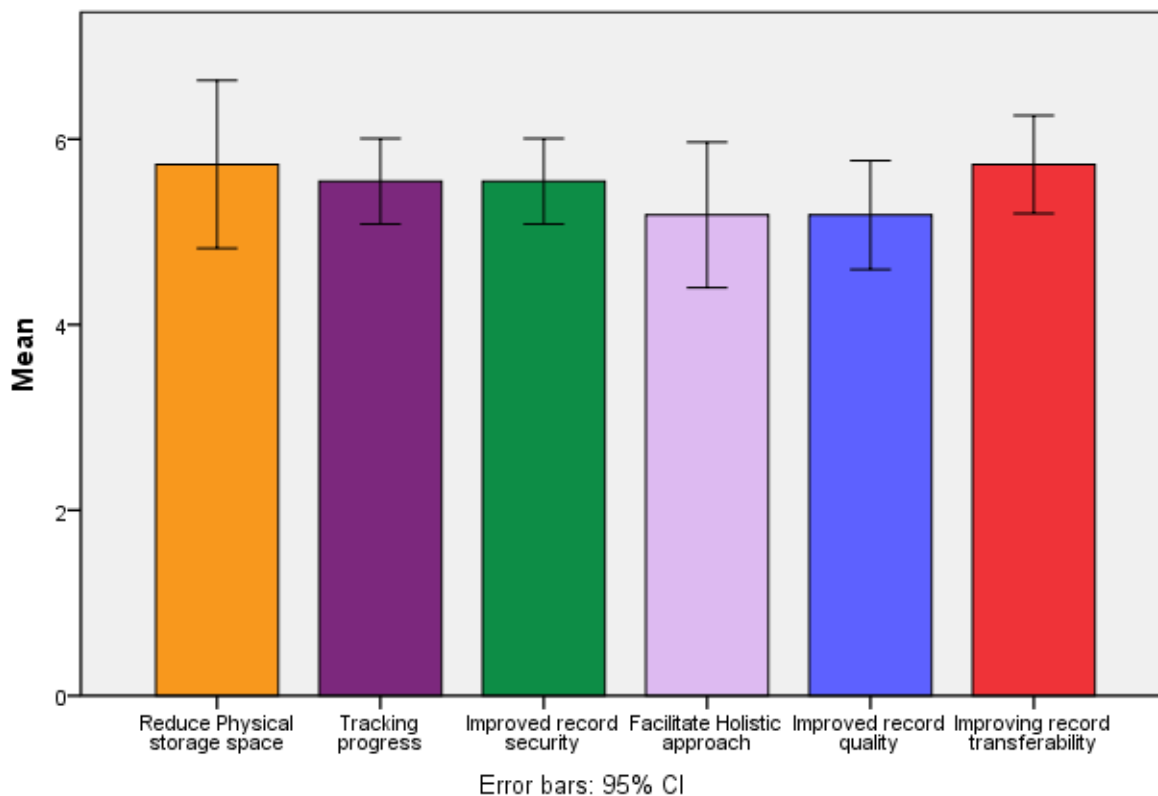


Figure 30: Participants' ratings on user identified potential ECRS benefits

The error bars confirm that ECRS users also had high perceptions that user- identified benefits were on track to be achieved. However the low response rate to this question may suggest that either participants could not identify extra benefits or they did not prefer answering the open ended questions.

The participants also indicated that they had a higher level of confidence and majority of them said they found it easy to use the ECRS. Figure 31 shows how confident participants felt in using the ECRS system.

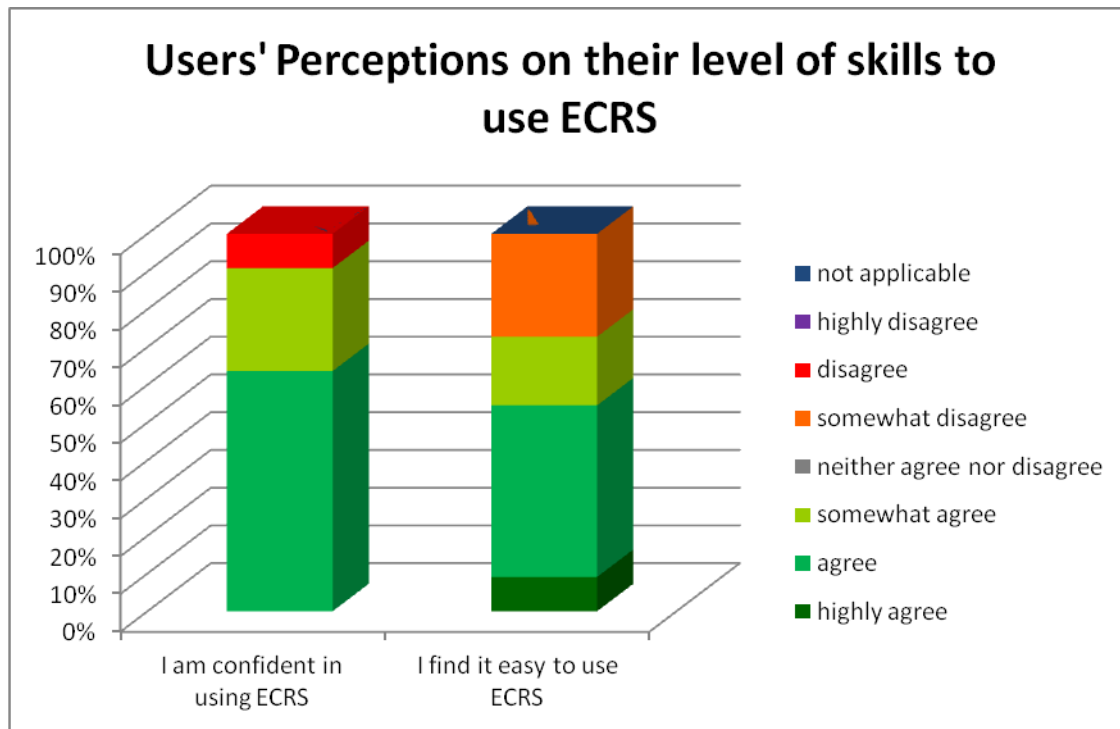


Figure 31: Participants' level of confidence to use the ECRS

Despite participants indicating a high level of subsequent perception albeit lower than the corresponding level of expectations, the general comments from Survey 2 indicated that participants were not happy with the status of the features of the ECRS. Figure 32 shows that majority of participants felt that the user-requested features were not yet in place by the completion time of Survey 2. From this researcher's own experience with using the ECRS the only features from the list which the researcher identified were the 'image storage' and limited 'exportability'.

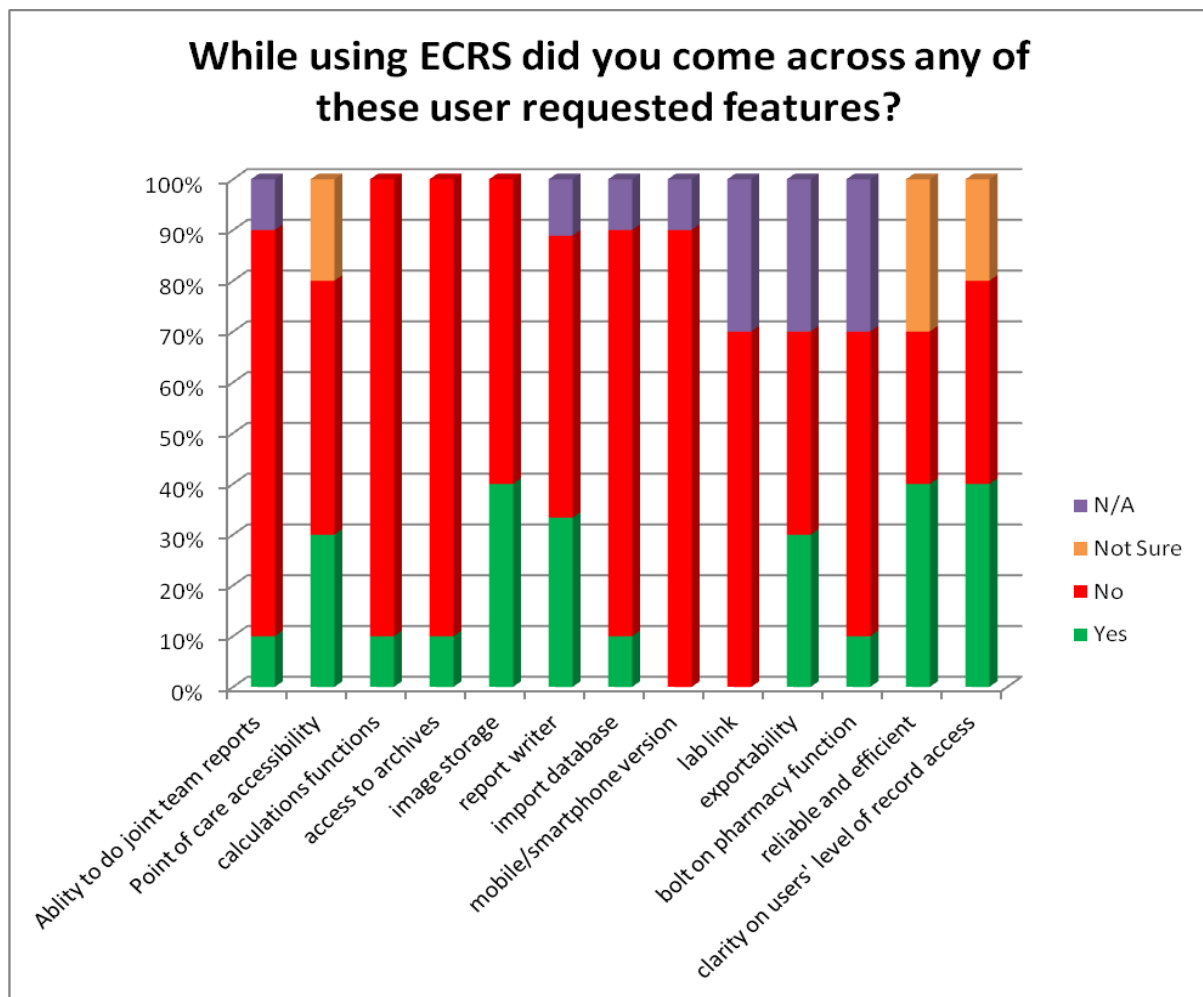


Figure 32: Participants' comments to status of the ECRS as it relates to presence or absence of user-requested features

When the participants were asked to rate the performance of the ECRS on 4 indicators shown in figure 33 the majority of respondents rated the system in the moderate to low categories with very few rating it above moderate category.

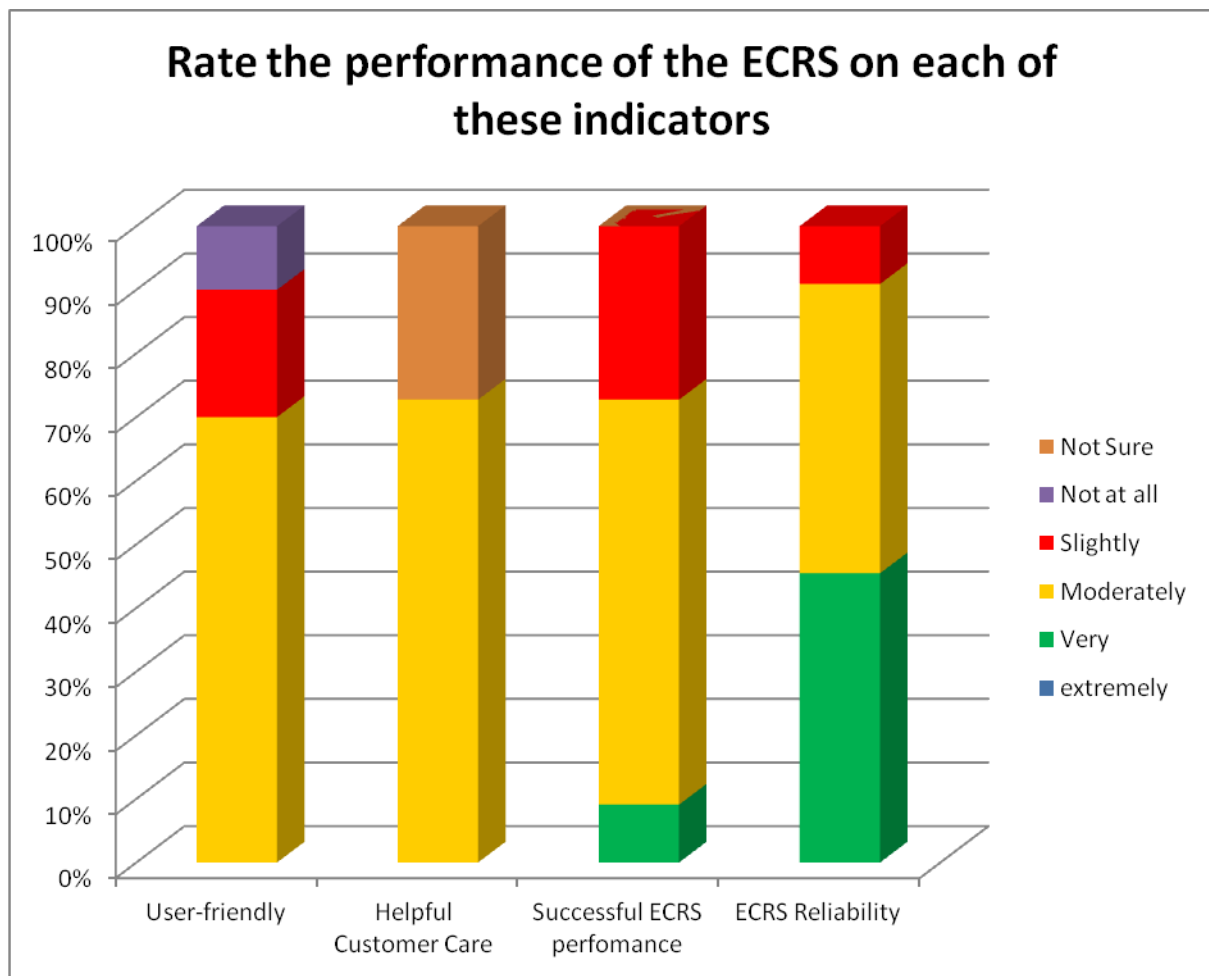


Figure 33: Participants' rating of the overall performance of the ECRS

Figure 34 confirms that majority of participant were not satisfied with the ECRS performance.

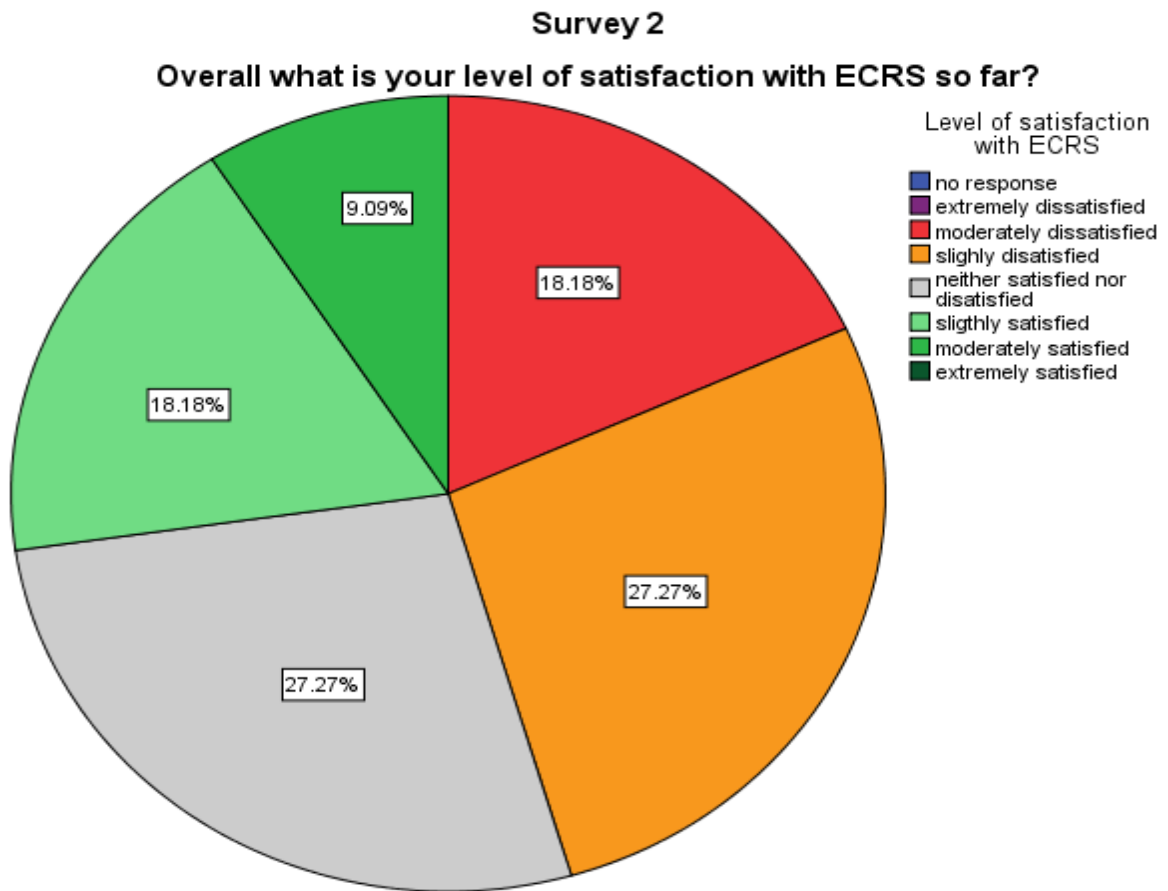


Figure 34: Participants' level of satisfaction with ECRS

An overall 27% of participants were satisfied with the ECRS while a majority of 45% were not. A substantial 27% indicated that they were neither satisfied nor unsatisfied with the ECRS so far.

All this may suggests that the ECRS was still far from meeting the user requirements at the end of data collection process despite the high level of benefit realisation expectations. This may suggest that participants were not entirely satisfied with the performance and status of the ECRS thus far.

One other indicator that users may have not been entirely satisfied with ECRS is the individual comments which participants gave. Majority of the comments highlighted problems related to lack of useful features and the fact that the ECRS looks more like a work in progress which at the moment is quite frustrating to work with.

Some users have indicated via comments that the difficulty with lack of proper navigation and user friendliness and its out-dated look was discouraging them from using the system.

When users were asked to provide suggestions as to how the ECRS could be improved so that it can better realise benefits the main theme coming out was that participants were requesting specific features that relate to their day to day work. There were also suggestions that the ECRS developers needed to work closer with the system users and take on board their comments.

Taking these other findings into consideration it may be reasonable to conclude that the actual level of perception was slightly lower than what the participants indicated.

There are some claims from the literature review which were not supported by the findings from this research. Some vendors and researchers claim that usage of EHRs improves quality of patient care and relationship with patients. In fact Häyrynen et al. (2008) claim that this is one of the main purposes of an EHR. Another claim is that usage of EHRs result in reduction of documentation time when it is compared to paper based patient record system. This research showed that participants did not perceive these claims to be true as far as usage of the ECRS was concerned. Figure 35 show that 55% of participants did not think that their usage of ECRS has improved the quality of care.

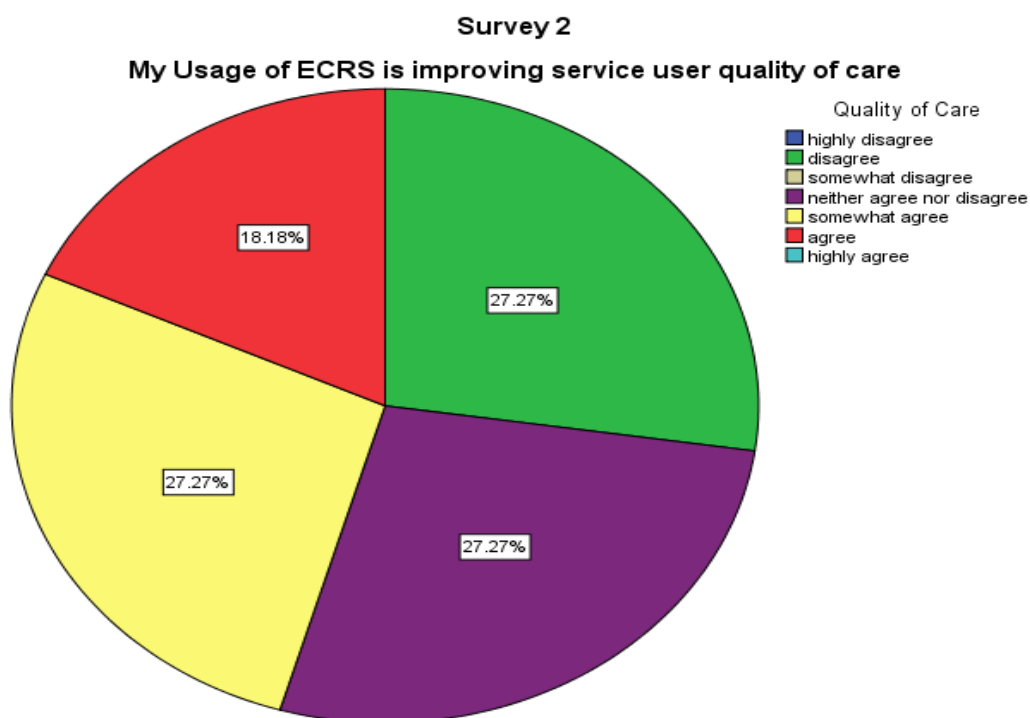


Figure 35: Participants perception on impact of ECRS on quality of care

A clear majority of participants (82%) did not think that usage of the ECRS affected their working relationship with clients in either direction.

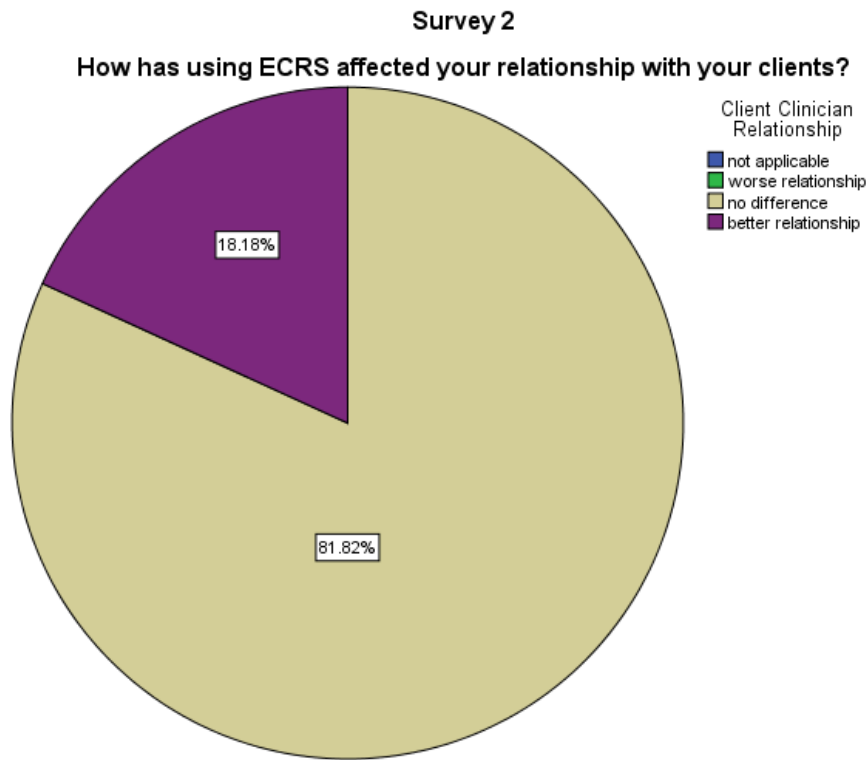


Figure 36: Participants' perceptions on impact of ECRS on their relationship with clients

Perhaps one of the most talked about specification requirement in the literature is the EHR interoperable capabilities. This is touted as one of the main requirements which is driving the standardisation agenda. Kalra (2006) pointed out that this feature helps to improve interagency communication. The results of this research showed that majority of participants (60%) in this research were '**not sure**' whether this feature is important at all to their daily work. Figure 26 showed the extent to which participants rated this and other EHR features. The other features where a small number of participants indicated they were not sure of their usefulness were; point of care access and multilocation access.

Despite these negative feelings majority of users who completed survey 2 indicated that their frequency of ECRS usage was high to very high as shown in figure 37.

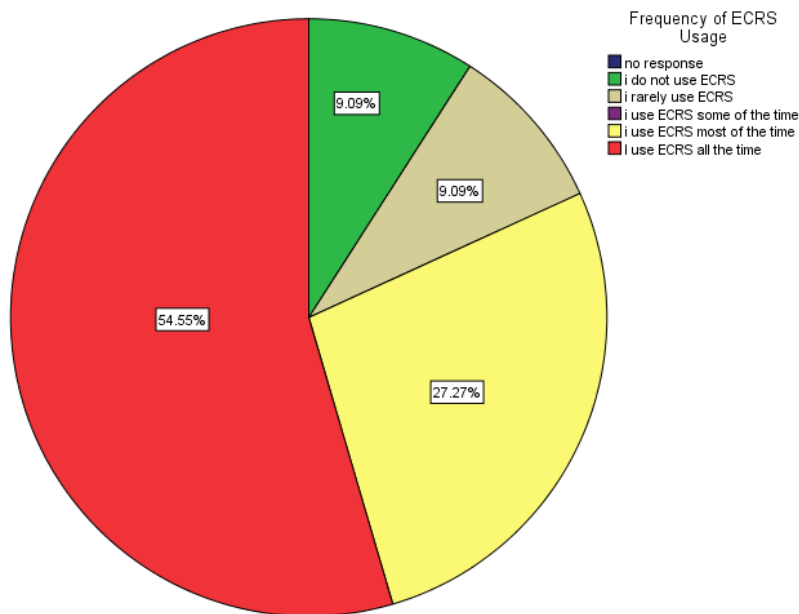


Figure 37: Participants' frequency of ECRS usage

This probably shows that participants remained optimistic that their experiences with ECRS will improve over time.

While it was beyond the scope of this research to establish if users who have more realistic expectations generally use the system more as postulated by Ginzberg, (1981), the findings of this research showed no relationship between high ECRS usage and high level of benefit expectation. The correlation was not significant and it was very weak as shown in table 20.

			Frequency of ECRS Usage
Spearman's rho	Combined 8 benefit score	Correlation Coefficient	.303
		Sig. (2-tailed)	.365
		N	11

Table 20: Relationship between benefit expectations and frequency of ECRS usage

This observation is contrary to Bhattacharjee (2001) who postulated that users with higher levels of satisfaction with an IT system tend to use the system more. The anomaly could be because the ECRS system is still in its infancy. It would be interesting to review this relationship again after at least 1 year of usage.

6.5 Relationship between Benefits and other Variables

The relationships between individual benefits that were maintained between the two surveys were the relationships *improved communication* and *improved teamwork* and the relationships *improved record accuracy* and *improved legibility*.

This suggests that users believed these benefits were complementary to each other. A new relationship between '*faster record access*' and '*improved legibility*' emerged in survey 2 suggesting that users may have noted this relationship only after using the system. This may suggest that with more ECRS usage, users may begin to note more complimentary relationships which can only be appreciated after usage of the ECRS system.

In general there appears to be no impact of clinicians ages on the level of benefit expectations and perception levels. The research showed however that the the age of the clicians rise so does the expectation that ECRS usage will lead to better communication among clinicians.

The research also showed that users' age does not influence the perception on how easy it is to use the ECRS or how confident the users are. This is despite that literature showed that younger users tend to adopt hence find it easy and are more confident in using new technologies than their older counterparts.

6.6 ECRS Status and Relationship Analysis

The reviewed literature raised the following arguments;

- a) The pre-implementation factors have an impact on users' pre-implementation expectations
- b) The EHR will not realise benefits if quality of the EHR product is not good

6.6.1 Relationship between pre-implementation factors and users' pre-usage expectations

In survey 1, participants identified training and involvement of users in the implementation process as some of the important pre-implementation factors which have an influence on users' pre-usage expectations.

According to Curtis (1992), Szajna and Scamell (1993), and Leslie et al. (2009) pre-implementation factors are vital to the success of IT systems such as EHR. With this in mind the following (figure 38) linear positive relationship between pre-implementation factors and users pre-usage expectations can be derived.

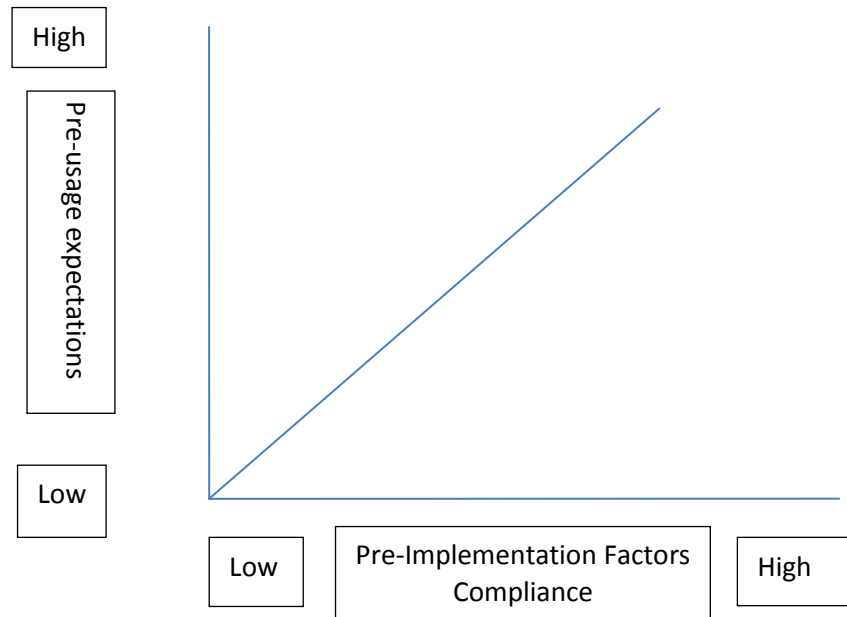


Figure 38: Linear positive relationship between users' expectations and pre-usage factors compliance (PiFC)

It seems logical to assume that high compliance to pre-implementation factors lead to high levels of benefit expectations, the former being the causal (independent) variable.

This research's findings showed that participants had high levels of benefit expectations and perceptions despite some dissatisfaction with the current status of the ECRS record. Following on from the above logic this may suggest that users perceived that there was a moderate to high level of compliance to pre-implementation factors.

6.6.2 Relationship between Users Perceptions during ECRS Usage and Quality of EHR

This research demonstrated that participants had a lower level of perceptions of benefit realisation than the prior corresponding level of benefit expectation. Also participants demonstrated that the ECRS was not yet operating at the optimum functional level hence moderate quality.

High compliance to critical success factors has been argued by many researchers as a huge contributory factor to EHR benefit realisation, (Tiernan and Peppard 2004, Ludwick and

Doucette 2009). High compliance to critical success factors discussed in the literature review was argued to lead to high quality EHR systems

With this in mind the following (figure 39) positive linear relationship between quality of EHR and subsequent perceptions of EHR benefit realisation can be derived.

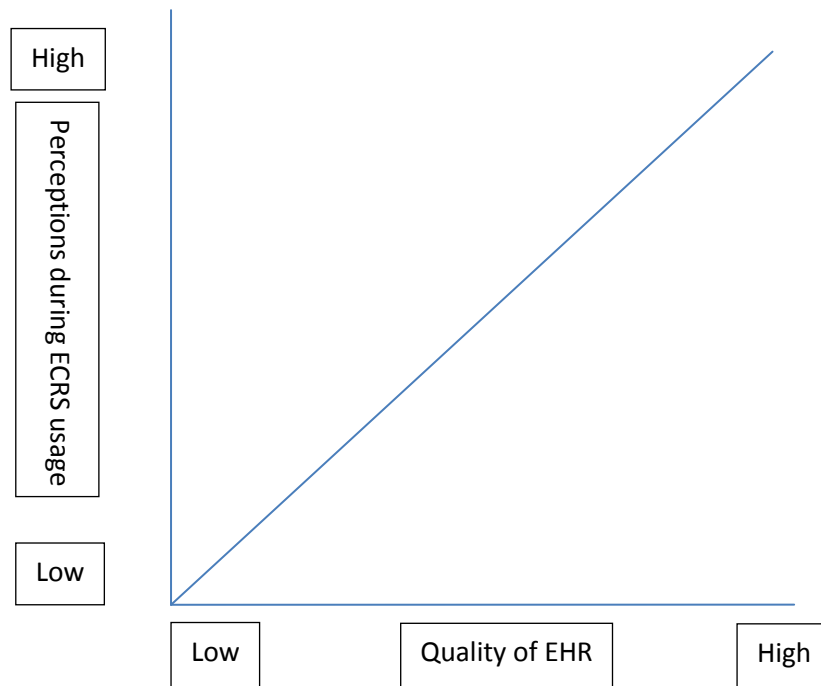


Figure 39: The positive linear relationship between users' benefit perceptions during ECRS usage and perceived quality of EHR.

It also seems logical to assert that low quality of EHR may lead to low perceptions of benefit realisation and so does high quality to high perception level.

6.6.3 The EHR Implementation Matrix

In a process to explain the observed pattern of relationship between the users' benefit expectations and perceptions together with the relationship between ECRS quality and the compliance with critical success factors, Figure 38 and figure 39 were combined into a matrix model shown in Figure 40. This model is a 4 square matrix which has a combination of pre-usage expectations and critical success factors on the x-axis (these two variables are assumed to have a linear relationship) against post implementation perceptions and quality of EHR system on the y axis (these two variables also assumed to have a linear relationship).

The ECRS Status Matrix Model

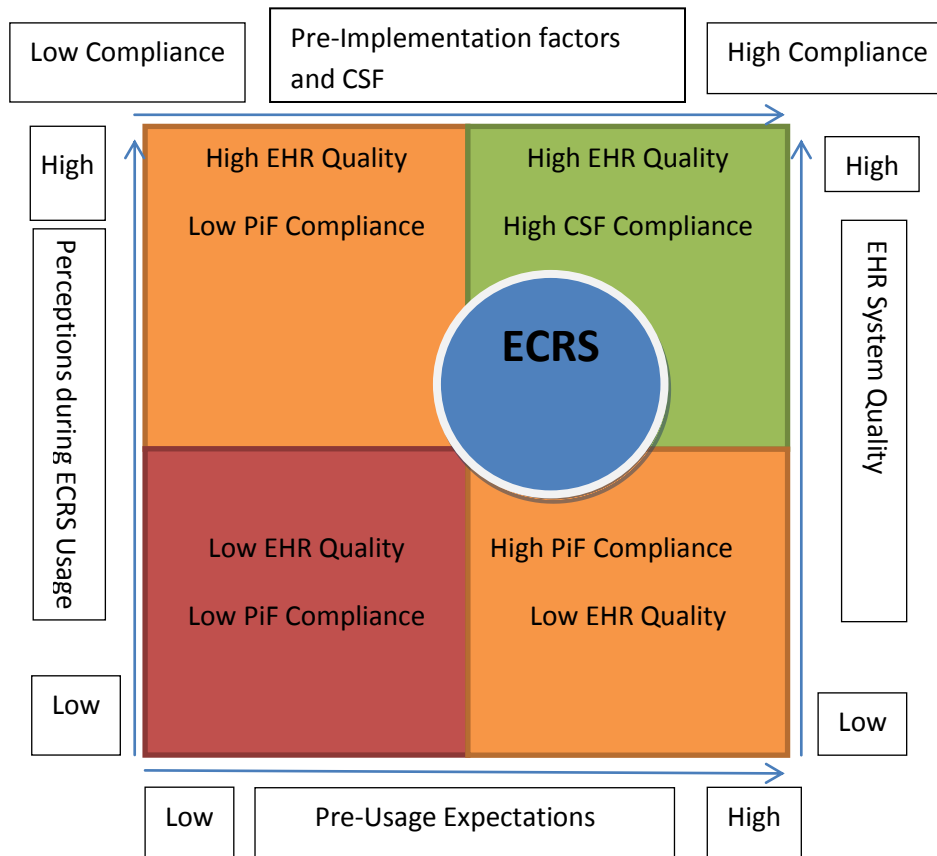


Figure 40: The ECRS status model.

By interpretation and interpolation of this research results, the model shows that the ECRS system is located mostly in the right upper quadrant (green). It however has small portions in the other 3 quadrants.

From this research it has been demonstrated that users had;

- 1) Relatively high pre- ECRS usage expectations that benefits would be achieved;
- 2) High levels of confidence to use the ECRS. The high levels of expectations also suggested a relatively satisfactory compliance to pre-implementation factors like training.
- 3) However a significant portion of participants still felt that pre-implementation factors such as user's involvement at the outset were not highly complied with.

Therefore the blue ECRS circle is located more on the right side of the matrix than the left to reflect the approximate level of benefit expectations and the level of pre-implementation compliance.

The research also demonstrated that users had;

- 1) Slightly high levels of perceptions that benefits will be achieved. Although the difference in the levels of perceptions was not significantly different from the prior expectation levels, the participants' data showed lower level of perception when compared with prior expectation levels.
- 2) Moderate levels of perceptions on the quality of the ECRS. While perception levels of benefit realisations were high, most participants felt the ECRS quality was not yet right.

Therefore the ECRS (blue circle) is more on the upper than the lower half of the matrix.

7 CONCLUSION

This research has demonstrated that preliminary usage of the ECRS did not change the users' pre-usage expectations. Users remained largely optimistic that usage of ECRS will lead to realisation of both literature based benefits and user-identified benefits. The results showed that both users' pre-usage benefit expectations and level of benefit perceptions during ECRS usage remained high.

This is in spite of the fact that participants felt that the ECRS was not operating at its optimum level. In particular users felt that the ECRS did not largely meet the user identified requirements and had largely underdeveloped features.

This incongruity of users' high level of optimism on one side and their perceptions of a relatively low quality of ECRS on the other side is rather surprising and difficult to explain. A possible explanation of the expression of high optimism notwithstanding the perceived low quality of ECRS may have potentially been driven by what Sedera et al (2001) termed the 'band wagon effect'. The incongruity also suggests that evaluation of the EHR should be multifaceted so that evaluation data is collected from many different dimensions in order to come up with a robust conclusion.

Given the potential impact of pre-implementation factors and critical success factors argued in the literature, the users' level of pre-usage benefit expectations and subsequent level of perceptions thereof, suggest that the ECRS quality is just above average as depicted in the ECRS status matrix model (figure 40).

The position of the ECRS on the matrix suggests that work on the quality of the ECRS and compliance with critical success factors should be the main focus for improving the ECRS.

This research appears to echo the view of Hillestad et al. (2005) that there is no conclusive evidence that EHRs improve clinical care or service users' outcomes and this is in direct contrast to what many Health Informatics practitioners reviewed in this research appear to be implying.

The research also failed to support the literature assertions that the EHR reduce time spend on documentation, improves the relationship between clinicians and patients and that users with high expectations tend to use the system more.

The researcher is unaware of any benefit realisation program which was implemented prior or in tandem with the implementation of the ECRS. Yet users showed high levels of benefit realisation expectations and at least high level of initial perceptions that those benefits are likely to be achieved. The user's views were based on their prior pre-use training and few months of usage of the ECRS. There seemed to be no impact of the lack of a benefit realisation program on users' levels

of expectations and perceptions. However the study was limited to a time frame which may have been too short to observe changes.

While some researchers such as Decker et al. (2012) suggests that younger people adopt technology faster than their older counterparts, this research demonstrated that the level of benefits expectations did not vary with participants' ages. Also age of clinicians did not influence their level of confidence or how easy they found the ECRS was, to use. Introduction of further technologies and new features should take advantage of this and target all clinicians with equal measure hence uniform costs.

Limitations

The data collection of this research was conducted over a short period of time. The time frame may have been too short to observe adequate impact of ECRS usage on levels of users' expectations and perceptions over time. It should also be noted that the ECRS is evolving and some issues and concerns raised may be transitory. They may change either direction with time.

While users' expectations and perceptions are vital measures of success or failure of EHR systems it has to be noted that there are other effective measures of actual performance discussed in the literature, albeit costly and difficult to implement.

The responds rate (40% and 24%) of this study was less than the industry average. The research also suffered from attrition. This could have potentially affected the nature of the results. It is also possible that the participants who responded to the survey were those who were more optimistic hence potentially introduced a positive or negative bias into the study. As a consequence type 1 and type 2 errors could not be ruled out completely.

The participants were drawn from a sample of convenience because of the low number of eligible participants. This meant that the sample was not random and therefore it was not normally distributed.

The non-parametric statistics were used to make inferences to the ECRS population. Non parametric tests are known to be less robust than parametric tests. The conclusions drawn as a result should be interpreted with these limitations in mind.

Future Recommendations

It was outside the scope of this study to determine the productivity level of the ECRS at various stages. In order to have a fuller evaluation of projects such as the ECRS it is useful to incorporate

actual measurement of productivity over time and compare with such graphical trend as suggested by Ross (1999). The ECRS status model can potentially be used to map the status of the ECRS over time in relation to the factors discussed in the model. An ideal position for the ECRS project is to occupy the top right part of the green square of the ECRS status matrix model.

Information obtained is potentially helpful in improving or maintaining the quality of the system.

More longitudinal collection of data over time is likely to yield more useful information than just two data collection events. From this research the two data collection episodes may have been too close and too few to show a difference in level of benefit expectations and perceptions.

The users expressed dissatisfaction with user-identified specifications and features. They identified specific features which they felt would improve efficiency and effectiveness to the new workflow processes hence add more value to the ECRS. Program vendors and project managers may want to note users' dissatisfactions and try and address those in order to improve chances of benefit realisation of the ECRS project.

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Appendices

Appendix 1: Enterprise System Benefit Network (Shang & Seddon 2002)

APPENDIX 1: ENTERPRISE SYSTEM BENEFIT FRAMEWORK

I. Operational benefits

1.1 Cost reduction

- Labour cost reduction in customer service, finance, human resources, purchasing, IT services and training.
- Inventory cost reduction in inventory turns, dislocation costs and warehousing costs.
- Administrative expenses reduction in printing and other business supplies.

1.2 Cycle time reduction

Measurable cycle time reductions in three kinds of activities that support customers, employees and suppliers.

- Customer support activities in order fulfilment, billing, delivery and customer enquiries.
- Employee support activities in month-end closing, requisition, HR and payroll and learning.
- Supplier support activities in order processing, information exchanging and payment.

1.3 Productivity improvement

Production per employee, production by labour hours, production by labour costs, increased work volume with same workforce and reduced overtime.

1.4 Quality improvement

Error rate, data reliability to data accuracy.

1.5 Customer service improvement

Ease of data access and inquiries.

II. Managerial benefits

2.1 Better resource management

- Better asset management for improved cost, depreciation, relocation, custody, physical inventory and maintenance records control, both locally and worldwide.
- Better inventory management in shifting products where they were needed and responding quickly to surges or dips in demand. Managers able see the inventory of all locations in their region or across boundaries, making possible a leaner inventory.
- Better production management for co-ordinating supply and demand and meeting production schedules at the lowest cost.
- Better workforce management for improved workforce allocation and better utilization of skills.

2.2 Improved decision making and planning

- Improved strategic decisions for greater market responsiveness, fast profit analysis, tighter cost control and effective strategic planning.
- Improved management decisions for flexible resource management, efficient processes and quick response to operation changes.
- Improved customer decisions with flexible customer services, rapid response to customer demands and prompt service adjustments.

2.3 Performance improvement in a variety of ways in all levels of the organizations

- Financial performance by lines of business, by product, by customers, by geographies or by different combinations.
- Manufacturing performance monitoring, prediction and quick adjustments.
- Overall operational efficiency and effectiveness management.

III. Strategic benefits

3.1 Support business growth

- In transaction volume, processing capacity and capability.
- With new business units.
- In products or services, new divisions or new functions in different regions.
- With increased employees, new policies and procedures.
- In new markets.
- With industry's rapid changes in competition, regulation and markets.

3.2 Support business alliance by

- Efficiently and effectively consolidating newly acquired companies into standard business practice.
- Building consistent IT architecture support in different business units.
- Changing selling models of new products developed by a merged company.
- Transiting new business units to a corporate system.
- Integrating resources with acquired companies.

3.3 Building business innovation by

- Enabling new market strategy.
- Building new process chains.
- Creating new products or services.

3.4 Building cost leadership by

- Building a lean structure with streamlined processes.
- Reaching business economies of scale in operation.
- Shared services.

3.5 Generating product differentiation by

- Providing customized product or services, such as early preparation for the new EMU currency policy, customized billing, individualized project services to different customer requirements, different levels of service appropriate for various sizes of customer organizations.
- Providing lean production with make-to-order capabilities.

3.6 Enabling worldwide expansion with

- Centralized world operation.
- Global resource management.
- Multicurrency capability.
- Global market penetration.
- Cost-effective worldwide solution deployment.

3.7 Enabling e-commerce by attracting new customers or getting closer to customers through the web integration capability. The web-enabled ES provides benefits in business to business and business to individual in:

- Interactive customer service.
- Improved product design through customer direct feedback.
- Expanding to new markets.
- Building virtual corporations with virtual supply and demand consortia.
- Delivering customized service.
- Providing real-time and reliable data enquiries.

3.8 Generating or sustaining competitiveness

- Maintaining competitive efficiency.
- Building competitive advantage with quick decision making.
- Staying ahead of competitors for better internal support.
- Using opportunities generated by ES to pull abreast of world leaders by using the same software and being compatible with customers.

IV. IT infrastructure benefits

4.1 Building business flexibility by rapid response to internal and external changes at lower cost and providing a range of options in reacting to changing requirements.

4.2 IT cost reduction in

- Total cost of maintaining and integrating legacy systems by eliminating separate data centres and applications, as well as their supporting costs.
- IT staff reductions.
- Mainframe or hardware replacement.
- Year 2000 compliance upgrading.
- System architecture design and development.
- System upgrade maintenance.
- System modification and future changes.
- Technology research and development.

4.3 Increase IT infrastructure capability

Stable and flexible support for the current and future business changes in process and structure.

Stability:

- Reliable platforms.
- Global platforms with global knowledge pipeline.
- Transformed IS management and increased IS resource capability.
- Continuous improvement in process and technology.

Flexibility:

- Modern technology adaptability.
- Extendibility to external parties.
- Expandability to a range of applications.
- Customizable and configurable.

V. Organizational benefits

5.1 Changing work pattern with shifted focus

- Co-ordination between different interdisciplinary matters.
- Harmonization of interdepartmental processes.

5.2 Facilitating business learning and broaden employee skills

- Learned by entire workforce.
- Shortened learning time.
- Broadened employee skills.
- Employees with motivation to learn the process.

Appendix 2: Measurement for Perceived Usefulness and Perceived Ease of Use

IT Usefulness and Ease of Use

Appendix Final Measurement Scales for Perceived Usefulness and Perceived Ease of Use

Perceived Usefulness

Using CHART-MASTER in my job would enable me to accomplish tasks more quickly.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
Using CHART-MASTER would improve my job performance.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
Using CHART-MASTER in my job would increase my productivity.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
Using CHART-MASTER would enhance my effectiveness on the job.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
Using CHART-MASTER would make it easier to do my job.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
I would find CHART-MASTER useful in my job.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

Perceived Ease of Use

Learning to operate CHART-MASTER would be easy for me.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
I would find it easy to get CHART-MASTER to do what I want it to do.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
My interaction with CHART-MASTER would be clear and understandable.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
I would find CHART-MASTER to be flexible to interact with.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
It would be easy for me to become skillful at using CHART-MASTER.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	
I would find CHART-MASTER easy to use.								
likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

340 MIS Quarterly/September 1989

Appendix: 2 Final Measurement Scales for Perceived Usefulness and Perceived Ease of Use (Davis 1989)

Appendix 3: Methodologies for Evaluating Socioeconomic Impact of EHR and ePrescribing Systems (Dobrev et al. 2008)

Method	Features	Disadvantages	Lessons learnt
UK Green Book	Appraisal and evaluation manual for central government in the UK. Economic assessment is one of several broad aspects. Costs and benefits are addressed. Perspective is public services. Adaptive to context. Applicable to <i>ex-post</i> and <i>ex-ante</i> settings, includes willingness to pay and other proxy measures	Needs expertise in the project topics to be used with many, complex cost and benefit variables	Methodological foundations used in eHI. Additional tools for investment decisions are optimism bias and risk.
RAND	Estimating future impact of health IT in the US. Focuses on efficiency savings to medical service providers. Evidence based on econometric models.	Extrapolation relies on technology diffusion estimates; disregards quality and access gains.	Underlines the importance of incentives; addressing price sensitivity useful for willingness to pay estimates.
Center for IT Leadership Study	At the centre of examination are transactions among the main healthcare providers in the US. Includes estimates of financial costs and benefits.	Limited number of stakeholders; financial perspective only.	Focus on all relevant stakeholders. Risk analysis - probability distributions in going forward in time.
ESA	Focuses on financial returns to medical service providers. Developed for a specific context.	High domain specificity, focusing on small number of stakeholder groups.	Addresses issues like legal and regulatory aspects.
eGEP - eGovernment Economics Project	Provides a generic approach for evaluating public value generated by eGovernment services, dividing value into financial, political and constituency value. Aims at enabling comparison between different projects in terms of impact, costs and risks.	Highly domain specific; indicators sensitive to political attitude and judgment; indicators not easily transferable to EHRI; no differentiation of stakeholder groups.	Includes differentiated risk adjustment; Standards issue and data requirements stressed.
WiBe	Generic manual for assessing an ICT project's profitability; offers a set of indicators, methods and tools in order to facilitate public sector investment decisions in the	General, requires specification to topic; comparison difficult as no single outcome measure;	Offers a useful framework for separating purely financial and other quantitative

Method	Features	Disadvantages	Lessons learnt
	ICT-sector; focus on ex-ante assessment. Adaptive to context.	focus on investing stakeholder can be limiting the value of analysis. Qualitative aspects are not quantified in any way.	impacts from qualitative ones.
eHealth IMPACT (eHI)	Focus on socio-economic net benefits over time, including all relevant stakeholders. Designed for ex-post and to support ex-ante analyses, applied to ex-post data from across the EU. Model adapts to data availability and includes change management and socio-cultural factors. Adaptive to context.	Usually needs high reliance on estimated data as few sites collect before and after performance data. Not designed to measure macro-economic impact	Generic methodological base. Can be developed further to improve comparability of findings.

Appendix 4: Survey 1 (Questionnaire 1): ECRS Pre-Usage User Expectations

Questionnaire 1: Electronic Health Record Pre-Implementation User

Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to.

Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised.

In the extremely unlikely event that illicit activity is reported the researcher will be obliged to report it to appropriate authorities.

1. To allow comparison of your responses between questionnaire 1 and 2 please assign yourself an easy to remember non-personally-identifying code and type it in the space provided below. Please use the same code when completing questionnaire 2 later.

2. Have you started using the Daughters of Charity Electronic Client Record System (ECRS or EpicCare) as yet?

☐ Yes

☐ No

Other (please specify)

3. If you said yes in previous question please indicate how long you have been using the ECRS (EpicCare) system?

☐ less than 1 week

☐ between 2 weeks and 3 weeks

☐ between 3 weeks and 4 weeks

☐ between 4 weeks and 5 weeks

☐ more than 5 weeks

4. The next 5 statements relate to your expectations in relation to using the Electronic Client Health Record system (Epiccare or ECRS) being introduced in your workplace.. Please indicate the extend to which you agree or disagree with each statement. Using Electronic Client Record System (ECRS- EpicCare) in my job will enable me to communicate more efficiently with other clinical team members

☐ extremely
likely

☐ quite likely

☐ slightly
likely

☐ neither
likely of unlikely

☐ slightly
unlikely

☐ quite
unlikely

☐ extremely
unlikely

Comment (optional)

Questionnaire 1: Electronic Health Record Pre-Implementation User

9. Using Electronic Client Record System (ECRS- EpicCare) in the service will enable clinical teams to collaborate and work better together as a team

☐ extremely likely ☐ quite likely ☐ slightly likely ☐ neither likely of unlikely ☐ slightly unlikely ☐ quite unlikely ☐ extremely unlikely

Comment (optional)

10. Using Electronic Client Record System (ECRS- EpicCare) in the service will enable clinical teams to keep more accurate service users' records

☐ extremely likely ☐ quite likely ☐ slightly likely ☐ neither likely of unlikely ☐ slightly unlikely ☐ quite unlikely ☐ extremely unlikely

Comment (optional)

11. Using Electronic Client Record System (ECRS- EpiCare) in the service will enable clinical teams to keep a more consistent format of service user records

☐ extremely likely ☐ quite likely ☐ slightly likely ☐ neither likely of unlikely ☐ slightly unlikely ☐ quite unlikely ☐ extremely unlikely

Other (please specify)

12. Using Electronic Client Record System (ECRS- EpiCare) in the service will encourage clinical teams to keep more complete service user records.

☐ extremely likely ☐ quite likely ☐ slightly likely ☐ neither likely of unlikely ☐ slightly unlikely ☐ quite unlikely ☐ extremely unlikely

Comment (optional)

Questionnaire 1: Electronic Health Record Pre-Implementation User

13. List any other 5 benefits of an Electronic Health Record system you consider to be important in enhancing service users' care

1	
2	
3	
4	
5	

14. Please rate each of your identified benefits according to how likely you expect the usage of ECRS will result in fulfillment of those benefits. Number '1' should correspond to the first benefit you identified on the previous question and number '2' should correspond to the second benefit on previous question and so on.

	extremely likely	quite likely	slightly likely	neither unlikely or unlikely	slightly unlikely	quite unlikely	extremely unlikely
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other (please specify)

15. If you have rated a score between slightly unlikely and extremely unlikely (inclusive) for any of your identified benefits in the previous question please explain why you have selected low ratings.

Questionnaire 1: Electronic Health Record Pre-Implementation User

16. Please rate the importance to you of the following features of an Electronic Health Record system designed for keeping records for the service users whom you provide a service for.

	Important	Not sure	Not important
Ease of use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multiple user views	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy navigation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enhanced security of records	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reliable network connection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
access of record at point of care	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
access of record from multiple locations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
interoperability with other referral agents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ongoing reliable system support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify and state the level of importance)

17. Please list any other features of the Electronic Health Record system you would consider to be important in making it easy and meaningful for you to use the system effectively and efficiently.

1	<input type="text"/>
2	<input type="text"/>
3	<input type="text"/>
4	<input type="text"/>
5	<input type="text"/>
6	<input type="text"/>
7	<input type="text"/>
8	<input type="text"/>
9	<input type="text"/>
10	<input type="text"/>

Questionnaire 1: Electronic Health Record Pre-Implementation User

18. Finally would you mind stating your current age category

- ☐ below 20
- ☐ between 20 and 29
- ☐ between 30 and 39
- ☐ between 40 and 49
- ☐ between 50 and 59
- ☐ between 60 and 69
- ☐ above 69

19. Your gender

- ☐ Female
- ☐ Male

20. What is your role/profession

- ☐ Nurse/Clinical Nurse Specialist
- ☐ Nurse Manager
- ☐ Medical Practitioner
- ☐ Physiotherapist
- ☐ Occupational Therapist
- ☐ Speech and Language Therapist
- ☐ Psychologist
- ☐ Social Worker
- ☐ Social Care Leader
- ☐ Administrator
- ☐ Care Assistant

Other (please specify)

Questionnaire 1: Electronic Health Record Pre-Implementation User

21. On average estimate the percentage of time you spend on all forms of documentation prior to using ECRS.

- ☐ less than 25% of my work roster
- ☐ between 26% and 50%
- ☐ More than 50%

Appendix 5: Survey 2 (Questionnaire 2): User perceptions during early ECRS usage

Questionnaire 2: Electronic Health Record User Perception of Success

Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to.

Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised.

In the extremely unlikely event that illicit activity is reported the researcher will be obliged to report it to appropriate authorities.

1. If you responded to Questionnaire 1, to allow for comparison of your responses between questionnaire 1 and 2 please type in the same self-assigned non-personally identifying code you used when you completed questionnaire 1, otherwise please proceed to the next question.

2. Did you have prior experience of using electronic patient record systems before?

☐ yes

☐ no

Other (please specify)

3. On the next few questions please rank your current level of perception on your usage of the ECRS (Epicare) system. The design and features of the ECRS are enabling me to work effectively and efficiently

☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

4. I am confident in using the ECRS

☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

5. Using Electronic Client Record System (ECRS-EpiCare) in my job is enabling me to communicate better with my team members

☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

6. I find it easy to use the ECRS

☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree or disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

Questionnaire 2: Electronic Health Record User Perception of Success

7. Using the Electronic Client Record (ECRS-EpiCare) in my job is enabling me to quickly access and use service users' records

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree or disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

8. My usage of ECRS is improving service user quality of care

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

9. Using Electronic Client Record System (ECRS-EpiCare) in my job is enabling me to spend less time on documentation

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

10. Using Electronic Client Record System (ECRS-EpiCare) in my job is enabling me to read and understand better the service users' records when compared with paper based service user files

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

11. Using Electronic Client Record System (ECRS-Epicare) in the service is enabling clinical teams to collaborate and work better together as teams

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

12. Using Electronic Client Record System (ECRS-EpiCare) in the service is enabling clinical teams to keep more accurate service users records

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

Questionnaire 2: Electronic Health Record User Perception of Success

13. Using Electronic Client Record System (ECRS-EpiCare) in the service is enabling clinical teams to keep a more consistent format of service user records across clinical disciplines

- ☐ highly agree
 ☐ agree
 ☐ somewhat agree
 ☐ neither agree nor disagree
 ☐ somewhat disagree
 ☐ disagree
 ☐ highly disagree

Comment

14. Using Electronic Client Record System (ECRS-EpiCare) in the service is encouraging clinical teams to keep more complete service user records

- ☐ highly agree
 ☐ agree
 ☐ somewhat agree
 ☐ neither agree nor disagree
 ☐ somewhat disagree
 ☐ disagree
 ☐ highly disagree
 ☐ not applicable

15. Using ECRS has increased my concern about privacy of service user personal information.

- ☐ highly agree
 ☐ agree
 ☐ somewhat agree
 ☐ neither agree nor disagree
 ☐ somewhat disagree
 ☐ disagree
 ☐ highly disagree
 ☐ not applicable

16. Please rate these benefits according to the extent to which you agree that they are on course to be fulfilled.

	highly agree	agree	somewhat agree	neither agree nor disagree	disagree	somewhat disagree	highly disagree	N/A
tracking service user progress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enhanced record security	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
holistic care approach	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
improved record quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
low cost and transferrability between centres	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If your earlier expectations were different from your current view point for any one of the above please explain why this is so.

17. List any other benefits which you think arose from using ECRS so far.

Benefit 1

Benefit 2

Benefit 3

Questionnaire 2: Electronic Health Record User Perception of Success

18. From all benefits presented to you on this questionnaire please select up to 5 benefits you consider to be the most important.

Benefit 1

Benefit 2

Benefit 3

19. In Questionnaire 1 the following were the top 5 features which participants identified and expected to see and use on the ECRS. Please indicate whether you encountered and used those features so far, as you had expected.

	Yes	No	Not sure	N/A
ability to do joint team reports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
accessibility of ECRS at point of care	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
in-built assessments with calculation functions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
access to archives	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
image storage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
report writer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
import databases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
mobile/smartphone version	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
easy to link to lab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
exportable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
bolt on pharmacy function	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reliable and efficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
clarity on users' level of records access	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comment

20. How has using ECRS affected your relationship with your clients

- ☐ no difference
- ☐ better relationship
- ☐ worse relationship
- ☐ Not applicable

Comment

Questionnaire 2: Electronic Health Record User Perception of Success

21. Using ECRS increases my worry about issues of liabilities

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

Please explain the reason why you believe so

22. To what extend do you agree/disagree with the following statement 'I have enough time during my work to use ECRS'

- ☐ highly agree ☐ agree ☐ somewhat agree ☐ neither agree nor disagree ☐ somewhat disagree ☐ disagree ☐ highly disagree ☐ not applicable

Comment

23. How user-friendly is the ECRS interface?

- ☐ Extremely user-friendly
☐ Very user-friendly
☐ Moderately user-friendly
☐ Slightly user-friendly
☐ Not at all user-friendly

24. How helpful is the customer support for ECRS?

- ☐ Extremely helpful
☐ Very helpful
☐ Moderately helpful
☐ Slightly helpful
☐ Not at all helpful
☐ Not sure/Not applicable

25. How successful is ECRS in performing its intended task?

- ☐ Extremely successful
☐ Very successful
☐ Moderately successful
☐ Slightly successful
☐ Not at all successful

Questionnaire 2: Electronic Health Record User Perception of Success

26. How often does ECRS freeze or crash?

- ☐ Extremely often
- ☐ Very often
- ☐ Moderately often
- ☐ Slightly often
- ☐ Not at all often

27. Overall, are you satisfied with the performance of the Electronic Client Record System (ECRS-EpiCare), neither satisfied nor dissatisfied with it, or dissatisfied with it?

- ☐ Extremely satisfied
- ☐ Moderately satisfied
- ☐ Slightly satisfied
- ☐ Neither satisfied nor dissatisfied
- ☐ Slightly dissatisfied
- ☐ Moderately dissatisfied
- ☐ Extremely dissatisfied

28. At the time of completion of this questionnaire how would you describe your level of usage of the ECRS for record retrieval and documentation? Please explain the reason for your choice of answer

- ☐ I use ECRS all the time
- ☐ I use ECRS most of the time
- ☐ I use ECRS some of the time
- ☐ I rarely use ECRS
- ☐ I do not use ECRS

Reasons for your choice (optional)

29. How can ECRS be improved?

Questionnaire 2: Electronic Health Record User Perception of Success

30. Finally if you participated in Questionnaire 1 and you used the same non personally-identifying code in this questionnaire you may skip the following questions.

Please select your age category

- ☐ below 20
- ☐ between 20 and 29
- ☐ between 30 and 39
- ☐ between 40 and 49
- ☐ bewtween 50 and 59
- ☐ between 60 and 69
- ☐ above 69

31. What is your gender?

- ☐ Female
- ☐ Male

32. What is your role/profession

- ☐ Nurse/Clinical Nurse Specialist
- ☐ Nurse Manager
- ☐ Medical Practitioner
- ☐ Physiotherapist
- ☐ Occupational Therapist
- ☐ Speech and Language Therapist
- ☐ Pyschologist
- ☐ Social Worker
- ☐ Pharmacist
- ☐ Social Care Leader
- ☐ Administrator
- ☐ Care Assistant

Other (please specify)

Appendix 6: Informed Consent Form: 2012

TRINITY COLLEGE DUBLIN **School of Computer Sciences and Statistics** **INFORMATION SHEET FOR PARTICIPANTS**

Background to the Study

My name is Cardwell Muvungani. I am a final year student with Trinity College Dublin and an employee of Daughters of Charity Service. I am carrying out a research in partial fulfilment of the requirements of the degree of Masters of Science in Health Informatics. I work as an Occupational Therapist.

Daughters of Charity Services is currently rolling out an Electronic Health Record system (Epiccare) to its clinical and administrative staff for the management of service users Health Care Records with a view to eventually replace or augment the current paper based record system. The system is currently being rolled out in phases to groups of users.

This research work is seeking to investigate the characteristics of the relationship between users' expectations before they use the Electronic Health Record System and their subsequent perceptions a few months after using the system. The objective of the research is to attempt to group users' viewpoints on the benefits and features of the Electronic Record System. This information could potentially be used as part of the evaluation process of the implementation of the Electronic Health Record System which may subsequently be used to funnel further rollout phases.

Procedure of the Study

In order for me to do this I am hoping to conduct a survey with volunteering members of staff who are due to start using the Electronic Health Record System in the next few weeks/days/month. You are being asked to complete the attached paper based questionnaire or an online questionnaire (whichever one you prefer) which seeks information about your expectations as they relate to the use of an Electronic Health Record system. Subsequent to this you will be asked to complete a follow up questionnaire after using the system for a while. The subsequent questionnaire will seek information about your perceptions of success of the implemented Electronic Record system. It is estimated that each questionnaire will take approximately 25 minutes of your time to complete.

You are being asked to participate in this study on voluntary basis. You must be 18 years or older to participate in this research. You have the right to withdraw your participation at any time with no obligations or any consequences to you. You can omit questions which you do not wish to give a response to, however the researcher will be grateful if all questions are responded to. You will remain anonymous and no identifiable personal details will be collected from the questionnaires.

Analysis of Data and Participants' Privacy

If you participate in this research you will be assigned a research ID number generated from your self-chosen non-personally identifying code, which will be used by the researcher to match your responses from the 2 questionnaires (i.e. if you participate in both parts of the research). All collected information will remain confidential and will be kept in a secure locked storage which is only accessed by the researcher and his supervisor. The results of the research will be reported in aggregate format. Upon completion of the coding process your questionnaires responses will be

shredded (if they are in paper format) or deleted from the secure electronic storage (if responses are in electronic format). If you have provided your email address for purposes of accessing the online questionnaires the email address information will be deleted from our storage in the same manner. If the research is to be published in a scientific publication your name will not be attached to any published results and your anonymity will be protected by using coded numbers to identify results obtained from individuals.

If you prefer to complete one or both of the questionnaires using the online format please type in the link below into your internet browser (Internet explorer, Firefox, Safari, Opera or Google Chrome) on any internet enabled device and you will find further information which will lead you to access the Online Electronic Questionnaires.

Here is the Link [Link to Survey Monkey]

Alternatively if you indicate your preference to the research contact person (gatekeeper) link(s) to the online questionnaires will be emailed to you. For the purposes of maintaining your privacy note that your responses will be received by the researcher anonymously and will not be linked with your email address.

Investigator's contact details: If you have concerns or questions about this study, please contact the researcher:

Cardwell Muvungani :
27 Wellington Walk
Mornington Park
Donacarney
Co. Meath
Tel 0419828936 or 0871239070
muvungac@tcd.ie
cardwell.muvungani@docservice.ie

TRINITY COLLEGE DUBLIN
School of Computer Sciences and Statistics
FOLLOW-UP INFORMATION SHEET FOR PARTICIPANTS

Questionnaire Two

The Researcher would like to thank you for taking part in this on-going study which is investigating the characteristics of the relationship between users' expectations before or just after they start using Electronic Record System and their subsequent perceptions a few months after using the Electronic Record System being rolled out at Daughters of Charity Services. You are also invited to participate in this part of research if you were not involved in the first part.

Having used the Electronic Health Record system for a while you are now being requested to complete Questionnaires 2. Questionnaire 2 is seeking information which relates to your perceptions of success of the implementation process of the Electronic Record System.

If you would like to take part in this part of the study you are being asked to complete the attached follow-up online or paper based questionnaire (whichever one you prefer).

As with the previous survey, you are not required to supply your names or any personally identifying information. You have been assigned a research ID number generated from the non-personally identifying code you supplied with your previous responses if you have taken part in the first part of the research. You are therefore being requested to use the same code which you used the last time if you took part in the first part of the research.

All collected information will remain confidential and will be kept in a secure locked storage which is only accessed by the researcher. The results of the research will be reported in aggregate format. Upon completion of the coding process your questionnaires responses will be shredded (if they are in paper format) or deleted from the secure electronic storage (if responses are in electronic format). If you have indicated your preference to use your email address for the purposes of accessing the electronic questionnaires the email address information will be deleted from our storage in the same manner. For the purposes of maintaining your privacy note that your responses will be collected anonymously and will not be linked with your email address. If the research is to be published your name will not be attached to any published results and your anonymity will be protected by using coded numbers to identify results obtained from individuals.

You will continue to reserve your right to withdraw your participation at any time you wish with no obligations or any consequences on you. You can omit questions which you do not wish to give a response to, however the researcher will be grateful if all questions are responded to. You will remain anonymous and no identifiable personal details will be collected from the questionnaire.

If you wish to complete this questionnaire using the online format please type in the link below into your internet browser (Internet explorer, Firefox, Safari, Opera or Google Chrome) on any internet enabled device and you will find further information which will lead you to access the Electronic Questionnaires.

Here is the Link <https://www.surveymonkey.com/s/GBY6XT8>

As with the case with the previous Questionnaire if you (have) indicate(d) your preference to the research contact person (gatekeeper), link(s) to the online questionnaires will be emailed to you. If a link to online questionnaire is sent to your email address note that for the purposes of maintaining your privacy your responses will be received by the researcher anonymously and will not be linked with your email address.

Once again thank you for your participation in this study.

Investigator's contact details: If you have concerns or questions about this study, please contact the researcher:

Cardwell Muvungani :

27 Wellington Walk

Mornington Park

Donacarney

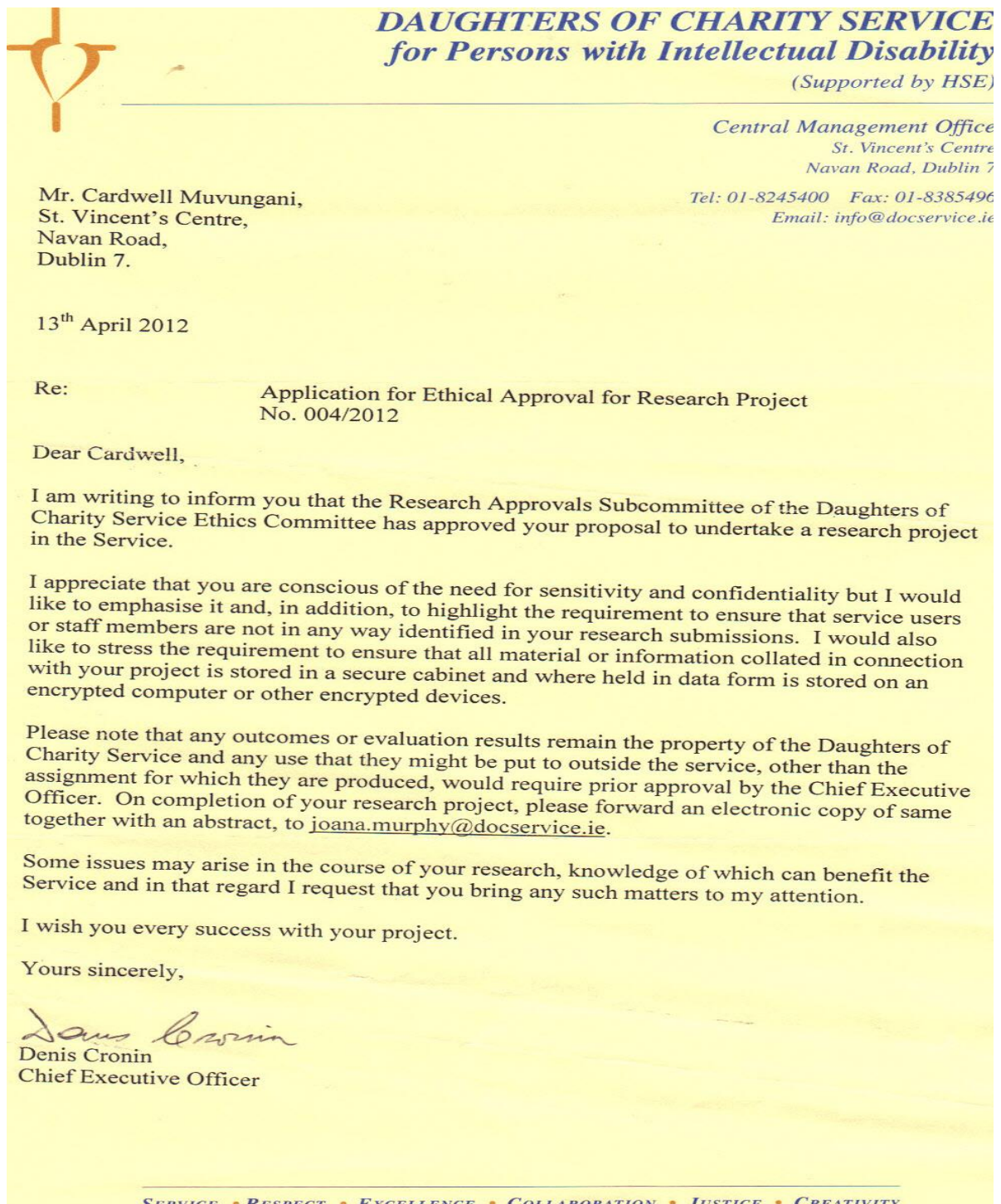
Co. Meath

Tel 0419828936 or 0871239070

muvungac@tcd.ie

cardwell.muvungani@docservice.ie

Appendix 7: Ethical Approval Letter for the research



Appendix 8: Statistics Data Tables

8a. Spearman Rank Order Correlation between the 8 benefits presented to participants (survey 1)

			Reduced Time Spend	Faster Record Access	Improved Legibility	Improved Team Work	Improved Records Accuracy	Improved Format Consistency	Improved Record completeness
Spearman's rho	Improved Communication	Correlation	.277	.631*	.705*	.824**	.825**	.347	.452
		Sig. (2-tailed)	.384	.028	.010	.001	.001	.268	.140
		N	12	12	12	12	12	12	12
	Reduced Time Spend	Correlation		.332	-.221	.152	.122	-.391	-.073
		Sig. (2-tailed)		.291	.491	.636	.705	.209	.821
		N		12	12	12	12	12	12
	Faster Record Access	Correlation			.254	.278	.583*	.234	.546
		Sig. (2-tailed)			.426	.381	.046	.464	.067
		N			12	12	12	12	12
	Improved Legibility	Correlation				.768**	.762**	.566	.592*
		Sig. (2-tailed)				.004	.004	.055	.043
		N				12	12	12	12
	Improved Team Work	Correlation					.727**	.530	.373
		Sig. (2-tailed)					.007	.076	.232
		N					12	12	12

	Improved Records Accuracy	Correlation						.465	.609
		Coefficient							
		Sig. (2-tailed)						.128	.036
	Improved Format Consistency	N						12	12
		Correlation							.437
		Coefficient							
		Sig. (2-tailed)							.155
	Improved Record completeness	N							12
		Correlation							
		Coefficient							
		Sig. (2-tailed)							.
		N							

8b. Spearman's Rank Order Correlation between 8 benefits in Survey 2

Correlations Survey 2

			Improved Communication	Faster Record Access	Reduced Time Spend	Improved Legibility	Improved Team Work	Improved Records Accuracy	Improved Record completeness	Improved Format Consistency
Spearman's rho	Improved Communication	Correlation Coefficient		.391	.291	.149	.627	-.129	.275	-.059
		Sig. (2- tailed)		.234	.386	.662	.039	.706	.413	.863
		N		11	11	11	11	11	11	11
	Faster Record Access	Correlation Coefficient			.030	.733	.309	.281	.324	.348
		Sig. (2- tailed)			.930	.010	.355	.403	.331	.294
		N			11	11	11	11	11	11
	Reduced Time Spend	Correlation Coefficient				.015	.466	-.061	.251	-.077
		Sig. (2- tailed)				.965	.149	.859	.457	.821
		N				11	11	11	11	11
	Improved Legibility	Correlation Coefficient					.312	.794**	.536	.309
		Sig. (2- tailed)					.350	.004	.089	.355
		N					11	11	11	11

	Improved Team Work	Correlation Coefficient							.198	.462	.103
		Sig. (2-tailed)							.559	.153	.763
		N							11	11	11
	Improved Records Accuracy	Correlation Coefficient								.536	.274
		Sig. (2-tailed)								.089	.414
		N								11	11
	Improved Record completeness	Correlation Coefficient									.126
		Sig. (2-tailed)									.713
		N									11
	Improved Format Consistency	Correlation Coefficient									
		Sig. (2-tailed)									
		N									

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

