Electronic Health Records

Can the scope of deploying Electronic Patient Records in Pre-Hospital Care be augmented through Participatory Design Approach at an Ambulance Service in England?

Author: Georgina Lucy Shikhukhulo
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Contact Information:
Author(s):
Georgina Lucy Shikhukhulo
E-mail: gesh16@student.bth.se

University advisor:
Professor Sara Eriksen
Department of Creative Technologies

Faculty of Computing
Blekinge Institute of Technology
SE-371 79 Karlskrona, Sweden

Internet : www.bth.se
Phone : +46 455 38 50 00
Fax : +46 455 38 50 57
ABSTRACT

Introduction and background: The use of Electronic Health Records (EHRs) sometimes referred to as Electronic Patient Care Records (ePCRs) amongst health and social care providers is increasing. Many countries are anticipating the benefits of maintaining patients’ records in one place to facilitate real time access by clinicians and other health and social care providers at the point of need; thereby saving resources, seeking to work more efficiently and indeed taking advantage of the rapid advancement in technology to enhance communication.

Objectives: Investigate challenges facing implementation of England’s EHRs programme by reviewing two design research approaches. Link the findings to possible barriers to augmenting the scope of the use of EHRs in the pre-hospital care at the Ambulance Service under study.

Approach and Methodology: Literature review on design approaches to rolling out EHRs systems of 4 countries. Followed by an examination available information on England’s EHRs implementation programme whilst considering the findings to draw out any similarities and differences with each of the countries examined. Follow-on enquiry through interviews whose results help draw relationships between success and design/implementation methodologies.

In this systematic review, several article sources are used, including ERIC, IEEE Xplore, ACM Digital Library, Google Scholar and Springer Link. Examples of cases are selected after reading titles and abstracts to decide whether the articles are peer reviewed, and relevant to the subject of enquiry. In addition, for articles to be selected they have had to meet the following criteria, a) written in English, b) full text is available online, c) had to have had primary empirical data, and d) focused on EHR implementation programmes. Interviews are carried out to gather first hand data for review, analysis and evaluation, to inductively make an end point explanation of patterns in EHRs implementation programmes.

Findings: Of the examples of EHRs systems across Europe and North America reviewed, independent and dependent variables closest to the research questions and hypotheses are identified, narrowing them down to design and implementation approaches to make probable causal link to implementation of EHRs system in England in general and the Ambulance Service in particular.

Conclusion: A connection with England’s EHRs implementation programme is made as the study alludes success to user driven bespoke solution as opposed to technology engineered systems. The study concludes that the design approach adopted by a country plays a significant role in gaining ‘buy-in’ when implementing EHRs systems. Subsequently recommendations are made to explore participatory design as a key promoter to ensure uptake of EHRs systems across main stakeholder groups whilst making a specific case for augmenting the scope of using ePCRs at the Ambulance Service provider in England. Furthermore, the conclusions deduce direct correlation to rollout progress and appetite for using EHRs in healthcare generally and could in theory influence behavior and attitudes that could foster acceptance and improve chances of successful implementation of ePCRs programme in England in general and the Ambulance Service under study.

Keywords: Electronic Health Records (EHRs), Electronic Patient Care Records (ePCRs), Design Approach, Ambulance Service (Pre-Hospital Care), Design Approach
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Georgina L. Shikhukhulo
September 2016
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<th>Description</th>
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<tbody>
<tr>
<td>CCG</td>
<td>Clinical Commissioning Group</td>
</tr>
<tr>
<td>CSCW</td>
<td>Computer Supported Cooperative Work</td>
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<tr>
<td>CT scan</td>
<td>Computerised tomography</td>
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<tr>
<td>Delphi</td>
<td>A programming language</td>
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<tr>
<td>DSS</td>
<td>Decision support systems</td>
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<td>EHRs</td>
<td>Electronic Health Records</td>
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<td>EMRs</td>
<td>Electronic Medical Records</td>
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<td>ePCRs</td>
<td>Electronic Patient Care Records</td>
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<tr>
<td>ePrescriptions</td>
<td>Electronic Prescriptions</td>
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<tr>
<td>ERIC</td>
<td>Education Resource Information Centre</td>
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<tr>
<td>GP</td>
<td>General Practitioner</td>
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<tr>
<td>H&amp;SCS</td>
<td>Health and Social Care Services</td>
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<tr>
<td>HCI</td>
<td>Human-Computer Interaction</td>
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<tr>
<td>HSC</td>
<td>Health Select Committee</td>
</tr>
<tr>
<td>IBIS</td>
<td>Intelligence Based Information System</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and communication technology</td>
</tr>
<tr>
<td>IEEE Explore</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>MHealth</td>
<td>Mobile Health</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic resonance imaging</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Service</td>
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<td>NHSFT</td>
<td>National Health Service Foundation Trust</td>
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<tr>
<td>NIB</td>
<td>National Information Board</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<td>PD</td>
<td>Participatory Design</td>
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<td>pPCR</td>
<td>Paper Patient Care Record</td>
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<td>SOCRATES</td>
<td>Social Cognitive Robotics in the European Society</td>
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<td>TEC</td>
<td>Technology-Enabled Care</td>
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<td>Trust</td>
<td>National Health Service Foundation Trust</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<td>USA</td>
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**Acronyms**

- **ACM Digital Library**: Association for Computing Machinery Digital Library
- **ePrescription**: Electronic prescription
- **CISCO**: An American multinational technology conglomerate
- **Google Scholar**: Academic Library search engine
- **Pre-Hospital Care**: Emergency Service or Ambulance Service
- **Springer Link**: Online Academic Library
1 INTRODUCTION

1.1 Introduction

In the introductory chapter, an insight into the area of enquiry is outlined. This is followed by a brief background and a snapshot of where a gap exists, mentioning the research problem area. The objective of the thesis is outlined and the related questions and scope presented. The final section of this chapter provides a summary outlook of the study.

1.2 Research Background

On 20 January 2016, Martin Wolf writing for the Financial Times, talked about “the penetration of recent innovations in communications technology, with 7bn mobile phone subscriptions denoting a 97% penetration rate by end of 2015 compared to only 10% in 2000” (Wolf, 2016). Suffice to say the rapid increase has not been relegated to personal use but has also been embraced by businesses, governments and voluntary sectors. One would claim that technology has enhanced the ability to collect, maintain, store, share and use information which has been an integral part of improving the way services are provided across various sectors. Information and communication technology (ICT) plays a key part in health and social care services across the globe and it is becoming generally acceptable to host, retrieve and use diverse types and sizes of information or records electronically.

These phenomena have been embraced across generations and societal classes resulting in a significant culture shift across the globe. According to a Cisco Visual Networking Index; global mobile data traffic has increased tremendously and looking into the future, the report estimates that “global mobile data traffic will increase 18-fold by 2016”. It goes on to say that by the end of that period, it is projected that there will be 10 billion mobile devices in use around the world (Cisco, 2016).

A study by Deloitte Centre for Health Solutions on how digital technology is transforming health and care reported an exponential advancement and plummeting cost (Taylor). The research looked at how connected health, also referred technology-enabled care (TEC) which comprises of health technology, digital media and mobile devices was being used to improve the way health practitioners and stakeholder groups
access patient data across a large demographic spectrum (Taylor). The report presented compelling statistical data stating that ‘technology is becoming more pervasive’ adding that in ‘2014, Smartphone penetration reached 70 in the UK, with top pharma companies having 63% more unique apps in 2014 vs 2013’. The report further said ‘that the number of health apps on iOS and Android has more than doubled in 2.5 years to over 100,000’. The report additionally predicted a significant grown in mobile health (mHealth) market bringing reviews of $7.1 billion to Europe by 2018 (Taylor).

The research was focused on patients using technology to manage their health and reported that 75% of UK’s population goes online for health information (Taylor) adding that 97% reported high satisfaction, 62% increased confidence in health care system and 94% felt there was better treatment compliance amongst practitioner (Taylor). This evidence was gathered in the on health and social care services in UK and USA. (Taylor). Taylor concludes by saying ‘there is enormous potential for digital technology to improve many aspects of health and social care provision’ (Taylor). It is important to note that this work touches on availability of health information which is not the same electronic patient records being explored in this study.

In 2002, England sought to bring benefits of innovations in communications technology to its Health and Social Care Services (H&SCS) by launching an Electronic Patient Care Record (ePCRs) system, sometimes referred to as Electronic Health Records (EHRs) or Electronic Medical Records (EMRs) (BBC News, 2015). These three terms are used interchangeably in this paper. The impetus was inspired by systems launched in other countries namely; USA-1991, Sweden-pilots-1995, then 2002 full rollout, Denmark-1999, Canada-2001 and England - the home of this study in 2002. The common theme and driver appears to be linked to promoting efficiency in costs and service delivery amongst service providers. There are several countries across the globe that could have been selected, but due to the scope and limited time, this work has restricted its enquiry to 5 countries only. The focus of this paper is EHRs in England, however, USA, Sweden, Denmark and Canada are reviewed, with the aim of providing insights into EHRs systems in disperse locations, with different dynamics, populations to help gain an understanding of how EHRs have been implemented and are being used elsewhere. These countries have been randomly nominated with minimum focus placed on subjective selection criteria. All countries globally had an
equal chance of being selected and any one could have fulfilled the basic selection criteria in their respective groups. The chosen countries seem to provide a good blend of thought-provoking variables to be examined, such as the country’s approach, rollout progress to-date, some issues encountered etc. The diversity in selection also helps outline the different approaches and probable course behind the prevailing status. Minimalist consideration informed the chosen countries, including some basic similarities such as similar technological aptitude, regulatory framework in place, general government policies and government’s maturity that would not inhibit user participation. These systems had to have implemented their EMRs systems before England. There are several countries that fit into this criterion however borderline subjectivity in selection to fit into the scope and timeline of this work has been applied.

1.3 Motivation and Justification

With the fast-growing adoption of technology as the link between information and communication in health care services, the implementation of an electronic system in health care would be seen as a key enabler for maintaining patient records that would ease access as well as facilitate sharing of patient information at the point of providing care. However, it would be extremely challenging for one to attempt to advocate for and demonstrate the advantages and values for a mass rollout of a universal type of EHRs system suitable for an entire nation’s health care service, across all the segments of their service provision. To be able to successfully achieve this type of rollout, a wider reaching study and appropriate design of a universal solution for implementation of a system targeting all relevant patient groups in a community (or at least a larger part of a community) would be required. As mentioned in section 1.2 above, England embarked on implementing a national EHRs programme in 2002 and very little progress has been made to date (Syal, 2013). One of the reasons might the need for different system requirements for dissimilar segments of health care providers. This area of enquiry is however, outside of the scope of this study and will therefore not be developed further.

One of the motivations for a national program was the anticipated benefits from a national procurement programme. The proponents of this approach ‘claimed that local procurement of systems had generally proved unaffordable in the past’ arguing that this approach would be ‘a more consistent development of IT across the
National Health Service (NHS), in contrast with the previous electronic islands’ (The Electronic Patient Record, 2016). They also supposed that there would be ‘greater potential for interoperability between systems than if a more localised approach was been taken’ (The Electronic Patient Record, 2016). Despite healthcare service providers’ embracing the idea of improving their services by implementing EHRs, the overall national programme continues to face significant challenges and it is on the verge of closing according to the latest report emerging from Caldicott’s review. (NHS England to close care.data programme following Caldicott Review, 2016). The review is named after the Dame Fiona Caldicott, appointed by United Kingdom’s (UK’s) Secretary of State for Health; to carry out an independent review of information sharing ("Caldicott Review: Information Governance in The Health And Care System - Publications - GOV.UK"). This study supposes that the challenges may have inadvertently impacted negatively upon implementation of EHRs systems generally and in pre-hospital care in particular. Further recommendations following recent consultation have pointed to the aspiration for at least 10% of registered patients in each General Practitioners (GP) practice should be using a digital service such as online appointment booking, repeat prescriptions and access to records by 2017 in a bid to increase take-up of internet enabled services in health and care (Department of Health, 2015). 10% of a population of a programme implemented in 2002 (15 years on) seems small. It is worth noting that the usage alluded to here does not attempt to tackle the issues under investigation in this thesis.

This paper seeks to establish whether some of the key challenges could be attributed to the design research methodology that informed the development of the EHRs system. An enquiry through interviews and review of available literature will be carried out on an EHRs pilot at a nominated National Health Service Foundation Trust (NHSFT), also referred to in this paper as Ambulance Service or Trust. The discussions will make a case for augmenting the scope of deploying EHRs in pre-hospital care through an appropriate design research methodology that effectively informs the system to be implemented. The paper reviews the EHRs pilot, querying the design by using two diametrically opposite design approaches and gathering evidence to make recommendations between Computer Supported Cooperative Work (CSCW) and Participatory Design (PD) methodology for the development of a suitable EHRs system. This approach is informed by further intelligence gleaned from
Baroness Fox’s report highlighting the need for user inclusion quoting; ‘This (the published recommendation) follows a commission from Health Secretary Jeremy Hunt who asked the former UK Digital Champion to look at ways in which there can be more digital inclusion across the NHS (Department of Health, 2015).

1.4 Theoretical Background
This study sits within the Department of Creative Technology in Computer Science with particular interest in the field of informatics. Informatics is defined by the University of Edinburgh as “the study of the application of computer and statistical techniques to the management of information” (What is Informatics, 2016). This study investigates and understands the possible barriers linked to design research methodology and overall benefits of implementing the use of EHRs systems in pre-hospital care. Identified literature on EHRs systems is examined in addition to data gathered from key stakeholder groups including patients, clinicians, software developers, legal and data protection policy and experts to help inductively explain patterns in national and EHRs implementation programmes. The findings in turn inform appropriate recommendations for possible re-design of an approach that would result in augmenting the scope of the use of ePCRs in pre-hospital care at the Ambulance Service.

The two design approaches selected are; Computer Supported Cooperative Work (CSCW) and Participatory Design (PD) methodologies whose issues and benefits are discussed, highlighting advantages of interactions with design researcher, key stakeholder groups, information, communication and technology throughout the system/solution development process.

Computer Supported Cooperative Work Methodology
Schmidt and Bannon refer to CSCW as “a design-oriented research with technology at the centre of the research agenda and it is aimed at understanding the nature of cooperative work so as to be able to design technologies that can support it in adequate ways” (Schmidt and Bannon, 1992). It is said to have grown out of a research area carried out in the 1980s of Human-Computer Interaction (HCI). This is as illustrated in the work presented in the book Psychology of Human-Computer Interaction which describes HCI as a methodology for unifying psychology and computer science (Card, Moran and Newell, 1983). In other words, a system is
developed based the appropriateness of variables such as design, the technology might be to enable/facilitate the application or use of the solution. These types of solutions have the experts, specialised teams, who may include developers and system designers at the helm of the development process seeking the best way to collaborate both during development of a solution and when in use. The solution would be based on the best technology available to support collaboration amongst users and not how best would the user benefit from the solution.

**Participatory Design Methodology**

Unlike CSCW, PD is ‘a user-centered design research approach where ‘the people destined to use the system play a critical role in designing it rejecting the assumption that the goal of computerization is to automate the skills of human workers, instead of seeing it as an attempt to give workers better tools for doing their jobs’ (Schuler and Namioka, 1993). This approach is being used in the study to test whether users themselves are best placed to determine what they want and how they want it, notwithstanding the wider stakeholder group that would include experts to offer skillful views on viability and feasibility of a user-centered solution. In PD methodology, all stakeholders are involved in the design process; (Endsley, Mica R and Debra G Jones) say that this is the best approach to confront information gaps according to The approach asks the users of the system to assist in design and development of a solution the complete opposite of expert and specialty driven design CSCW solution.

It is said to have been called cooperative design, originated in Scandinavia through a partnership between academics and trade unions. According to Bjerknes in Scandinavian countries, ‘user participation’ in system development has been discussed and practiced for more than two decades (Aarhus 1975, Bjerknes et al. 1987) (User Participation and Democracy: A Discussion of Scandinavian Research on System Development, 1995). Another scholar says that user participation refers ‘to the involvement of users in work activities during system development—the forms and degree of involvement vary (representative or direct involvement, consultants, or collaborators)’ (Hart, 1998). The theoretical perspective helps validate this study’s hypothesis.
1.5 Why these two design approaches?

There are a variety of other design approaches that could have been selected most of which lend themselves to these two main methodologies and therefore not deemed appropriate for this study. In addition, CSCW and PD seem to present the sharpest contrast in research design, development process and application.

CSCW as a form of computer system for supports collaboration, which have been developed and improved over the years and are often referred to as Groupware (Marca and Bock p.60). Marca further states that ‘the development of Groupware was not merely another evolutionary step in the history of computer science, but “a conceptual shift; a shift in our understanding”. Some computing examples view the computer as a tool for using and exchanging data. However, with CSCW or Groupware; the computer is used or perceived as a shared space for individuals collaborate and may be regarded as a shift in the relationship between people, tools and information. Nonetheless this approach obviously supports users with collaboration capability who can employ their expertise or contribute to the development of a solution or system. These users could be drawn from a variety of stakeholder groups some of which may be users of certain calibre, knowledge and skills set.

To address this seeming similarity between CSCW and PD, the main distinction is that the stakeholder groups in PD approach may not have any expert knowledge, skills or ability to collaborate on a computerised platform but rather would have vital information that might be useful in informing the design of a solution. Some stakeholder groups may never actively utilise the solution but would have strong views of what information they would like captured on an EMR and how that information for use should the need ever arise. These views may represent sizeable proportion of the stakeholder group and could potentially influence attitudes towards uptake of a system if omitted from the design journey.

Another key factor about PD approach, is that data may be collected by a researcher, processed and returned to the interviewees for validation. This could involve a number of iterations until all parties are happy that voices have been heard, views taken on board and tested before a solution is development for
The underlying principle of CSCW is to ensure ethical boundaries are not crossed by ‘buddying’ with users through invitation participate in the design process. The fundamental thinking alludes to the risk of a system being irrationally influenced by inexperienced and emotional participants. This update comes on the backdrop of a recent study that attempts to incorporate participants, collaborators, co-creators through a more social scientific, participatory and action-oriented methods reported following a CSCW 2014 workshop (Branham et al. p.305). This study will maintain the original principles underpinning CSCW-HCI research design methodology due to unavailability of sound body of knowledge to the author to help validate the shift in thinking reported as an outcome of the CSCW-2014 workshop. Diagrams 1.1 and 1.2 below show the distinctive movement of information in CSCW and PD approaches.

Diagram 1.1: People-artifact framework of collaboration (copyright Dix et al.1993)

The diagram above represents people-artifact framework of collaboration (Michelucci P.434) and addresses ‘functional relationships between actors in a cooperative process and tools to support it’. Michelucci further says that ‘the focus is on the role of shared objects and the way information flows between cooperating actors to allow for integration of two dimensions namely humans and computational intelligence as well as cooperation between the human users’ (Michelucci P.434). This collaboration is designed for users to share knowledge from their points of view and it is aimed at enabling the collaborators to interpret the information available in their own way. It is important to note that the information subjected to collaboration would have already been gathered to suit the computer system/technology or platform from which collaboration bounces off rather than involve the users in contributing to the data/information in order to build as solution or even a platform for collaboration.
Diagram 1.2: Participatory design approach illustrating iterative nature.

Capturing user stories under participatory design approach requires iteration, to have discussions to ensure that users, product managers, developers, designers and all other relevant stakeholders are in agreement on what is being designed. When users are taken on the design journey, the process avails opportunities for ambiguity to be clarified and excessive demands and expectations managed appropriately. PD provides for dialogue early in the design and development process.

1.6 Objective of the Thesis

As an avid user of handheld devices, this study starts on the premise that implementation of ePCRs would improve convenience. In addition, when any company, government or institution decides to change the way they work to enhance efficiency, some of the key drivers are cost effectiveness, to deliver value for money and improve quality of life for users in the case of this study patients. The steps taken within the scope of this paper include reviewing some best practice examples and where possible, examine design methodology, evaluate the status of EHRs implementation programmes across health care service providers and relate the findings to the nominated Trust whilst focusing on the design approach. This work seeks to uncover the perceived barriers/hindrances facing health care providers from latching onto England’s data and technology programme. The study hopes to gain insight into what the key stakeholders perceive to be reasons for the slow progression...
in adopting ePCRs in their respective areas of work generally and in particular during pre-hospital care.

1.6.1 The key objectives are as follows:
   a. Establish the key factors considered during EHRs systems design process for implementing large scale data and technology programmes;
   b. Evaluate whether and how design methodology has/had any bearing on the challenges the EHRs systems implementation programmes may be facing abroad and in England;
   c. Compare possible outcomes of technology-centred design to user-centred design approaches;
   d. Determine whether user-centred design approach would augment the scope of implementing the use of EHRs at the nominated Trust.

1.6.2 Justification for investigating the objectives:
   a. To establish whether and how key stakeholder groups impact or would impact the design and use of an EHRs systems especially in pre-hospital care;
   b. Determine whether and how knowledge (tacit or explicit) and information including technical, clinical and experiential, possessed by key stakeholders would inform a successful system design and solution;
   c. To have prior understanding of how stakeholder groups use/apply or intend to use/apply EHRs;
   d. Identify the best design research methodology through an appropriate system design process suitable, implementable and bespoke EHRs system useable in pre-hospital care at the Trust;
   e. Establish sound basis to recommend that the chosen system is evaluated by running a number of pilots in an agile environment prior to mass rollout;
   f. Propose follow on action that will allow the results from the pilots to be evaluated on capturing user stories and refining the EHRs system for pre-hospital care at the Trust;
   g. Determine whether systems developed through certain selected design methodology would be transferred to the users (key stakeholder groups) after implementation in order to provide an enduring solution;
h. Confirm whether identifying and training as well as working with early adopters from the user group to act as ambassadors and advocates for the use of EHRs at the Trust would increase the chances of augmenting the scope of deploying EHRs in Pre-Hospital Care at the Trust;

i. Finally, once sound evidence has been gathered, make recommendations for augmenting the implementation of use of EHRs at the Trust.

1.7 Problem Discussion

There are different factors that drive the need for organisations, governments and voluntary sectors to seek different ways in which to increase efficiency. Taking the case in hand, it is clear to see that one of the drivers may have originated from pressure to improve public sector performance and at the same time contain expenditure growth by Governments of the Organisation for Economic Cooperation and Development (OECD) countries as citizens continue to demand value for money against their taxes as reported by (Curristine, Teresa, et al: 2007, Improving Public Sector Efficiency). The authors point out that: ‘There is no blueprint for enhancing public sector efficiency. Countries have thus adopted diverse approaches to reforming key institutional arrangements, which include: increasing devolution and decentralisation; strengthening competitive pressures; ……… changing budget practices and procedures………..’ (Curristine, Teresa, et al: 2007, Improving Public Sector Efficiency).

Whilst OECD’s approach is of a devolved nature, indication from England’s case points to a single, ‘fit for all solution’ which leads to the questions raised in this paper; of whether the data and technology approach adopted by England through the National Information Board’s (NIB) data and technology programme (“About - National Information Board - GOV.UK”) that lends itself to the original CSCW design research methodology was indeed appropriate, feasible and deliverable?

This paper looks at how England’s Department of Health EHRs system which is being delivered by ‘NIB’ and ‘whose role was to put data and technology safely to work for patients, service users, citizens and the caring professionals who serve them, as well as ‘to help ensure that health and care in England is improving and sustainable’. (Personalised Health and Care 2020:2014). Another aim of setting up
NIB was to ‘help take forward the ambitions of the Care Act 2001, the Government Digital Strategy (2013), the Department of Health’s Digital Strategy: Leading the Culture Change in Health and Care (2012) and the proposals in the Department of Health’s Power of Information (2012) an information revolution: that was meant to put people first, giving them more control and more transparency’ (Webster and Watson, 2002).

1.8 Hypothesis
The earlier and the more key user groups are involved in the design and solution development process the greater the chances of EHRs systems programmes to succeed.

1.9 Research Questions
Health and social care user groups are often of a diverse nature, with different user requirements and needs and therefore one solution developed based on a particular user group only is not likely to suit all user requirements. It is to this end, that this work believes that unless design gaps are closed, EHRs systems may not fully take off. This paper carries out an enquiry and attempts to answer the following questions:

a. Is a universal solution, centered upon Design, Data and Technology Computer Supported Cooperative Work (CSCW) appropriate for a large scale national EHRs system programme?

b. Would a Participatory Design approach make a difference in getting England’s EHRs system implementation programme back on course and facilitate the rollout of ePCRs system at the Trust under study through an agile and scalable implementation programme?

1.10 Research Scope
The topic of enquiry is extremely broad as it covers both health and social care services. There are several strands within health care that comprise of diverse and vast user groups. These user groups could potentially be divided into cohorts thus requiring specific focus to help query their user requirements in order to develop suitable solutions for each. There may be some facets of health care services that may overlap and have similar characteristics and these may be grouped and addressed together. These could possibly include imaging, X-ray, scanning requirements – one would imagine a EHRs solution may be developed that could meet the user group
requirements. Recent ground breaking research in the use of EHRs in documenting ‘vital signs’ in patients identified yet another cohort with bespoke EHRs user needs (Stevenson, Jean E.). The same would apply to social care, where services may range from vulnerable adults to children under a certain age, children in foster care and so forth. Each of these parts may require tailored information on their care records that may not be relevant to the other user groups.

To this end, this paper limits its work to pre-hospital care, a service provided within out-patient and emergency health care cohort. Furthermore, the work confines its quest to two research methodologies, detailed in section 1.4, namely, original Computer Supported Cooperative Work (CSCW) and Participatory Design (PD) approaches to help examine and determine the feasibility of augmenting the use of EHRs in pre-hospital care.

1.11 Outlook of the study
Chapter 1: Introduction
Chapter 2: Related Work
Chapter 3: Methodology
Chapter 4: Results
Chapter 5: Analysis and Discussion
Chapter 6: Conclusion and Future Work
Table 1.1: Summary Outlook Table of key headings in the paper

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>Introduction and Research Background</td>
</tr>
<tr>
<td></td>
<td>Motivation, Justification and Theoretical Background</td>
</tr>
<tr>
<td></td>
<td>Objective of the Thesis &amp; Problem Discussion</td>
</tr>
<tr>
<td></td>
<td>Hypothesis, Research Questions and Scope</td>
</tr>
<tr>
<td>Two</td>
<td>Related Work</td>
</tr>
<tr>
<td></td>
<td>Literature Review and Body of Knowledge: A look at selected Electronic Health Records systems</td>
</tr>
<tr>
<td></td>
<td>Conclusion on related work</td>
</tr>
<tr>
<td>Three</td>
<td>Methodology</td>
</tr>
<tr>
<td></td>
<td>The Research Approach: Quantitative and Qualitative Research Method</td>
</tr>
<tr>
<td></td>
<td>Theoretical Framework, Data Review, Descriptive Analysis, Evaluation and Limitations</td>
</tr>
<tr>
<td>Four</td>
<td>Results: Literature review results, Benefits of EHRs</td>
</tr>
<tr>
<td></td>
<td>Analysis and Discussion</td>
</tr>
<tr>
<td>Five</td>
<td>Conclusion and Future Work</td>
</tr>
</tbody>
</table>

Chapter One above introduces the study and covers: introduction; the thesis background; motivation and justification; theoretical background; objective of the thesis; problem discussion; hypothesis, research questions; research scope and outlook of the study. It is an overview and a precursor for the discussions that ensue in the subsequent chapters and provides the foundational information required to help understand the study.

Chapter Two covers the literature review using mixed literature review methods. It here that EHRs systems are discussed, existing body of knowledge on EHRs systems of selected countries (5 countries including England) whose programmes started before England’s implementation programme around the globe are referred to. A correlation between CSCW and PD design research methodology is made during the discussions. Each country’s body of knowledge is gathered and sorted in categories and reviewed within specific areas in order to address the objectives set out in Section 1.5. New information discovered through interviews that may not have been previously captured in relation to the Trust under study is explored and helps address objectives in Section 1.5. This section subsequently informs discussions in Chapters 4, 5 and 6.
Chapter Three outlines and justifies the chosen research methodology used in gathering, exploring and analysing evidence for the study.

Chapter Four presents results deductively and inductively derived from quantitative and qualitative methods literature review. The results are gathered into meaningful categories to inform analysis and discussions in Chapter 5.

In Chapter Five is an analysis of results is carried out, interpreted and evaluated. The findings are presented in simple graphs and tables which are linked to the Trust and research questions presented in Chapter One.

Chapter Six delivers a summary of the thesis, confirms the hypothesis and provides deductive and inductive conclusions of the study, making recommendations for future work for testing an appropriate design research methodology through pilots in order to help augment the scope of the use of EHRs in pre-hospital care at the Trust under study.
2 RELATED WORK

“Better use of data and technology has the power to improve health, transforming the quality and reducing the cost of health and care services”.


In this section data on known cases is identified, grouped and source articles are summarised in draft form. The literature is assembled thematically with a view of identifying gaps in the way EHRs programmes are being developed and implemented (Creswell, 2014). A combination of online literature resources in form of books, journals, peer reviewed papers, government publications, surveys, articles and newspaper articles are used to form the body of knowledge. Additional data is obtained from qualitative research gathered through interviews.

To address the hypothesis in Section 1.8, this work applies the intervening (mediating) variables method to identify the independent and dependent variables to help articulate the correlation between design methodology and EHRs systems identified in the literature and interviews. Intervening or mediating variables stand between the independent and dependent variables, and they mediate the effects of the independent variable on the dependent variable. (Creswell, 2014).

Another key outcome of this section is to apply quantitative research to review available historical data to examine a scientific explanation of what this work expects to find as gaps in the way EHRs systems are currently being developed and delivered by examining the two design methodologies (original CSCW and PD) in the available scenarios (Creswell, 2014).

2.1 Literature Review:
A review of previous and relevant literature is an essential feature of any academic project and creates a firm foundation for advancing knowledge (Webster &
Watson: 2002). The study uses this section, to present the body of knowledge on EHRs, original CSCW and PD for subsequent investigations and discussions in Chapters 4 and 5. This is aimed at helping explain and understand the dynamics of implementing EHRs systems and associated issues that are linked to design research methodology. The study aligns itself to Hart’s (1998) definition of literature review as ‘the use of ideas in the literature to justify the particular approach to the topic, the selection of methods, and demonstration that this research contributes something new’.

(March & Smith: 1995) endeavour to demonstrate that a good research requires both natural and design science research to be carried out and argue that ‘both design science and natural science activities are needed to ensure that IT research is both relevant and effective (March and Smith, 1995). A distinct divide is outlined between natural and design science where natural science research tends to explain why things are the way they are, aiming at discovering and attempting to justify phenomena in the EHRs systems programmes whilst focusing on user participation in design whilst the design science approach endeavors to be creative in coming up with a fit for purpose solution by iteratively passing through various developmental stages and reviewing existing technology centered systems (CSCW) until the perfect and fitting solution is reached.

In Social Cognitive Robotics in the European Society (SOCRATES) article by Per Flensburg, the author starts by providing an insight into problems faced during systems development and the driving force behind the need for systems to be developed or improved. The author further combines both natural and design. Flensburg’s work on SOCRATES quotes from the Hazards of leaving users out (Schuler and Namioka, 1993) science research in probing a system development process; this work embraces these two approaches to determine whether the NIB solution has been or is a fit for purpose using the March & Smith framework to seek answers for the current staggered uptake of EHRs. It is assumed, for the purposes of this work, that all those interviewed for the study have come across electronic records at one level or the other and are familiar with their functionalities.
2.2 Body of Knowledge

2.2.1 Health information technology

The science of information and the engineering of information systems have developed hand-in-hand. In 1956 a German computer scientist; Karl Steinbuch coined the word ‘Informatik’ by publishing a paper called Informatik: Automatische Informationsverarbeitung ("Informatics: Automatic Information Processing") from which the discipline of informatics has evolved; enhancing the ability to communicate more effectively whilst keeping abreast of advancement in technology (Fpl.uni-kl.de, n.d.).

There has been a surge in the amount of information available and a corresponding need to use it resulting in considerable pressure being brought upon various facets of society. This in turn, has prompted scientific enquiry in order to keep up with rapid societal changes and technological advances in an era of abundant information. Many services are embracing technology and using it to enhance their ability to offer improved services. The advancement of technology has for a long time been at the centre of improving health care services globally. Nations and organisations maintain significant resources dedicated to research and technology to improve services. According to the latest figures for example, the UK assigns about £11,000 of its budget to research and development per person per year, ("Government Spending - Scienceogram UK"), out of which £1,900 per person per year is spent on health-related research ("Health - Scienceogram UK").

Annual world digital health, mobile health, telehealth and telecare congress is held in London every year to discuss the various ways in which digital health can transform the global healthcare industry. Recommendations derived from the congress are often implemented in different participating countries annually, (Digitalhealthcareworldcongress.com, 2016). All this illustrates the interest improving health care services through better use of available technology.

Earlier work by the Deloitte Centre for Health Solutions in 2012 on Telecare and Telehealth – game changer for health and social care cited challenges in adopting digital technology generally in the UK and identified solutions and international good practice examples. However, the solution did not include mobile or digital technology.
and adoption by health care providers (Taylor p.28). The study found that the most available digital applications have been designed for fitness, medical reference and wellness but lack functionality to do more in health care provision. (Taylor P.4) The report says ‘a further problem that TEC solutions have been technology-driven, often without involvement of the people they are aimed at’ (Taylor P.4).

2.2.2 Electronic Health Record or Electronic Patient Care Record

What is an electronic health record (EHR) or electronic patient care record (ePCR)? The online IT encyclopedia (WhatIs.com, 2011) defines an electronic health record as ‘an official health record for an individual that is shared among multiple facilities and agencies’. Adding that the purpose for ‘digitized health information systems are expected to improve efficiency and quality of care and, ultimately, reduce costs’.

The US Department of Health (Healthit.ahrq.gov, n.d.) defines an EHR/ePCR as “an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization” and “are made up of information from a variety of sources, including hospitals, clinics, doctors, pharmacies, and laboratories”. There is evidently a common theme in the definition of EHRs and for the purpose of what this paper seeks to establish, the two definitions above will be accepted and used appropriately.

2.2.3 Electronic Patient Care Record and Paper Patient Care Record

Traditionally, patient information was recorded manually and stored as a paper record. Diagram 2.1 is an example of a paper patient record used by the Trust understudy and many ambulance services in England. Advancement in technology brought about computers that facilitated patient records to be keyed into a desktop computer at the point of giving care. These were restricted to GPs and hospitals. Most records continue to be captured manually to this point of introducing ePCRs. Table 2.1 has been populated providing a comparison of information currently detailed on a pPCR and that for a proposed ePCR and being trailed via the pilot. It can be seen that the ePCRs are being designed to capture a lot more information that may be useful at the point of giving care.
Diagram 2.1: example of a Paper Patient Care Record
<table>
<thead>
<tr>
<th>Proposed Details on ePCRs</th>
<th>Comment</th>
<th>Total Score</th>
<th>Current paper PCRs</th>
<th>Comments</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Patient current and previous records</td>
<td>Yes</td>
<td>1</td>
<td>Patient current and previous records</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>2 Incident Number</td>
<td>Yes</td>
<td>1</td>
<td>Incident number</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>3 Personal data, such as your age, name and address;</td>
<td>Yes</td>
<td>1</td>
<td>The birth / pediatric boxes information</td>
<td>Incomplete</td>
<td>0.50</td>
</tr>
<tr>
<td>4 Allergies: allergy tests and other screenings;</td>
<td>Yes</td>
<td>1</td>
<td>The airways and breathing boxes are in the right order</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>5 Immunisation status;</td>
<td>Yes</td>
<td>1</td>
<td>Immunisation status</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>6 List of medications;</td>
<td>Yes</td>
<td>1</td>
<td>List of medications;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>7 Hospitalisation records including reason for admission to hospital, discharge records, including results of treatment and follow-up appointments/care</td>
<td>Yes</td>
<td>1</td>
<td>Hospitalisation records including reason for admission to hospital, discharge records, including results of treatment and follow-up appointments/care</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>8 Details about any surgeries or procedures performed;</td>
<td>Yes</td>
<td>1</td>
<td>Details about any surgeries or procedures performed;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>9 General Practitioner where patient is registered;</td>
<td>Yes</td>
<td>1</td>
<td>General Practitioner where patient is registered;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>10 Consultation notes, which your doctor takes during an appointment;</td>
<td>Yes</td>
<td>1</td>
<td>Consultation notes, which your doctor takes during an appointment;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>11 Treatments received or ongoing;</td>
<td>Yes</td>
<td>1</td>
<td>Treatments received or ongoing;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>12 Any reactions to medications in the past;</td>
<td>Yes</td>
<td>1</td>
<td>Any reactions to medications in the past;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>13 Any known long-term conditions or diseases, such as diabetes or asthma;</td>
<td>Yes</td>
<td>1</td>
<td>Most significant change is the addition of Mental Capacity Assessment form and Code Yellow form</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>14 Medical test results such as blood tests;</td>
<td>Yes</td>
<td>1</td>
<td>Medical test results such as blood tests;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>15 Any clinically relevant lifestyle information, such as smoking, alcohol or weight;</td>
<td>Yes</td>
<td>1</td>
<td>Any clinically relevant lifestyle information, such as smoking, alcohol or weight;</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>16 Patient's condition status</td>
<td>Yes</td>
<td>1</td>
<td>Cardiac Arrest Downloaded is a new addition – this is a prompt to remind you to send in your download to help with self-reflection and debrief</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>17 X-rays photographs and image slides, such as magnetic resonance imaging (MRI) or computerised tomography (CT) scans.</td>
<td>Yes</td>
<td>1</td>
<td>X-rays photographs and image slides, such as magnetic resonance imaging (MRI) or computerised tomography (CT) scans.</td>
<td>No</td>
<td>1</td>
</tr>
<tr>
<td>18 Cardiac Arrest Downloaded is a new addition – this is a prompt to remind you to send in your download to help with self-reflection and debrief</td>
<td>Yes</td>
<td>1</td>
<td>Cardiac Arrest Downloaded is a new addition – this is a prompt to remind you to send in your download to help with self-reflection and debrief</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>19 In free text box, the existing conditions tick boxes have been removed</td>
<td>Yes</td>
<td>1</td>
<td>In free text box, the existing conditions tick boxes have been removed</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>20 National Early Warning Scores NEWS – changed from MEWS; the NEWS table is on the reverse of the PCR to assist with calculating the scores</td>
<td>Yes</td>
<td>1</td>
<td>National Early Warning Scores NEWS – changed from MEWS; the NEWS table is on the reverse of the PCR to assist with calculating the scores</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>21 Concerns about mental capacity and/or safeguarding tick boxes</td>
<td>Yes</td>
<td>1</td>
<td>Concerns about mental capacity and/or safeguarding tick boxes</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>22 Scope to capture details about current incident</td>
<td>Yes</td>
<td>1</td>
<td>Details about current incident</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>23 Crew details</td>
<td>Yes</td>
<td>1</td>
<td>Crew details</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>24 Triage</td>
<td>Yes</td>
<td>1</td>
<td>Triage</td>
<td>Yes</td>
<td>1</td>
</tr>
</tbody>
</table>

| ePCR | 24 | pPCR | 10 |
Diagram 2.2: ePCR and pPCR features compared

Table 2.1 and Diagram 2.2 give flavor of the difference in details contained in the two types of patient record. An ePCRs seems to contain insurmountable amount of information while paper Patient Record (pPCR) has just basic information.

Implementers of EHRs hope to realise the following benefits among other strategic objectives:

a. Are accessible to clinicians in real time at point of need;
b. Lend themselves to better care;
c. Can generate automated preventative health reminders and warning prescribers about potential harmful interactions with existing prescriptions;
d. Enable rapid receipt of important data;
e. Provide an audit trail useful for performance management, quality assurance and could inform research;
f. No matter where a patient is tested, allows laboratory technicians to enter results into a database that will be linked to the patient’s EHR available for viewing.
2.3 A look at selected Electronic Health Records systems:

2.3.1 United States of America: first implemented in 1991:

When the US Federal government endorsed implementation of a EHRs programme, it was to address some of the issues that were to be addressed help cope with the outgrown paper record systems and improve quality and cost of managing patient records. (Dick, Steen and Detmer, 1997). USA, like many nations where EHRs have been rolled out, the care patient record (EMRs) was and still is a repository of health care information about a single patient that resided/still resides in a system specifically designed to support users through availability of complete and accurate data, alerts, reminders, clinical decision support systems that link to medical knowledge, and other aids (Atherton, Jim).

In 2009, the project received a financial boost, an indication of the US government’s commitment to progress with the EHRs programme; however, the uptake continues to be  slower than anticipated with only a few clinicians (physicians) latching onto the programme (Quality Matters,). Some reasons given were cost (the cost variable will not be subject to further scrutiny as sovereign budgets are relative to respective government’s priorities and disbursement policies) and a non-suitable system that does not seem to serve user needs as documented in a survey report of July 2008 reports that despite the benefits of EHRs systems, US seems to lag behind other developed countries with only 29% in use (Des Roches et al., 2008).

America’s EMRs implementation programme is controlled by the Federal Government with states at liberty to disburse budgets accordingly. Budgets, functional and technical specifications guidance are prescribed centralised. The various states have the liberty to rollout EMRs as they deem fit if they meet the prescribed guidance requirements.

2.3.2 Sweden 1st implemented in mid-1960s, rolled out EHRs in 2002

The actual computer support for health care in Sweden was implemented mid-1960s however, pilots to hold centralized records were launched in 1995, Sweden launched EHRs in 2002. The implementation was phased in according to demand and requirement (Impagliazzo, Lundin and Wangler, 2011) subsequent levels of patient
records have since been introduced and the country continues to phase new functionalities appropriately.

Sweden operates a devolved model with funds channeled from the central government through the now twenty independent county councils. Who are said to have enough financial strength (the cost or finances variable will not be subject to further scrutiny as sovereign budgets are relative to respective government’s priorities and disbursement policies) to support the introduction of record systems in all the primary care centres of their respective areas ("Epsos: Sweden") and (Falan, Sandro). In its devolved system, each healthcare centre or regional, or municipal provider decides which e-services patients can use to interact with them. Users log onto a portal using either an electronic identity or their Swedish personal identity number. Updated figures show that over 2 million people have set up accounts in My Healthcare Contacts which accounts for approximately 1/5 of the country’s population.

During November 2014 over 135 000 contacts with healthcare were made through the portal nationally ("INVÅNARTJÄNSTER"). A quote from the History of Nordic Computing discussion on rollout of EHRs in Sweden says that ‘The general size of a rather large group practice of four-to-ten doctors and perhaps ten-to-thirty other staff members also meant that there was a power of scale that facilitated the investment, installation, and management of the small server-based systems on a local area network with relatively advanced software’ (Impagliazzo, John et al.). Over 90% physicians use EHRs in Sweden and this is attributed to the devolved approach and phased rollout (Bradford, Gray H. et al.). The development in the way Sweden uses EHRs continue as additional features, functionalities and abilities are added to the initial infrastructure (Hagglund, M. and S. Koch). On the whole, the Swedish EHRs system seems to be progressing well with 90% use of EHRs.

2.3.3 Denmark: Implemented in 1999

The online Time Magazine of July 2009, reports Harrell Eben writing about Frederiksberg University Hospital’s notable feature of a hospital without clipboards (TIME.com, 2009).
Denmark embarked on a journey to electronic patient records in 1977 not realising that the basic national centralised patient record system intended to serve as a database for auditing purposes at the time would form a sound technological foundation for implementation of EHRs 22 years on. In 1999, the country was able to implement a national interoperable electronic medical (EMR) system and with 98% advanced functionality. The system allows clinicians to access patient records via wireless handheld devices thus explaining why Frederiksberg was reported as a ‘clipboardless’ hospital. A functional specification (or sometimes functional specifications) is a formal document used to describe in detail for software developers a product's intended capabilities, appearance, and interactions with users, (Contributor: Waine, Paul). Detailed functionality discussions are outside the scope of this paper and therefore will not be elaborated upon.

The Danish model is devolved and perhaps the most important feature is that even though Denmark has nationwide EHRs system it does not have a single national medical-data system. There are multiple providers of software from which to choose and, as noted above, several medical databases providing a variety of options to choose from by user groups. The key has been creating systems that work together (Grosen, Lene). From early on in the process, Medcom, a government-financed cooperative venture (the variable will not be subject to further scrutiny as sovereign budgets are relative to respective government’s priorities and disbursement policies), has acted as a data integrator ensuring interoperability. As software providers continue to develop new features, it creates standards for them. Thus, the market has provided solutions to many of the technical problems that have arisen but has not fragmented the ability of medical professionals to communicate. (Reforminghealthcare.eu, n.d.)

The system includes a functionality that has the ability to trigger an alarm even in an emergency to alert clinicians of pre-existing medical complications or error that could be exacerbated by lack of vital information or miss-prognosis (TIME.com, 2009). This functionality strikes a code in this study that relates to pre-hospital care and will be elaborated upon in Chapter 4. Progress status and challenges faced by Denmark’s EHRs system will be visited in Chapter 5 under Analysis and Discussions. Denmark reports contentment with its EHRs system stating that it allows different healthcare professionals to get a quick view of the patient’s entire medical history,
and see how existing treatments might interact with ones they are considering (Reforminghealthcare.eu, n.d.).

Some of the EHRs benefits reported have been increased efficiency, primary care givers have been saved an average 50 minutes per day as a consequence of reduced paperwork and faster communication thereby allowing for 10% additional scope to see more patients (Reforminghealthcare.eu, n.d.). Overall it is reported that the Danish EHRs systems is working and seem to be on track to continue delivering the anticipated benefits. There is also evidence that in its evolution, user groups have made contributions to the design of the systems.

2.3.4 Canada: Implemented the EHRs 2001

EHRs programme in Canada was initiated in 2001 by creating Canada Health Infoway, a federal agency charged with assisting the provinces to implement electronic health records to help deliver the programme (Infoway).

To monitor implementation progress, a committee, comprising of representatives from each of the participating legislative audit offices, developed common objectives and criteria for the EHRs audits and delivered an Electronic Health Records in Canada Audit report for the period 2009-2010 (Volpe, 2010). Key information relevant for this paper states that the total usage of electronic records as at 2010 was 41% falling slightly short of the 50% by 2010 ambition (Amanda L. Terry, 2008).

A large cross section of stakeholder groups (federal, provincial and territorial governments, political parties and provider groups such as the Canadian Healthcare Association, and the Canadian Medical Society, and the College of Family Physicians of Canada) are supportive of the approach and the idea of EHRs. However, reports show that there have been delays in achieving set targets. The findings of the audit varied from province to province but a few common themes ran across the findings. Some of the reasons for the delay and slower implementation progress were as follows (Electronic Health Records in Canada):
• Costs constraints; (the variable will not be subject to further scrutiny as sovereign budgets are relative to respective government’s priorities and disbursement policies).
• Difficulty in reaching key user groups such as physicians whose concerns are around reimbursements for hardware, software and training;
• Data protection and privacy issues to provide assurance that patient data will be safeguarded under legislation; (data protection and privacy issues are touched upon later in the discussions in exploiting design research approach);
• different starting points and varying priorities among jurisdictions; (this variable is not investigated further as it seems to stand alone);
• the time required to implement change management strategies; (this point will not be exploited further because delivery timetables are largely varied and peculiar to the countries being studied domestic priorities);
• Contracting scandals - this variable was not listed elsewhere in the body of knowledge and therefore will not be pursued further.

At the heart of EHRs in Canada was intention to facilitate health care professionals to view and update a patient’s health record and help resolve persistent problems in the country’s health system, some of the problems were perceived to be because of using paper health records (Office of the Auditor General of Canada).

Going forward, the audit expected federal and provisional governments to reviews the findings and forge forward with re-affirmation/re-establishments of priorities, objectives, budgets and timelines to ensure overall success of the implementation of EHRs across Canada (Office of the Auditor General of Canada). There is scope to review current position in further research as well as capture any further lessons that may have been learned.

2.3.5 England: Implemented EHRs in 2002
Health care in the UK falls under and forms part of the Department of Health’s budget. A free service at the point of use for all UK residents (approximately 64 million people and 1 million every 36 hours at an estimated cost £116bn – 2015-2016) is provided through the National Health Service (NHS) England which was launched in
1948. Various health care providers sit under the NHS and included in the list is the Ambulance Service (also referred to as the Emergency Service). (Nhs.uk, 2016).

The ePCRs programme in England started in 2002, intended to replace the traditional paper Patient Care Reports (PCRs) shown in Diagram 2.1 above. The paper PCRs were to replace by ePCRs in a programme that was to be completed by 2016. As previously touched upon in section 1.7 above, the initial purpose of the National Information Board’s data and technology programme was to have a database by which clinicians/practitioners could be audited. Just like in many other countries some of which have been mentioned in sections above, the programme was meant to improve efficiency, eradicate duplications and reduce errors as well as save tax payers money. In England, the EHRs programme was rolled out by the government and continues to be run under the government’s arm. (BBC News, 2011).

In the government’s response to a consultation which included the need to introduce Summary Care Records (SCRs) to help clinicians provide emergency care was designed with a single standardised front screen feature to display key health information vital for emergency care. A series of concerns and controversies over privacy and consent arrangements were discussed at length as one of the flaws of the technology behind EHRs, (The Government Response to the Health Committee Report on the Electronic Patient Record, 2007). Suffice to say NIB’s 2020 programme was not progressing as anticipated and faced several challenges alongside some criticism leading up to another government response to consultation commissioned by England’s Health Select Committee (HSC) on electronic patient record programme - (A Health Committee in England is appointed by the House of Commons to examine the policy, administration and expenditure of the Department of Health and its associated bodies.) A response presented to Parliament by the Secretary of State for Health in November 2007 on the Department of Health’s data and technology programme in particular, EHRs following a consultation addressed among other things the difficulties in using Summary Care Records (SCRs) particularly in emergency situations (Recommendation paragraph 116:2007). Concerns had been raised about the Department of Health’s data and technology team’s ability to deliver the programme. The full consultation that involved seeking public and expert opinion and
requiring the Government’s response to concerns raised were documented in the Health Committee Report on the Electronic Patient Record in 2007.

Despite all these issues, England is determined to forge ahead with EHRs programme as echoed in a briefing paper of 25 April 2016: *quote “The Government is committed to complete the digitisation of the National Health Service and, through the National Information Board and implementation of the Personalized Health and Care 2020 Strategy, to deliver a series of important digital milestones on the road to a paperless NHS by 2020.”* (BRIEFING PAPER Number 07572, 25 April 2016 A paperless NHS: electronic health record (Perkin, 2016)).

Six reasons why England’s digital programme failed were reported in 2010. These were all centred around commercial benefits, technological solution, benefits for users (referring to clinicians) and no mention of user centred solution encompassing all user groups (Maughan, n.d.) namely:

a. Patients negative attitude - resistance (this variable is a key factor and therefore will inform the interview questions and sample);

b. Intelligence information sharing boards not developed to capture all required information and share it appropriately (this variable is a key factor and therefore will inform the interview sample);

c. Project manager responsible for delivery the EHRs solution etc; (this variable is a key factor and therefore will inform the interview sample);

d. In England, EHRs, electronic imaging records systems and electronic prescriptions (ePrescriptions) were some examples of the applications that are already in use as reported - (The Government’s Response to the Health Committee Report on the Electronic Patient Record, 2007).
There isn’t concrete evidence indicating the percentage usage of EHRs in England that may be compared directly as reported in Deloitte’s report and Stevenson’s thesis-Documentation of Vital signs on EHRs (Taylor p 2-6), (Stevenson) with Canada, Denmark, Sweden and USA. Clusters of the NHS service providers use aspects of EHRs pending official rollout. For purpose of this study, the author assumes a usage rate of 10%.

2.4 Conclusion on related work

In concluding this section, evidence revealed from all the literature reviewed, points to the incentive to implement EHRs as being noble but each country took a different route to rollout. Sweden’s subsequent implementation phases sought users’ input, while Denmark and Sweden’s success could be attributed to the phased in approach, population and tech savvy citizens may have contributory factors. USA, Canada and England can also be said to be populated by tech savvy individuals and therefore this variable not considered in detail during this study.

The question of population is relative and could be misleading if not reviewed critically. One would assume that USA, Canada and England are more populous than Denmark and Sweden however, according to available statistic presented in Table 4.1 and Diagram 4.1 (source: ("Population Density Per Square Mile Of Countries"); Canada has the least population per square mile and United Kingdom and therefore if size of a country’s population was a determining factor, then Canada’s rollout would have been

Apart from Denmark and Sweden, the rest of the countries did not exhibit how the involvement of users in development and rollout of their respective EHRs. However, it is evident from the concerns raised by Canada deduced from the audit, UK as detailed in the various government publications and consultation reports, and USA from the literature that some of the may have been around user involvement during the design process. It has not been crystal clear from the literature that users were consulted or their views taken on board during research, design and development EHR systems or at any point in the decision-making process. Finally, as this work relates the use of EHRs in pre-hospital care there, wasn’t sufficient literature available on how EHRs were or are to be used in a pre-hospital setting which leads to a gap in the body of knowledge that lends itself to further research.
3 METHODOLOGY

This is a participatory action research that involves a cyclic and iterative process (Maughan, n.d.) required to refresh the body of knowledge and information gathered from interviews. It is necessary to refresh information since technology programmes are not only dynamic but tend to evolve fast – making information collected a few years ago, redundant or requiring an update. In addition, and due to the nature of this study, further information is collected representatively of the user group cohorts and not by cohesion but voluntary participation. Scholars refer to this type of data collection as participatory action research quote: ‘We can contend confidently that indeed the production of knowledge can be democratized through participatory action research’ (Cronholm and Goldkuhl p.47-53). It is true that the definition of PAR could be contentious however, this study will adopt the search for information by involving potential and current users (Kaplan et al. pp.661-662). This study narrows the definition to one that fulfills two criteria namely: democratisation and iteration to assist in data collection. The term participatory in this section is not to be confused with participatory design methodology which is a user-centred design approach.

The paper aims to collect and reflect on data about EHRs systems, NIB’s data and technology programme and attempts to understand the reasons behind the poor up-take of the electronic patients record by the health providers in England broadly and the Trust understudy in particular. The study gathers through interviews and reviews some specific examples and stakeholder experiences. It is this exercise that in turn informs the subsequent analysis and discussions that ensue in chapter 4. The study adopts a participatory action research approach as the author believes that the soundness of a system or solution relies a great deal on its design whilst design depends on or is informed by user requirements; therefore, any attempt to review one variable in isolation would pick up a part and not the whole matter under investigation.

3.1 The Research Approach:

To achieve the objectives, set out in section 1.6 above, mixed method research approach is used. This combines both quantitative and qualitative research methods ‘to provide a more complete understanding of a research problem than either approach alone’ (Creswell, 2014).
Sources include randomly selected materials identified using key words to help locate information from ERIC, IEEE Xplore, ACM Digital Library, Google Scholar and Springer Link academic libraries. This process helps collate a reasonably representative sample of available examples of EHRs systems across the globe of surveys, feedback reviews and information gathered from interviews. According to Cooper (1988), the types of scholarship found in literature material may be empirical, theoretical, analytic, or methodological in nature hence the combined approach used in this study. Suffice to say, this work will generate considerable amount of subjective data, which will be sifted through, explored analysed and interpreted appropriately in order to deductively and inductively draw out meaningful and reasonably accurate conclusions presented in chapter 5.

Scholars say that ‘descriptive research does not fit neatly into the definition of either quantitative or qualitative research methodologies’, which explains why it has been selected for this study. Scholars add that, ‘instead this approach can utilise elements of both, often within the same study’. Descriptive statistics is used in this study to ‘tell what is, in addition to inferential statistics that is used try to determine cause and effect. The methods of collecting data for descriptive research can be employed singly or in various combinations, depending on the research questions at hand. Descriptive research often calls upon quasi-experimental research design (Campbell & Stanley, 1963)’. The aim of this research approach is to establish patterns within various literature or data, mainly in order to help make inferences. (Creswell, 2014) defines theory as “a scientific prediction or explanation”. The research combines epistemology and ontology to inductively and deductively draw conclusions after gaining an understanding and interpret existing practices on how research design is applied. Equipped with this knowledge and understanding, the study draws conclusions based on the understanding of the problem using the course literature.

3.1.1 Quantitative Research Method

Within the quantitative method, literature review of existing data on EHRs and electronic patient records systems is carried out by examining the relationship between the control/independent and confounding/dependent variables in order to support the hypothesis in Section 1.8. (Creswell, 2014). Results are deductively drawn with a generalised inclinations towards EHRs systems.
Information is obtained from journals, reports, articles and books by first systematically identifying the relevant data in order to help discover facts related to this study. Data, evidence and rational considerations shape the author’s knowledge of EHRs to help explain phenomena (Creswell, 2014). The study takes a broad view of EHRs systems across a large spectrum and aims to understand how similar systems are working in other countries and therefore a systematic review of the information is carried out which informs analysis and discussions in chapters 4 and 5. Furthermore the effects of the independent and dependent variables to determine the probable cause of tendencies deduced from the data collected (Creswell, 2014). Results are presented in tables and graphic diagrams.

3.1.2 Qualitative Research method

In the qualitative method, this work carries out interviews and inductively builds up broad plausible explanations from results of the data collected from interviews. Detailed information is gathered from a randomly identified sample of 35 respondents drawn from user/stakeholder group. The Trust understudy serves three counties with just under 4 million inhabitants and only under half a million of the population interacted with the Ambulance Service in the year 2015/2016 (Annual Report And Accounts 1 April 2015 – 31 March 2016). It operates across 3,600 square miles, has 3,300 staff working from 110 sites. In addition, it interacts with 22 Clinical Commissioning Groups (responsible for commission health care services – a UK bespoke model), 18 acute trust sites (included in the receiving facility sample), 6 top tier local authorities ("Ambulance Service About Us"). It is evident that the stakeholder groups are diverse in nature and large, and it would be inconceivable to select a representative from the each of the segments of the stakeholder groups. Great deal of attention has been put into selecting a sample with to ensure a reasonable representation. It was vital to ensure representation from each stakeholder group hence the use of a simple random sampling technique which permits a group of subjects (a sample) for study from a larger group (a population) to be selected. Each individual from each sample (stakeholder group) has an equal chance of being selected and is chosen entirely by chance. Every possible sample of a given size has the same chance of selection; i.e. each member of the population is equally likely to be chosen at any stage in the sampling process. Information is gathered through interviews using
structured, standardised questionnaires. Therefore, for purposes of this study, the randomisation in sample selection has been narrowed down but a few representatives from the stakeholder groups listed below:

a) Front line clinicians – because they would be and are potential EHRs users.

b) Patients – both current and prospective because it would be their details hosted on the ePCRs.

c) Operations Clinical Managers – because they are localised budget holders and team leaders responsible for achieving performance targets (Annual Report And Accounts 1 April 2015 – 31 March 2016) and therefore anything that enhances performance should be useful.

d) Receiving Facility – these are key during triage and therefore their opinions would potentially count. As a matter of fact, some of the receiving facilities are hospitals and GPs who have some form of EHR system and their views on how things are working is key.

e) EOC Staff – are the interface between clinicians and patients requiring emergency service and their tacit knowledge is invaluable to this research.

f) Legal/Information Management/Data Protection experts – privacy and data protection issues have been voiced in the body of knowledge and an insight on the experts’ confidence in the rollout would be useful.

g) Intelligence Based Information System desk – these are designed to hold vital information about patients which becomes handy during some types of referrals and triage for patients whose details are in their databank usually patients with long term illness – point worth noting is that not all ambulance service users have long term illnesses and therefore this repository is limited in its scope but representative of a different type of dataset. Their views would add to the value of this work.
h) Information Governance expert & IT systems Manager – this stakeholder group would make up enablers and therefore key to design, development, implementation and rollout of ePCRs.

i) EHR Implementation Managers – as overseers of the implementation programme if involved early in the process, would be able to ensure stakeholder views are reflected in the final system and the delivery plans are adhered to, to scope, spec, functionality, plan, cost and quality.

j) International Doctor – the study looks at systems working elsewhere and an opportunity to discuss what is working well and what is not from a practitioner in another country adds the versatility this study requires. Due to limited resources, time and scope, it is not feasible to include more than one international entity.

In this enquiry process, the paper seeks to understand respondents’ behavior through observation during the interviews, and actively captures and records in as close a language as the interviewees present. The respondents are all potentially involved in one way or another in the pre-hospital care process and triage which includes some that are already using EHRs systems. This approach helps the enquiry to gain an in-depth understanding of the user group’s respective, points of view and attitudes towards EHRs.

The questionnaire is structured in such a way that in encapsulates a combination of open and closed preset question types to ensure that the results are not too subjective nor open to ambiguous interpretation. A combination of face to face, telephone and survey interviews are carried out to ensure several variables are considered to minimise the danger of bias creeping into the study. Thereafter a thematic analysis is carried out to establish patterns in the collected data in order to establish links to CSCW and PD design research methodologies. Thematic analysis is preferred due to its simplicity and flexible nature suitable for this study. The study takes a broad view of EHRs systems across a large spectrum and aims to identify themes and patterns in an effort to categorise and analyse respondents’ behavior (Dawson, 2009).
Great tact is employed during the interviews to ensure that information collected can inform the next course of action. The questions have been structured in such way that they create a decision-making moment to draw from the respondents what they would choose to use if they were tasked with using ePCRs than what they believe the interviewer would like to hear. Several hypotheses have been drilled down into small chucks to help identify the persona, problem, value of the responses to help make better decisions, what the potential users see and think as well as the prospective usability of the solution. The aim of the questions structured in the afore mentioned format it so that a usable solution is developed.

Descriptive conclusions are deductively drawn and presented in chapter 5 and responses categorized in themes. From these themes, broad patterns, will are developed into generalizations that are then compared with personal experiences or with existing literature on the topic. The themes and categories are development into patterns, theories, or generalizations as suggested by (Creswell, 2014) in order to draw meaningful conclusions.

ComputerSupported Cooperative Work and Participatory Design are just but two types of a host of other design research methodologies and but have preferred for this study because they are diametrically opposite approaches and fall well within the scope of analysis that will make for sound academic argument.

The interviews:

Some of the common data collection methods applied to questions within the realm of descriptive research include surveys, interview and observations. Due to time constraints, this paper will not cover all EHRs systems in the world, and will limit the qualitative research to a total of thirty-two (32) respondents are interviewed as follow out of 35 respondents identified, 3 of whom declined to participate.
The breakdown of the participants is as follows:

- 6 other clinicians;
- 6 of patients;
- 3 members of pre-hospital senior operational clinicians and budget holders;
- 3 members of receiving facility (hospital, specialist centre and GP Surgery);
- 3 members of dispatching team (from 3 Emergency Operations Centres);
- 3 Legal experts on data protection and information management;
- 3 members of Intelligence Based Information System (IBIS) desk ("IBIS);
- 2 of information governance experts and IT system manager expert;
- 2 EHR Implementation Managers at the Trust;
- 1 international General Practitioner (GP).

Two sets of questions are prepared as shown in Tables 3.1 and 3.2 below. Questions in Table 3.1 are the initial screening questions, intended to get conversations moving, however, if answers do not seem to be forthcoming, questions in Table 3.2 are used to draw out reasonable responses without leading the respondent. These questions have been structured in preparation prevent any dismissive responses and encourage those with nonchalance attitudes to engage. The key outcome is to gain an understanding about how they feel about ePCRS and what they think they may be able to contribute in developing them. The aim is to get the value responses designed to inform development of a suitable solution for stakeholder group. It will be noted that Table 3.1 general questions and Table 3.2 are more specific aimed at drawing out information.

Interviews are carried out by the author, who is neither clinical nor technical and possesses limited knowledge of the pre-hospital health care systems and EHRs. This is to help minimise, if not eliminate any tendency towards bias during the study. The interviewees are informed that sessions are being recorded. All personal and confidential details are redacted (Appendix 2) and not included in the findings of this case study nor sample templates or forms used in this study in adherence with UK’s Data Protection Act 1988 (Parliament 1998). Summary of the statements and questions and the thinking behind the content and structure is explained below. It can be noted that the responses do not provide for yes or no answers to avoid misinterpretation. The
statements and questions are targeted to the respondents and seek to capture their own views:

a) **Electronic Health Records are a good idea and I would support their implementation:** this is an objective question with an opportunity to express an opinion in a word or two. This approach helps deduce attitudes and capture tacit knowledge.

b) **This is the first I am hearing of EHRs and feel I should have been contacted before they were implemented:** this statement does not assume that all respondents know and have heard of EHRs and therefore provides an opportunity for clarification.

c) **I would like to get more involved in the process to ensure that the EHRs are suitable for my needs:** opinion is sort and the degree of desire measurable.

d) **I would like all health records held in one repository and accessed at the point of need as may be deemed:** this statement is aimed at making sure the respondent understands that EHRs would be held in one place but accessed severally. It is a thought provoking statement that lends itself to making a decision as to whether or not one would like that seeing that the outcome would impact them directly.

e) **I have confidence in the machinery of government (MoG) and trust them to deliver a good solution, fit for purpose:** the population in England has different views of MoG and perceptions tend to influence attitudes towards government led initiative. However, as the EHRs programme falls under the NHS which is government funded and led, opinions on MoG may not hold too much water but could potentially contribute to how receptive or repulsive of EHRs people might be. This variable is not discussed in full but will be measured in the graphic representation of collected data.

f) **The area of privacy and data protection concerns me and I would like to fully understand who is handling my health record and for what purpose:** this has been covered above under the choice of stakeholder groups representation for the interview sample.
g) I would like to give consent in as much as it is feasible before any information about me and my family is shared: personal data held on EHRs may be deemed as involuntarily obtained, unlike information provided to Banks or insurance companies. Patients do not necessarily and voluntarily publish their health records for all to see, yet, the introduction of EHRs potentially means that one’s data is availed to more than their local GP or hospital as the case may be. This question is to ensure that the respondents are aware of this fact and therefore respond appropriately.

h) I have received training and believe I can handle the ePCRs without a problem, ePCRs will help me do my job better: this statement is directed mainly to clinicians, EOC staff, IBIS etc who might be or would potentially use the ePCRs and knowing whether they understand how to use ePCRs or would like to know how to use them is vital. The statement also provides an opportunity of issues that may arise from privacy and data protection.

i) I need to get involved in providing the information that is key and relevant to my needs: this work is centered around design research approaches and therefore it is vital to understand whether respondents are content with technology/computer centred approach or if taking them along the design and development journey would increase confidence and augment the scope of the use of ePCRs in England and the Trust understudy.

j) Any additional comments: an opportunity to capture anything that may have been missed out of the two questionnaires.

In concluding this section, it is obvious that this study go into deeper analysis/discussion of answers to interview statements and questions as it is a unique study data, that could benefit from further exploitation and analysis. However, the scope and resources for this study limit what can be covered in this paper.
Table 3.1: e-PCRs simple questionnaire for descriptive analysis ("Understanding Descriptive And Inferential Statistics")

For this section, please complete the following questionnaire with specific regard to the above enquiry, by placing a CROSS in the appropriate box

<table>
<thead>
<tr>
<th>Statement</th>
<th>strongly agree</th>
<th>agree</th>
<th>No/ not applicable</th>
<th>disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electronic Health Records are a good idea and I would support their implementation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. This is the first I am hearing of EHRs and feel I should have been contacted before they were implemented</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I would like to get more involved in the process to ensure that the EHRs are suitable for my needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I would like all health records held in one repository and accessed at the point of need as may be deemed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I have confidence in the machinery of government and trust them to deliver a good solution, fit for purpose.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The area of privacy and data protection concerns me and I would like to fully understand who is handling my health record and for what purpose.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I would like to give consent in as much as it is feasible before any information about me and my family is shared.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I have received training and believe I can handle the ePCRs without a problem,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. ePCRs will help me do my job better.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I need to get involved in providing the information that is key and relevant to my needs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Any additional comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2: ePCR narrative questionnaire (for persona/problem and value response and inferential analysis) ("Understanding Descriptive And Inferential Statistics")

Introduction: Thank you for setting time aside to see/speak to me. My name is ……. and I am carrying out a little research on Electronic Medical Records, a term that has become ever so familiar nowadays.

Sample response extracted from one questionnaire

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Statement/Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tell me what you know about electronic health records</td>
</tr>
<tr>
<td>2.</td>
<td>At what point, did you know that your records were no longer in paper form?</td>
</tr>
<tr>
<td>3.</td>
<td>When was the last time you required an ambulance</td>
</tr>
<tr>
<td>4.</td>
<td>Was that for you or someone else</td>
</tr>
<tr>
<td>5.</td>
<td>Who was involved and what was the overall experience</td>
</tr>
<tr>
<td>6.</td>
<td>Was it any different from the previous time you received emergency care?</td>
</tr>
<tr>
<td>7.</td>
<td>What was your experience?</td>
</tr>
<tr>
<td>8.</td>
<td>Tell me how you would feel if you learned that all your medical records were available to the frontline clinician before they got to you</td>
</tr>
<tr>
<td>9.</td>
<td>Tell me how the details of the incident were taken</td>
</tr>
<tr>
<td>10.</td>
<td>Now that you have had a chance to use ePCR, can you tell me what your overall experience was?</td>
</tr>
<tr>
<td>11.</td>
<td>What did you appreciate about the system and what didn’t you like</td>
</tr>
<tr>
<td>12.</td>
<td>The government seems to be going digital in many of their services now, what do you feel about that?</td>
</tr>
<tr>
<td>13.</td>
<td>Has any service been rolled out of late that has caught your attention, one that you found you could engage with? Tell me why you liked or disliked that service</td>
</tr>
<tr>
<td>14.</td>
<td>If you had an opportunity, would you like to be have a say in developing the new ePCRs that will host your details and those of your family and friends</td>
</tr>
<tr>
<td>15.</td>
<td>What would you like us to tell those involved in design and developing EHRs</td>
</tr>
</tbody>
</table>
3.2 Selected Theoretical Framework

A theoretical framework is vital to help explain the relationship between ideas and hidden variables. *In order to have a solid structure, one must have a very solid foundation even if it cannot be seen that is why theory is often noted as the foundation of the research or theoretical background indicating the fundamental building block for any research.* (Levy, Yair and Ellis, Timothy J (2006): pp.195[36]). Section 1.4 above introduces the two selected design research methodologies that are used throughout this work to explain patterns noted and observed in implementing an EHRs system using mixed methods theories to link to draw a theory at the end of the qualitative enquiry (Creswell, 2014) considering the following design research methodologies:

Computer Supported Cooperative Work, an approach that centers on technology used collaboratively to provide a solution or system; and

Participatory Design which focuses on the User group needs to develop a bespoke solution or system.

Cases that form the background literature for review as part of the foundation of this study are listed below to help provide a rational and clear sequence and are drawn from:

EHRs/ePCRs systems in:


<table>
<thead>
<tr>
<th>Country</th>
<th>Year implemented</th>
<th>Standard features in section 2.2.2</th>
<th>% Uptake to date</th>
<th>Design Research Approach</th>
<th>Security related issues recorded</th>
<th>Delivery Model</th>
<th>RAG Status</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1991 (Federal Gov Boost in 1998)</td>
<td>Yes</td>
<td>29</td>
<td>Lends itself more to CSWC</td>
<td>Yes</td>
<td>Not clear (more national)</td>
<td>Amber/Red</td>
<td>Under review with a view to rescope and relaunch</td>
</tr>
<tr>
<td>Sweden</td>
<td>1990 start, rollout 2002</td>
<td>Yes</td>
<td>90</td>
<td>Participatory Design</td>
<td>Yes but resolved</td>
<td>Devolved</td>
<td>Green</td>
<td>Excellent progress, additional functionality being introduced</td>
</tr>
<tr>
<td>Denmark</td>
<td>1999</td>
<td>Yes</td>
<td>98</td>
<td>Participatory Design</td>
<td>Yes but resolved</td>
<td>Devolved</td>
<td>Green</td>
<td>Excellent progress, additional functionality being introduced</td>
</tr>
<tr>
<td>Canada</td>
<td>2001</td>
<td>Yes</td>
<td>41</td>
<td>CSWC</td>
<td>Yes</td>
<td>Devolved</td>
<td>Amber/Green</td>
<td>Recently completed an national audit, recommendations being implemented</td>
</tr>
<tr>
<td>England</td>
<td>2002</td>
<td>Yes</td>
<td>10</td>
<td>CSWC</td>
<td>Yes</td>
<td>National</td>
<td>Red</td>
<td>Under review with a view to rescope and relaunch</td>
</tr>
</tbody>
</table>
The key features and application of electronic systems of selected cases is discussed in highlighting the flaws, issues and successes. With the literature review, the study demonstrates, relates and classifies patterns from selected countries by reviewing each case study and aligns the two design research methodologies to the findings, by identifying key features, strengths, weaknesses and issues and endeavours to make a connection between the fitness of a solution and its design. The challenges and successes of England’s NIB’s data and technology programme are linked to issues and best practice examples identified from the 4 cases (USA, Sweden, Denmark and Canada) noting how similar issues are addressed by other service providers elsewhere. This dual approach eclipses thematic and inverted pyramid framework (Ferfolja, and Burnett: 2002) starting broadly and keying into the area of enquiry in order to draw meaningful deductive conclusions.

3.3 Data Review, Descriptive Analysis and Evaluation

The chosen area for investigation combines both natural and social design science discussed in Section 2.1 in that it seeks to investigate how clinicians whose work is rooted in natural sciences use and would like to use information which can only be understood through a social science framework by seeking to understand how best a service may be improved. A critical phase in the literature review is the process of data review, descriptive analysis and evaluation using graphical presentation of the collected data.

The results obtained from the literature review are used to answer the two research questions, formulate findings, and draw conclusions. Results are assessed and examined to decide, select, draw conclusions and make recommendations that demonstrate how the outcomes support and extend the topic under investigation. It is anticipated that the study may be able to provide evidence on how a design approach could contribute to augmenting the use of electronic records in pre-hospital care. In so doing, the author provides a critique of the research through voicing a “construct-deliberately and consciously adopted for this study” (Newsted, Huff and Munro (2006): pp. 40[37]). This study represents a construct that may not be easily measurable and possess unobservable variables and therefore the results are expressed as a latent variable: (latent variable is defined as a scientific representation of a
construct that “can only be assessed indirectly” (Meyers, Gamst, & Guarino, (2006): pp. 28).

3.4 Limitations
The study is about gaining insight into the role that design research methodology and approach plays in developing an appropriate EHRs system that would encourage uptake and increase the use of EHRs systems, however the following limitations were present:

a. The author has very little knowledge of the clinical field; therefore, any conclusions deduced from results may be distorted due to lack of expert facts;

b. As the sample selected for interviews was random, results may bear a bias due to clinicians’ personal experiences and may not represent the totality of the health service, in particular the Trust under study;

c. Making a direct comparison or using good practice examples from other countries may not be sound enough to draw parallels due to the difference in demographics, cultures and background and is therefore cautiously considered;

d. The author no longer works for the Trust and consequently has no direct access to colleagues and internal records to facilitate a refreshing, updating and validating of the findings;

e. It is likely that the NHSFT upon which the project was based may have progressed in the areas of implementing ePCRs and therefore the findings may require further update;

f. Due to the nature of this study and the need for personal information to be gathered, there is a risk that respondents may be unwilling to provide detailed responses more so in the case of clinicians who may not be technology savvy and likely to view the introduction of new technology as taking them away from their way of working.
g. It is likely that things have since moved along and all the initial assumptions would need to be validated.

h. There is a risk that as this validation is being sought by a person no longer part of the organisation, it may not be easy to authenticate the information especially from the clinicians and the programme delivery team. Should this risk materialise, the study will seek the support of senior management team, to help cascade the need for cooperation across the Trust.

To further overcome the aforementioned barriers, the research tactfully shares best practice examples from similar settings to help improve confidence and boost receptivity. In addition, the study highlights the anticipated benefits to beneficiaries to help allay any suspicion in order to gain a buy in from the respondents. The choice of topic and enquiry was identified and selected in 2014 and was informed by first-hand information gathered by the researcher who at the time worked for the NHSFT. It therefore behooves the researcher/author to curve out some time and deliberately schedule the course with a view complete it.

Finally, there is also an overarching risk which is that NHSFTs in the UK are currently undergoing major digital changes that are not privy to the writer and therefore there may be an overlap in research and the anticipated outcomes may already exist elsewhere. Should this be the case, the writer will make specific recommendations to the selected NHSFT based on the findings for pilots to be implemented or prior to embarking on a mass rollout across the Trust.
4 RESULTS

4.1 Literature review results

Of the 183 initially identified articles, this study analyzes the 16 articles that met the requirements. From these articles, 5 EHRs systems were identified that are generally applicable and these were placed in a framework consisting of the following four interacting dimensions: (1) EHR context, (2) EHR content, and (3) EHR implementation process (4) Data from interviews formed the current perspectives on EHRs at the Trust under study.

Dorst, Kees, Massimo Negrotti, Morelli, N and Flensburg, P, all talk about design and problems as well as questions designers need to ask themselves when developing a solution. In their various forums discussing design problems and design paradoxes, without belaboring the point, they bring out the need for identifying an appropriate design in science and scientific methods as opposed to subjective selection choreographed by a designer or consultant.

The results in this section are grouped in three main categories as follows:

a) Sweden and Denmark. These two countries seem to have made significant progress and appear to have similar had approaches do design with over 90% of the user groups engaged and using EHRs. They both have devolved models.

b) USA and Canada look to have made some progress but not as much as anticipated by their respective governments on inception of their individual programmes. They seem encumbered about with similar issues such as cost (covered earlier in the study) of rollout, unclear implementation model - with somewhat blurred lines between devolved and federated approaches as well as the need to maintain control through nationwide rollout approach. There doesn’t seem to be clear indication of user group involvement at any stage of research, design or development process.

c) England being the focus of this study appears to have taken on an approach tending more towards USA and Canada model but must be discussed in its own merit to facilitate a closer look at the possible contributing factors to current challenges.
4.1.1 Sweden and Denmark:
Discussions in Chapter 2 on related work (the body of knowledge), revealed a degree of success in implementing EHRs, in the case of Sweden in section 2.2 and Denmark in section 2.3. Further enquiry on Sweden and Denmark seems to attribute their respective successes to the relatively small populations of approximately 9.0 million (Sweden) and 5.4 million (Denmark). Some scholars argue that this population size lends itself to simpler and easier implementation of technology (Reforminghealthcare.eu, n.d.). Quoting Kenneth Ahrensberg of SDSD, the Danish government body responsible for the development of electronic health records saying the success is as a result of 'Denmark being a small country (population: 5 million) with an IT-savvy citizenry. However, in the grand scheme of things, Denmark is no different from Canada if viewed in terms of population density per square meter.

Table 4.1 and Diagram 4.1 below show that, Canada and Sweden have the least density per square mile of 3 and 5 respectively, followed by Denmark and USA at 129 and 84 respectively.

England is smaller in land area but has the highest density per square meter ("Population Density Per Square Mile Of Countries"). Therefore, the size and population assertions are contestable and therefore discounted in this study.

Table 4.1: Full Population Density per square mile for countries under study

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Country</th>
<th>Population</th>
<th>Land area (sq mi)</th>
<th>Density per sq mi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Canada</td>
<td>33,679,263</td>
<td>3,560,217</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Denmark</td>
<td>5,484,723</td>
<td>16,359</td>
<td>129</td>
</tr>
<tr>
<td>3</td>
<td>Sweden</td>
<td>9,016,596</td>
<td>158,927</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>United Kingdom</td>
<td>60,609,153</td>
<td>93,278</td>
<td>650</td>
</tr>
<tr>
<td>5</td>
<td>United States</td>
<td>298,444,215</td>
<td>3,539,225</td>
<td>84</td>
</tr>
</tbody>
</table>

Source: Population Density Per Square Mile Of Countries
Table 4.2: Summary of population in nearest billion for computation

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Country</th>
<th>Population in billions</th>
<th>Land area (sq mi)</th>
<th>Density per sq mi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Canada</td>
<td>33.6</td>
<td>3,560,217</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Denmark</td>
<td>5.5</td>
<td>16,359</td>
<td>129</td>
</tr>
<tr>
<td>3</td>
<td>Sweden</td>
<td>9.0</td>
<td>158,927</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>United Kingdom</td>
<td>60.6</td>
<td>93,278</td>
<td>650</td>
</tr>
<tr>
<td>5</td>
<td>United States</td>
<td>298.4</td>
<td>3,539,225</td>
<td>84</td>
</tr>
</tbody>
</table>

Source: Population Density Per Square Mile Of Countries

Diagram 4.1: Population Density per square mile for countries under study

Trust in the federal government is high in Denmark; the country's healthcare is run by the public sector which receives high support from the citizens unlike the UK whose government receives a high amount of criticism on various government-led projects (TIME.com, 2009). Despite criticism of MoG in England, people have different views of MoG and perceptions tend to influence attitudes towards government led initiative. However, as the EHRs programme falls under the NHS which is government funded and led, opinions on MoG may not hold too much water but could potentially contribute to how receptive or repulsive of EHRs people might be. This variable is not discussed in full but forms part of the interview statements and will therefore be measured in the graphic representation of collected data.
Another school of thought claims that a significant contributing success factor is the involvement of clinicians in the design and implementation early in the process. In both Sweden and Denmark involved and continues to involve clinicians among other stakeholders in the design and implementation process which in turn led to rapid clinical acceptance of EHRs. Although EHRs were made mandatory in 2004 in Denmark, they were developed in close consultation with physicians to ensure their utility, rather than have them imposed on them. The Swedish and Danish governments are said to have also provided financial incentives (Bradford H., Bowden and Koch 2011). This does not seem to have been the case for USA, Canada or England. In Canada and USA, cost seems to be another frequent barrier to acceptance of EHRs as outlined in sections 2.1 (O’Neill Hayes 2015) and 2.4 (Office of the Auditor General of Canada 2010) above which included paying for technical support, sending data-consulting teams to medical practices. Budgets and financial incentives cut across many of the EHRs rollout programmes but will not be scrutinized in great detail in this study. The little information gathered on EHRs systems points to central governments allocating budgets to the programme but disbursing the funds in different formats. England would channel the funds through commissioning bodies, who would be accountable to NHS England and subsequently to the Department of Health. USA and Canadian Federal Governments hold the budgets which are disbursed to states and provinces. However, the main difference is that Canada has a devolved approached with a centralised appointed body - Infoway, which is responsible for managing the budgets. USA’s semi-federated approach seems to expect practitioners to invest on EHRs and put a claim for resources spent to be reimbursed. This approach may seem laborious and off putting as well as being at risk of de-prioritisations. Sweden operates a model similar to Denmark and England. The bottom line is that cost is relative to the countries administrative policies and procedures but incentives seem to make a difference where they have been used.

The devolved approach in Denmark has large variety options which in one way is a strength of its system. This strength may somewhat be viewed as a weakness due to the different systems adopted by different practitioners. It is reported that accessing patient data across several systems is still sometimes a challenge. Doctor Smith of The National Board of Health’s explains that, quote; “we must make sure that when the patient goes from the GP to the hospital, to the municipality, to the private
specialist, to wherever, that the information flow is with the patient.” (Reforminghealthcare.eu, n.d.).

The current national strategy for digitisation of healthcare services 2008-2012 is attempting to do just that by strengthening national standards and leading to the convergence of local systems, so that all the information on every database can be accessed in one place by medical professionals wherever a patient appears for care. That is the ultimate goal of all electronic patient records, but the Danish and Swedes seem likely to get there first. Both Sweden and Denmark had security and privacy concerns which were addressed and got the implementation back on track (Thomson 2005). The issue of privacy and data protection has come up in all the countries studied and will therefore be included in the interview statements and questions.

The success in Sweden has been attributed to the importance attached small-scale developments and the sense of participation that the clinical staff felt in being able to influence many details of the systems. This contrasted with the later development of more advanced systems which were introduced through the central IT management system covering various counties and were often developed by large, or at least somewhat larger, software companies. In these instances, only a few clinicians were able to influence the design and many felt alienated from these systems (Kajbjer, Nordberg and Klein, 2011). Nonetheless, the masses had been engaged in the first round of development and implementation and Sweden may have continued to benefit from their legacy.

Denmark attributes one of EHRs benefits to user participation, reports on Denmark suggest that the electronic patient records have indeed paid off by bringing about the anticipated benefits in reducing paperwork, and are said to freeing doctors and nurses to spend more time with patients.

4.1.2 USA and Canada:

The USA’s model was not crystal clear from the literature but it leaned towards having been given a go ahead by the federal government and was meant to be implemented by each state on making a good case to draw finances. The model expected practitioners, physicians and health care providers to first invest in the EHRs
and seek reimbursement. However, without clear cut benefits case, developed by involvement of user groups, one would understand why this approach would slow down uptake. According to David Blumenthal, the United States National Coordinator for Health Information Technology, “Few U.S. doctors or hospitals — perhaps 17% and 10%, respectively — have even basic EHRs, and there are significant barriers to their adoption and use: their substantial cost, the perceived lack of financial return from investing in them, the technical and logistic challenges involved in installing, maintaining, and updating them, and consumers' and physicians' concerns about the privacy and security of electronic health information.” (DesRoches et al., 2008). In US, the key barriers to uptake were reported to have been due to systems that did not suit the users namely physicians, again highlighting the need for participatory design approach in the first place - (barriers to adoption) (DesRoches et al., 2008). This highlights the need to take the users on the design journey to improve the chances of by-in and successful implementation.

This study found that in Canada ‘each province’s approach to electronic health records is unique’. Their definitions of electronic health strategies, priorities, timelines, and approaches were distinctive. In addition, Canada’s devolved approach seemed to allow for each Province (County) to manage its own progress and completion timelines were not pegged to a national target (Volpe, 2010). Canada’s issues lay in the extent in which their devolved approach influences delivery of EHRs. It is not clear how and whether users have been involved in the process even though each Province is autonomous in the way it roles out EHRs which may account for the 41% uptake.

In an ‘Overview of Federal and Provincial Audit Reports:2010 Electronic Health Records in Canada’ the ambition of the government is that ‘Eventually Canadians will have EHRs; there is strong public and jurisdictional support for new technology in health care’. Jurisdictional governments are convinced that investments in EHRs will improve safety and quality as well as save money in the long run.

There have been barriers to faster progress; some of which have been attributed to limited funding; citing that progress has been spotty in reaching out to Canada's physicians (94% of physician records were paper based in 2007); and there is a limited supply of experienced health information technology managers in the country. (Volpe,
2010). There were concerns over privacy in both USA and Canada that are to be addressed through their respective forums.

4.1.3 England:
England adopted a nationalised approach delivered through NIB, it also promoted a technology centered solution for implementation nationally. Reports reveal that England’s EHR’s programme’s challenges included concerns and controversies over privacy and consent arrangements. Notwithstanding pockets of health care providers have implemented EHRs but struggle to embrace the usefulness and diverse functionality, some of which serve real purpose to the health care providers

It was evident that patients had not been consulted or involved in the design process and therefore had not been fully appraised of how their information was being used or going to be used. (The Government Response to the Health Committee Report on the Electronic Patient Record, 2007). England’s County wide targets were pegged to national timelines which did not necessarily take into account the dynamics, requirements and uniqueness of each County.

4.2 Benefits of EHRs
Benefits of EHRs as deduced from the literature review are summarised in this section are as follows:

a. The ability to automatically share and update information among different offices and organisations;

b. More efficient storage and retrieval;

c. The ability to share multimedia information, such as medical imaging results, among locations;

d. The ability to link records to sources of relevant and current research;

e. Easier standardisation of services and patient care;

f. Provision of decision support systems (DSS) for healthcare professionals;

g. Less redundancy of effort;

h. Lower cost to the medical system once implementation is complete.

It is hoped that these benefits may be achieved in the long run once the various countries embrace the appropriate design and development methodology.
4.3 Analysis and Discussion

There is a common theme throughout the study that governments are working to ensure all citizens have standardised electronic health records and that all records include the same types of information and are accessible at the point of giving care. Two major barriers for the adoption of electronic health records seem to relate to cost and the design approach. All the countries in this study had their governments set aside substantial budgets for EHRs implementation programmes and therefore this study will not consider cost as a strong enough variable to base its argument upon as part of the challenges to rollout. However, where notwithstanding pockets of health care providers have implemented EHRs but struggle to embrace the usefulness and diverse functionality, some of which serve real purpose to the health care providers financial incentives for Sweden were noted as reason for augmenting the scope of the use of EHRs like in the case of Sweden.

Whilst the OECD’s approach is of a devolved nature, evidence from England’s case points to a single, ‘fit for all solution’ which leads to the question of whether the data and technology approach that lends itself to a technology based or CSCW methodology was appropriate, feasible and deliverable. Suffice to say the NIB’s 2020 programme has not taken off as anticipated and has faced several challenges alongside criticisms leading up to a government’s response to a consultation commissioned by England’s Health Select Committee (HSC) on electronic patient record programme.

According to the original definition of CSCW as a technology collaborative tool, it bases its design methodology on technology and with which interested parties can collaborative, it was engrained in HCI. To help understand and contextualize the use of original CSCW, the definition is repeated as follows: Schmidt and Bannon refer to CSCW as “a design-oriented research with technology at the centre of the research agenda and it is aimed at understanding the nature of cooperative work so as to be able to design technologies that can support it in adequate ways” (Schmidt and Bannon, 1992). It is said to have grown out of a research area carried out in the 1980s of Human-Computer Interaction (HCI). This is as illustrated in the work presented in the book Psychology of Human-Computer Interaction which describes HCI as a methodology for unifying psychology and computer science (Card, Moran and Newell, 1983). Whilst reviewing Canada, United States and England EHRs implementation
programmes, there is evidence and as reported in a recent publications, that found all three countries had reported an issue of technology-induced error as being of critical importance (Kushnriuk, Andrew W, Bates, David W etal:2013)[40]. The report further states that ‘the three countries had developed approaches for dealing with this issues that have some commonalities; however, they are at varying stages of maturity. As technology-induced errors found in Canada, England and USA EHRs systems may arise from different phases in design, development, implementation and use of IT and are often only detected once systems are deployed within complex real-world contexts and environments an Agile approach to a participatory design solution would bring up these errors in the pilot releases. The manifestations of such errors are often revealed in the complex interactions between health professionals, the new information technology and the complex human factors associated with their use in varied healthcare contexts and settings are errors that result from the use of health information technology when it is implemented within healthcare settings and contexts.

One would argue that innovations within CSCW

On the issue of privacy and data protection, an overview of the three countries alluded to the fact that England has the longest standing and most developed safety programs, while Canada and the United States are at earlier stages’ (Kushnriuk: 2013: etal). Nonetheless and according to England’s Health Select Committee report and the recent publication, ‘Recommendation …… voices concerns over security and privacy as being a key reason for slackened progress in the NIB data and technology programme (Government’s response to the Health Committee Report (2007)[41]’.

It is vital to reiterate that even though Canada EMRs implementation programme is devolved, it fails to evidence user participation in the design and development process, and this may perhaps account for the programme’s inability to achieve the set target to have 50% of its population e using EMRs by 2010 (Hpm.org, 2009). It is safe to say that user participation avails opportunities for issues and problems to be sighted in a timely manner and more so, during iteration and before programme start date. One would say participatory design is many things to many people; especially since technologic solutions would traditionally, sit with systems engineers and programmers. In a sense, this may be the right approach, however, for a solution to be developed by an expert without taking the users on board, deprives the system the
intricate input from user-perspective and the ability to express their interaction with the system (Schuler and Namioka, 1993). One may argue that Groupware (Marca and Bock p.60) may facilitate collaboration during design and development, however, as Groupware and CSCW are technology driven, it is difficult to see how an ordinary patient, perhaps a geriatric patient may be able to make a contribution on how their EMRs are developed by collaborating on Groupware or CSCW unless they are fully versed in using the collaborative tools and technology. Conversely, when employing participatory design, user needs may be captured in their rawest form through different forums such as workshops, one to one discussions, a letter from the stakeholder etc.

Deducing from the findings and discussions in this study, the consensus is that any other approach other than participatory design because ‘can indeed be hazardous to leave out users in the design process’ as echoed by Bravo Ellen. In an article cited by Flensburg, Per, the writer adds that leaving out the users isn’t just ‘undemocratic’ – but it has serious consequences for worker health, human rights, job satisfaction, and also for the work process and the bottom line’ (Schuler and Namioka, 1993). Ellen Bravo “The Hazards of Leaving Out the and Users” (Schuler and Namioka, 1993).

In the USA unlike the rest of the countries reviewed, the objective for implementing EHRs systems was to cope with the increasing volumes of information. This was captured as follows: EHRs (then called electronic medical record (EMR) or Computerised Patient Record (CPR) received a go ahead in 1991 and one of the key drivers is said to have been ‘the increasing volume of data collected and the continued growth of medical knowledge had created a dramatic need for information technology appropriate for the task of sorting through all the information available, assessing the strength of the evidence, and bringing it to practitioners whenever they need it, particularly at the time they are making care decisions’. The approach adopted by US included an element of ‘identifying the customers; understanding their requirements; and translating those requirements into functional characteristics of the system (Dick, Steen and Detmer, 1997). However, the extent of the customer’s involvement and what comprised the customer group was not clear.
Canada’s EMRs implementation programme is devolved however, the
government’s delivery partner Infoway’s approach precludes provisional or regional
autonomy as it seeks to:

a) ensure systems elements are built with consistent standards, to enable future
interoperability within and across jurisdictions and simplifying the movement of
knowledge and people across jurisdictions; this in itself restricts the extent of
devolved participation;

b) that systems served as a catalyst for new info structure developments and ensure
common platform quality across all jurisdictions; bringing the entire delivery
approach to one national set of accountability notwithstanding the user’s
preferences or the relevant and appropriateness of model;

c) where possible, encourage cooperation, thereby eliminating redundancy and
duplicative efforts in systems design, vendor negotiations – again without the user
group bespoke participation, there are no guarantees that the dynamics of each
region/province may differ greatly thereby impacting upon the choice of a solution;

d) reduce long-term costs and implementation time by leveraging scale and cross-
jurisdictional knowledge (Canada Health Infoway 2007) – no emphasis will be laid
upon costs in this paper.

Recent reports indicate that despite having started on time and been assigned a
specialist body to support delivery of EHRs; Canada may not be on track as
anticipated. Infoway established an objective of providing 50% of Canadians with
EHRs by 2010. As at 2009, it became clear that the goal would not be reached a host
of issues faced by both Infoway and the provinces that have impeded progress
(Hpm.org, 2009).

User needs across provinces were bound to be different and therefore honing
into any of the above to a design process points back to technology-centred systems
and therefore CSCW-HCI comes to play and may somewhat explain the current
challenges of missing targets.
Health records in Canada are kept in a central repository and are available to all eligible users which enables on-demand access to information at the point of need. The challenge with this is that the information is not maintained locally and it is said that it could potentially encounter greater resistance from providers because they do not maintain their own data systems, (Infoway-inforoute.ca, 2009). Another hindrance reported was lack of time and training to identify and train champions early in the process which is possible through participatory to help overcome barriers.

Canada reported that another barrier to uptake was in how to impact upon new users in particular, those that might not have fully understood the scope of the change required to implement an EHR system. A participant in an Implementing electronic health records study said that users do not have ‘knowledge of what an electronic health record package will do to their work flow in their office and how it will just throw the whole office on its head essentially because it does require massive undertaking with regard to reorganisation’ (AL et al. 2008). These are assertions that point to lack of knowledge of EHRs that may be due to non-involvement in the research, design, development and implementation process.

Some participants said ‘learning to use EHRs was difficult when there was little time available in a busy workday’. Another participant in the AIUPC study described a phased-in implementation process: ‘Initially, it was strictly by demographics and appointment scheduling, period. Then the billing clerk was being trained ‘adding that ‘we lived with that for about 4 or 5 months before we went to computerized medical records’ (Amanda L. Terry, 2008) and (Reforminghealthcare.eu, n.d.). These comments would have been reviewed during iteration should PD have been adopted.

The experiences of participants in another research on Building a Privacy, Ethics, and Data Access Framework for Real World Computerised Medical Record System Data: A Delphi Study. Contribution of the Primary Health Care and Informatics Working Group team members participating in the study indicated how time was a crucial component to the user groups and getting involved in the implementation process would slow them and stressing the was importance of not to underestimating the time required to learn and understand how to use EHRs by saying: ‘Time is the biggest [consideration] of all isn’t it? It’s going to take 10 times longer
than you think it’s going to take.’ In addition, other participants noted that family physicians’ principal commitment was the delivery of patient care, so it was difficult for them to allocate the time needed to learn to use the software and redesign the work flow in their practices saying that ‘They’re ... awful busy’. ‘There’s a lot of physical running around in family practices ... and so because of that there wasn’t a lot of time to be able to navigate through 5 screens ... so that learning process was too slow for them and led to frustration.’ (AL et al. 2008) and (H et al. 2008). The experience of participants in the study illustrated how the type of training available was also very important. For example, some of the care providers in DELPHI practices attempted to learn through remote telephone-based training, but ultimately requested on-site help. As one participant in the study noted: They liked real people sitting beside them responding to their expressions, pausing when they looked confused ... I mean you can imagine people that are not accustomed to technology at all, must do a pretty high processing technological thing which is taught remotely. I mean that’s pretty fancy even for people that are comfortable with computers’, (AL et al. 2008) and (H et al. 2008). It is safe to say that when stakeholders are involvement in design, development and implementation, they acquire expert knowledge of the service or product or outcome along the way and therefore require less time to train and would more often than not buy in to the service as well as voluntarily seek to champion the service or product. This points yet again to PD.

4.3.1 Conclusion on Analysis and Discussion from Quantitative Research

USA’s issues may seem to stem from the centralised approach and commercial model lacking real incentives for user groups to want to get involved. There is no evidence to show that users were involved in the design process. Further deductive assertion drawn from this study is that the selected countries’ vary in progress in their implementation of electronic patient records with Sweden and Denmark topping the list and USA struggling.

Looking at Denmark’s success, it is noted that despite the added features and capabilities, the report, suggests that Denmark's transition to digital records has not been seamless. ‘After the government decided to move away from paper records in 1999, a team of officials came up with a new coding system that required doctors to
insert all information and notes in alpha-numerical form. The system was never implemented and eventually abandoned in 2006 after many physicians and nurses complained. Now, instead of one over-arching system, record keeping, utilise various compatible systems, linking networks established by regional health agencies (Harrell, 2009).

Denmark, England and USA seem to have adopted a centralized approach with Denmark’s model having evolved over a time to devolved – starting off as a database and being developed into a record management system.

Implementing electronic health records in Canada was a Pan-Canadian initiative that required the collaboration of stakeholders, including the federal government, Canada Health Infoway Inc., and the provincial and territorial governments, as well as other organizations involved in the delivery of health care. Every audited jurisdiction has at least one core electronic health record (EHR) system in place, and some provinces have almost finished implementing their EHR systems (Office of the Auditor General Canada, (Volpe, 2010)). Given the significant challenges of this undertaking and the substantial potential benefits of EHRs, stakeholders need to work together to comprehensively report to legislatures and citizens/patients Canadians on progress made and benefits achieved. Electronic Health Records in Canada An Overview of Federal and Provincial Audit Reports, Office of the Auditor General of Canada (Volpe, 2010).

Although each province and territory will have an EHR system adapted to its needs, it is important that provincial and territorial systems are based on an agreed set of principles and characteristics (Office of the Auditor General Canada, (Volpe, 2010)). To this end, Infoway - in consultation with the provinces, territories, and other stakeholders—identified the key requirements and core components of an EHR and developed the Electronic Health Record Solution Blueprint to guide the national development of EHRs. Released in 2003, the Blueprint is a technology framework for sharing health information securely and appropriately across Canada. It was revised in 2006 and now includes more detail on how standards support the sharing of health information. It also includes more on how they comply with federal, provincial, and territorial requirements as well as privacy and security requirements across
jurisdictions. Infoway believes that provincial and territorial alignment with the Electronic Health Record Solution Blueprint and compliance with standards are essential to achieving EHRs that are compatible across the country (Volpe, 2010).

Canada seems to have adopted what one would regard as ‘semi’ devolved approach, with each province left to make its own EHRs implementation decisions but according to a nationalised, centralised, specifications, which again throws out user involvement and may explain the slow up take. As an added advantage discovered during this study and echoed by the Canadian story, a good project management process is an enabler to rolling out EHRs quote ‘Ministries of Health with inadequate project management processes are less able to properly manage costs, risks, and problems (Volpe, 2010).

Sweden’s progress may be attributed to the phased in approach and the inclusion of key stakeholders and crucial point ensuring that they were taken along the journey of a system that they would be required to use. Two interviews with a Swedish medical doctor and medical ward nurse (equivalent of receiving facility staff) found the EHRs systems laborious and time consuming. The clinicians added that the use of ePCRs left them less time to spend with patients as they concerned themselves with electronically logging information onto the EHR citing that one of the features of the EHRs system creates an audit report that tracks the time between a discussion with a patient and when the information is logged on which, according to the clinicians, puts unnecessary pressure on them and reduces available between the patient doctor. The same concerns were echoed by an under nurse at a receiving facility.

England’s approach has encountered some challenges that may be attributed to the centralized model as well as lack of evidence that stakeholders were involved in the design process. England’s EHRs programme was paused in February 2014 to address concerns raised in section 2 above and it is said to have been recommissioned in 2015 with a new phased approach. It is too early to evaluate and provide updates on the status of each pathfinder. In addition, the new approach proposes patient’s involvement as an informative exercise on the option to opt in or out of the EHRs
programme which does in itself not address the design approach where a system is developed with the users and not for the users (Perkin, 2016).

In England, the government appears resolute about rolling out EHRs. It is said that £2.7 billion has been spent over nine years, the government is determined to forge ahead to a successful implementation of the EHRs and will not abandon the programme especially in the emergency setting ("About - National Information Board - GOV.UK") but will seek ways to address the following:

a) Fear of breaching privacy laws;
b) Pre-perceived increase in ambulance run times that could lead to decreased ambulance availability;
c) Possible difficulty integrating with existing information systems used in hospitals, doctors, specialists and social services;
d) Resistance to change by key stakeholder groups including frontline clinicians;
e) Slow adoption to technology.

Government mandate requiring adoption of ePCRs and in countering the challenges that would hinder a positive outcome, the research captured recurring emerging strategies that could help implement a mass rollout as follows:

a) Ensure project is embedded into NHSFTs’ strategic objectives and assign funding to support implementation nationally.
b) Leverage regional health information organisations to support implementation of most effective solution;
c) Ensure NHSFTs build internal capacity to support mass rollout.

The Trust under study started phasing in the ePCRs in their pre-hospital care services in 2014 two years before the national target end date. In the Trust’s News Edition on the 21st of December 2015, the Trust’s ePCRs programme team leader published an article providing feedback from a 5-man pilot project citing a degree of success and challenges faced by both the users and the developers. - (a redacted version could be made available on request). After 12 months, the pilot is planned for live assessment in December 2016 ("South East Coast Ambulance Service | Electronic Patient Records (EPCR)" 2016). The ePCRs, like the paper PCRs, are aimed at collecting data during and after attending an incident.
The body of knowledge points to a strong correlation between the design research approach and the success or otherwise of ePCRs in the countries understudy. It would seem Denmark’s centralised approach developed into a devolved design and development, that included and continues to include clinicians, patients and an array of stakeholders into the process. **Diagram 4.2** deduced from Table 3.3 illustrates this claim. There is undoubtedly a strong correlation between design research approach and the appetite for EHRs.

**Diagram 4.2:** Results of Quantitative study linking design approach to % uptake

Evidence shows that there is a significant cost element and technological requirements that would need to be discussed and agreed outside of the scope of this study. It also seems apparent that there would be a necessity to engage other health care providers in the chain from whom a significant amount of patient information would be derived. These may include GPs, Long Term Illnesses Care Providers, receiving facilities, Law Enforcement Agencies, Specialist Units, to name a few. Nonetheless the general feeling is that of a motivated group of stakeholders eager to effect changes in the pre-hospital care is delivered thereby contribution to improved and efficient services. The findings of the case study are summarised and evidence for the implementation presented in a logical and easy to follow format and recommendations to introduce the use of EHRs in pre-hospital care for the Trust understudy. These are made with a hope that this would be implemented by other NHS Foundation Trusts in England.
4.3.2 Conclusion from Results from Qualitative Research

The key observation from the qualitative research was of ‘user’ participation which in the most part took the form of consultation without any decision-making involvement. The difference between suggesting and having the power to make decisions plays an important part in participatory design (Schuler and Namioka, 1993).

Could there be a risk that clinicians may be tempted to move away from viewing each case on its own merit if they can access multiple patients records with similar alignments under their care electronically and make a judgment/prognosis based on a similar condition without taking into account the patient at hand’s own information? (Just a thought that may be probed sometime in the future once there is sufficient evidence).

4.3.3 Summary of Interview Analysis presented in diagrams and tables

The interviews produced mixed responses as shown in tables and diagrams below. The sample questionnaire in Table 3.2 and redacted responses sample in Appendix 2 achieved the objectives for which they were designed by facilitating dialogue that helped draw out information from respondents. The statements successfully opened discussions with the respondents as soon as there was a realization that it was about their health service, and not just the NHS. Most respondents’ initial reluctance was the notion of the interview being mistaken for a consultation, commenting that no matter how much they said during consultations, their views seemed inconsequential. However, on clarifying that the discussions were in fact an enquiry on how best EHRs could be rolled out, and how important their views were, attitudes somewhat changed and countenances softened ready to engage. It is important to note that no promises were made that this work would for certain influence policy, but was an academic paper.

In Appendix 1, represents raw of results from interview questionnaires in response to questions in Table 3.1.

A redacted sample of questionnaires in Table 3.1 and 3.2 are attached in Appendix 2 for information.
Diagram 4.3 above illustrates the way data and information is required and must be captured before, during and after care is provided for the incident at hand. This activity can be time consuming, leading to unnecessary delays. When a call is placed to an emergency service provider in the UK it is received by a Dispatcher who runs the caller through a series of questions to inform and determine course of action required that leads to a triage using the correct pathways that would provide the appropriate help. The information taken/required consists of location, a description of what has happened or is wrong with the patient, the age (approximate age), and their state (if conscious and awake) and if they are breathing. This information helps the Dispatcher decide what type of help is required.
During interviews with key stakeholders at the Trust understudy, it became evident that they had not been involved in the pilot but had been lined up to test the prototype. Which again points to a failing in CSCW methodology that seems to have been adopted by the Trust. It is probable that the pilot may not yield positive outcome until and unless those people who have an interest in the outcome are taken on board and their views included in the design and delivery of an ePCR solution on presented in and obtained through interviews it is evident that the benefits that accrue to the use of EHRs elsewhere within the healthcare services would benefit the pre-hospital care teams by ensuring real time information is available to them at the point of need. Pre-hospital care is driven by speed and accuracy and it would seem logical to ensure that all due diligence to promote safety, enhance efficiency and improve patient experience. The Trust understudy has spent 12 months on a pilot of 5 devices which on one had may be replicating the Danish model of slow penetration into the market but without taking all the user group with the through this journey, the endeavor may yield very little fruit.

Diagram 4.4: Question 1 of Table 3.1 (Questionnaire)

The results above show that cumulatively over 71% of the respondents felt EHRs were a good idea, this response could potentially translate to a willingness to participate and support the implementation of EHRs.
This result represents 15.6% of the respondents had never heard of EHRs, this meant that the before embarking on capturing responses to questions in Table 3.2, the interviewer had to explain to the respondents what EHRs were and what they would be used for. Just about 34% responded as not applicable, and this result could either mean, they may have been ignorant and did not want to appear so or they hoped by this response, the interviewer would be put off. As this was fact finding mission, the 2nd questionnaire in table 3.2 was use. These answers represent 50/50% about not knowing anything and being aware of the EHRs implementation programme.

Diagram 4.6: Question 3 of Table 3.1 (Questionnaire)
An overwhelming 93% expressed their desire to be involved in the EHRs design, development and implementation process, this may be due to the nature of the information captured on patient records and therefore wanting to influence what captured, how it is captured, whom it is shared with and understanding why. This points strongly to PD approach.

Diagram 4.7: Question 4 of Table 3.1 (Questionnaire)

![Diagram 4.7](image)

A total of 71% of the respondents would be happy to have records held in one centralised place. This signals to potential support of ePCRs implementation programme.

Diagram 4.8: Question 5 of Table 3.1 (Questionnaire)

![Diagram 4.8](image)
Less than 5% of the respondents had confidence in the government leading on the delivery of the EHRs system. The current model in use in the UK is nationalised however, recent reports in addition to this study have been advocating for a devolved approach – thereby given local and regional counties autonomy in making decisions about their health service. This could also be interpreted as the need for smaller groups to influence what is implemented, therefore by pointing to PD approach.

Diagram 4.9 Question 6 of Table 3.1 (Questionnaire)

Diagram 4.9 above gives a flavor of respondents concerns about privacy and data protection issues. These sentiments were echoed across all the countries studied and it can be confidently said that if users are taken on a design and development journey, they may be able to raise concerns early in the process. This intelligence may be useful to experts who may be able to play out various scenarios, testing them iteratively thereby proactively addressing the issue. This is type of dialogue seems more likely with PD approach.
Diagram 4.10 represents sentiments about date collection, usage. It is evident that due to the nature and purpose for gathering information, respondents are keen to have a say in what and how information about them and their families is collected and shared, again lending itself to PD.

Diagram 4.11 represents sentiments about date collection, usage. It is evident that due to the nature and purpose for gathering information, respondents are keen to have a say in what and how information about them and their families is collected and shared, again lending itself to PD.

Over 62% of the respondents had not received training on the use of ePCRs, these statements referred to all users, in particular staff. The pilot at the Trust had begun testing without practitioners receiving appropriate training. This is would be undeliverable in the event of live implementation programme. This approach would
not save time and may result in several errors as reported in pilots carried out by Stevenson J (Stevenson).

Diagram 4.12 Question 9 of Table 3.1 (Questionnaire)

It is not surprise that the result was split into about half on each side. Some of the respondents were not direct users of ePCRs and therefore did need ePRCs to work.

Diagram 4.13 Question 10 of Table 3.1 (Questionnaire)

The respondents showed a desire to get involved in the ePCRs work with 98% seeking indicating that they would wish to be part of the programme.
Question 11 did not receive any response and this could be attributed to the longer questionnaire in Table 3.2 that was used conjunction Table 3.1.

In concluding this section, it is safe to say that majority of the respondents were proponents of getting involved in ePCRs design, development and implementing process. A sample of 32 out of under 4 million potential candidates may not be as representative as to give definitive assertions, however, as it was a simple random sample and for purposes of this study, it is very likely that it represents view of the thinking of key stakeholders across the three counties. There is scope to for implementers and policy makers to apply the knowledge and framework in this paper to carry out further enquiry on a larger scale as appropriately.
5 CONCLUSION AND FUTURE WORK

5.1 Future work - recommendations

Overall 74% of the respondents indicated interest in getting involved and have a say in EHRs implementation programme. The result on the issue of privacy was one that would require attention and would need to be resolved to stakeholders’ satisfaction if the programme is to succeed. Data protection and information security is a specialist area, and it is believed that legal experts, policy makers and patients would, through iteration in PD approach arrive at an appropriate solution. It seems plausible to take key stakeholders along on the journey to successful implementation of EHRs in England and elsewhere in the world.

The investigations carried out in this study suggest that a central purpose of most developed health systems is the creation, expansion and linkage of electronic patient care record (ePCR) systems. Countries reviewed for purposes of this study strongly vouch for the introduction of ePCRs stating that this technology offers numerous and significant benefits. There is also a common theme that emphasises the importance of storing and transferring patient information electronically and how this has the potential to significantly reduce clinical errors and improve patient safety as well as allowing clinicians to communicate more quickly and accurately and to identify relevant information more easily. The consensus is that, good ePCR systems can increase efficiency, reduce duplication and wastage, and improve the cost-effectiveness of health services. It is also clear from the cases studied that ePCR systems could also make information much more readily accessible to patients, allowing them to assume more control over their health records and thereby become more active in their own care. In addition, electronic databases of health information could potentially be used for a range of purposes other than direct care provision, for example clinical audit and research. Consequently, it seemed accurate to describe ePCR as “potentially a transformative technology”

This study recognises the need for culture change and substantial training requirements that would have to accompany rollout of EHRs. The primary reason for making a case for universal rollout of ePCRs is the potential for systems to enhance the way information is gathered and used in emergency services and support quality
assurance efforts which will in turn improve patient experience and save resources. The scope for the use of ePCRs in prehospital care is enormous. This work focused on advocating for the implementation of EHRs highlighting the essential benefits of an appropriate design research, development and implementation approach within informatics in health care whilst making a connection between the fundamentals a workable solution to improve the uptake in rolling of ePCRs especially in the Trust understudy. The need for incentives and high motivation to adopt the use of EHRs to gain early adopters from user groups may be enhanced through participation of these groups throughout the design, development and implementation process. This would improve confidence in systems developed and encourage buy-in on a larger scale. In addition, there could be challenges that face any universal rollout of a new system including those common to health information. These challenges and concerns may be assuaged if stakeholders are aware of what, when and why data is being collected through participatory design.

It is evident from the literature review that all the countries reviewed embarked on the implementation of EHRs systems with a hope that they would realise the following benefit significant benefits by reducing costs and working more efficiently. Although EHRs systems are said to have positive impacts on the performance in health care their implementation seems to have been somewhat challenging. This study has uncovered some reasons for these the challenges and presents two key outputs that may be applied to intervene and accelerate EHRs systems implementation progress as well as motivated key stakeholders’ uptake. It is believed that a clear and better understanding of the various stakeholder groups’ perspectives would a steer and help tackle the way clinicians and other key users welcome the use of EHRs in pre-hospital care.

Health services impact a across section of society and it is likely that each person in England has at one time or another had to visit their doctor therefore would like to have a say on how a service that impacts them directly would be delivered. Overwhelming evidence points to the need for user-participation in developing EHRs systems. Emphasis is laid upon the level of participation which from the findings, point to carrying users along all the way, from consultation, research, design, development and rollout. The voice of the user in participatory design is bound to
yield better outcomes for all stakeholder groups as it helps deliver a bespoke solution, and would gain early buy-in and earn advocates with considerable understanding of the solution being implemented.

The findings of this study confirm the hypothesis: that the earlier and the more key user groups are involved in the design and solution development process the greater the chances of EHRs systems programmes to succeed.

5.2 Future work - recommendations
Consulting user groups to design is not the same as taking the users along during the design process. The former is important but it is not an end in itself and requires the additional steps of testing the prototypes with the users, refining the system to ensure that the users understand all there is about the EHRs system and they can indeed use the system. This study recommends the use of a combination of PD design research methodology and agile project management approach to address these two keys issues because a ‘one size fits all’ solution across these countries or even regions will not deliver a quality EHRs system as it does not take the user groups along the entire journey – which is a key component and driver of success as established in the Swedish and Danish delivery models.

It is the recommendation of this work for the Trust understudy to adopt a user centred, participatory design approach in developing a solution to a bespoke, fit for purpose ePCRs system. It is also the recommendation of this work to have a devolved approach that will ensure that each cohort can articulate its needs from user’s input as well as those of key stakeholders and rollout the programme in an agile way allowing a series of iterations to ensure the final system serves the purpose it was intended for. As EHRs involve large amounts of information and diverse user group, appropriate legislation governing data protection same as is subjected to Banks, Vehicle Registration and Licensing Body, Voters Registers and Insurance companies be imposed on EHRs systems providers to provide patients the assurance they need that their records will not be abused or used to bias.
LIST OF APPENDICES

- **Appendix 1**: Interview results from activities carried out with a sample of 32 randomly selected individuals drawn from key stakeholder groups on ePCRs.

- **Appendix 2**: Sample redacted interview questionnaire.
REFERENCES


