iPREP

Improving Perioperative Efficiency and Patient Throughput

By

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Declaration

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Doctor of Philosophy is entirely my own work, that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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Conference Presentations

29th January 2015 – Theatre Directorate Beaumont Hospital, Dublin, Ireland (Presentation)

21st April 2015 – Theatre Directorate and Trust Research Team, Queen Elizabeth Hospital, Birmingham, UK (Presentation)

20th May 2015 – Clinical Specialist Quality Improvement Monthly Meeting George Eliot Hospital, Nuneaton, UK (Presentation)

21st October 2015 – Project Presentation to Operating Theatre Teams, The Academic Medical Centre, Amsterdam, The Netherlands

20th May 2016 - Research Roadshow Queen Elizabeth Hospital, Birmingham, UK (Poster Presentation)

24/25th May 2017 – Summer Scientific Meeting Royal College of Physicians, Dublin, Ireland (Poster Presentation)

12th October 2017 – Operating Room Efficiency Conference, Royal College of General Practitioners, Euston, London, UK (Presentation)

22-25th October 2017 – INFORMS (Institute for Operations Research and the Management Sciences) Annual Meeting, Houston, Texas, USA (Poster Presentation)

13th September 2018 – Operational Research Society's Annual Conference (OR60), Lancaster, University, UK (Presentation)

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Glossary of Abbreviations

ACT – Anaesthesia Controlled Time
ADN – Associate Director of Nursing
BBC – British Broadcasting Company
BMJ – British Medical Journal
CCG – Clinical Commissioning Group
CT – Computed Tomography
DCU – Dublin City University Republic of Ireland
ED – Emergency Department
GDP – Gross Domestic Product
iPREP – Improving Perioperative Efficiency and Patient Throughput - mnemonic for project title
ICU - Intensive Care Unit
ITV – Commercial Television Channel in the United Kingdom
KPI – Key Performance Indicator – measurable value the demonstrates how effectively a company is achieving key business objectives
LEAN – Manufacturing Methodology
MeSH – Medical Subject Headings thesaurus used for indexing articles for PubMed
NASA – National Aeronautics and Space Agency – USA Federal Aerospace Agency
NHS – National Health Service in the United Kingdom
NVivo – Qualitative Data Analysis Computer Software Package
OECD – Organisation for Economic Co-operation and Development
ONS - Office for National Statistics
OR – Operating Room (USA abbreviation)
PICS – Prescribing Information and Communication System – developed and used by QEHB
PubMed – Citation Website for accessing Biomedical Literature
QEHB – Queen Elizabeth Hospital Birmingham United Kingdom
QUB – Queen's University Belfast Northern Ireland
RAD – Role Activity Diagram
SCT – Surgical Controlled Time
TPOT – The Productive Operating Theatre Initiative
TQM – Total Quality Management
UK – United Kingdom
US – United States of America
WHO – World Health Organisation

Abstract

Improving Perioperative Efficiency and Patient Throughput

Gerard Doyle

The research has arisen from operational experience of the clinical provision of surgical services. This has led to the main research question

How can efficiency be improved in an Operating Theatre environment?

The research question involves a thorough investigation of the clinical flow process for surgical patients within the perioperative setting. It is hoped that the results of the research will produce recommendations on how to increase clinical productivity across the surgical pathway. Although there is a body of literature on efficiency in Theatres there are few reports on the whole clinical pathway involving all the stakeholders responsible for the service.

The research is case study focused and as such it is set in one of the largest teaching hospitals in Europe. Queen Elizabeth Hospital Birmingham, part of University Hospitals Birmingham NHS Foundation Trust in the United Kingdom has gained recognition as one of the leading hospitals in Europe and has an international reputation for quality of care, informatics, clinical training and research. The hospital provides direct clinical services to well in excess of one million patients per annum. It has over 1200 beds, 42 operating theatres and procedure rooms and a 100 bed critical care unit, the largest co-located critical care unit in the world. The comprehensive nature of the hospital's clinical service provision has provided a very suitable environment to undertake this research programme.

The clinical data requested from the Trust offered the researcher eighteen months of surgery time performance from the Theatre suites. All the data in this research is anonymised. Three intermediate procedures that averaged a one hour duration were selected for review as it was felt that this type of high volume low variety activity would be most suitable for the introduction of a clinical intervention trial.

The performance data revealed regular late starts, delayed turnaround between patients and unplanned, unfunded overruns. This preliminary data set confirmed the impetus for this study.
The stakeholder interviews and the structured observation of the patient flow from the surgical wards to the Theatre suite provided further evidence of the challenges faced in a busy environment to undertake the scheduled work. Stakeholder interviews provided perspectives on the recurring issues from different positions along the patient pathway. The structured observations provided evidence that there are common inertias that impact on the timely transportation of patients to the Theatre suite. These inertias can lead to repercussions for the rest of the scheduled work.

Common themes extracted from the interviews and observations through a coding process include incomplete patient preparation, patients not admitted onto the digital health record system,

unsigned consent forms, incomplete patient notes, unavailable test results, late arriving staff and unavailability of staff for patient escort duties.

These operational constraints influencing patient flow are experienced throughout the global healthcare sector as borne out in the literature review. Most studies have aimed at one particular area to improve performance. This study adopts an over-arching position for 'system led' working. Promoting cohesive working from all the stakeholders responsible for delivering surgical services will shift away from the 'silo' working practices that is evident in healthcare.
These constraints impact on time, efficiency, process and performance.

In this thesis an exploratory case study methodology is employed to examine the constraints affecting patient flow.

This study contributes at three levels. Firstly the identification of the gap in the literature around surgical teams working in cohesion. Secondly the confirmation from the clinical data, the stakeholder interviews and the structured observations that the completion of the planned clinical activity is affected by common inertias. Lastly the researcher offers recommendations for clinical interventions for trial and audit.

Recommendations for Clinical Intervention

1. Link Practitioner
2. Introduction of Turnaround Teams

The recommendations for future trial and evaluation include :-

- The introduction of a **link practitioner** to work between the surgical wards and the Theatre suite. The link practitioner would be responsible for ensuring that the patients were prepared and ready for transportation to the Theatre suite at the allotted time and that all their documentation and notes were in order.

- The introduction of **turnaround teams** in the Theatre suite would allow the Theatre staff involved in the surgery to focus on preparing the instrument sets for the next case rather than having to clean and prepare the room and furniture for the next case as well. The idea of the turnaround teams undertaking the cleaning of the room and the preparation of the equipment and furniture is to reduce the time taken between the end of one procedure and the beginning of the next.

These recommendations are intended to overcome some of the recurring operational difficulties experienced in the surgical services setting and are offered for future integration and for further research.

CHAPTER ONE : INTRODUCTION

1.1 Introduction

There is a long tradition of surgical audit and studies of surgical performance. More recently there are many studies and interventions intended to improve surgical efficiency, usually in terms of throughput of patients in a surgical suite, such as The Productive Operating Theatre (Kasivisvanathan, Chekairi 2014). This is in the context of rising health care costs, and significant pressures on health care systems in developed countries (OECD 2019).

The main research question is:

How can efficiency be improved in an Operating Theatre environment?

The research question involves a thorough investigation of the clinical flow process for surgical patients within the perioperative setting. It is hoped that the results of the research will produce recommendations on how to increase clinical productivity across the surgical pathway. Although there is a body of literature on efficiency in Theatres there are few reports on the whole clinical pathway involving all the stakeholders responsible for the service.

The clinical data requested from the Trust offered the researcher eighteen months of surgery time performance from the Theatre suites. All the data in this research is anonymised. Three intermediate procedures that averaged a one hour duration were selected for review as it was felt that this type of high volume low variety activity would be most suitable for the introduction of a clinical intervention trial.

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The United Kingdom Office of National Statistics (ONS) reported in 2015 that between 1995 and 2008 the NHS has experienced a 0.3% annual fall in productivity with specific focus on improving perioperative clinical efficiency (Appleby, Ham, Imison and Jennings 2010).

There has since been a revision of these figures by the ONS after a revised methodology included a rate of growth for previously unmeasured healthcare activity provided by non-NHS organisations. Improved data sources were used for the revision exercise. The outcome after this reconfiguration and methodological improvements is that productivity has remained broadly constant at 0.6% per annum (ONS 2019).

In the context of this project the original data released by the ONS covering the period 1995 -2008 exhibits an appropriate assessment of the organisational ability of the NHS. This assessment is without the addition of the performance of non NHS institutions which function in the private sector environment. In relation to the extra resource and finance provided for the NHS by the Blair (1997-2007) and Brown (2007-2010) governments these flat line productivity figures are unremarkable. Appleby et al report that real spending in the NHS almost doubled between 1999 and 2010. This uplift in financial resources from both these governments was not met with improved productivity (Appleby, Ham, Imison and Jennings 2010).

A third of Trusts failed to balance the books in 2005-06 leaving the NHS with a deficit of over £500 million. Performance during this period was broadly static (Appleby, Ham, Imison and Jennings 2010).

This Kings Fund paper by Appleby 'Improving NHS Productivity' describes the productivity gap and the NHS options for improvements. Appleby and his team state that either singularly or in combination there are three ways of making up the shortfall in funding; namely reductions in real spending across all departments, increases in taxation or improvements in NHS productivity. The conclusion was that the scale of the reduction in spending and the increases in taxation were so large as to be unlikely options. However a £21 billion gap would only be addressed by a 6% annual productivity target which Sir David Nicholson noted was extremely challenging. This 'Nicholson' challenge between 2011 and 2014 looked to achieve 4% efficiency savings year on year. This had never been attempted before. The previous best performance in the NHS had been 2%. (Health

Select Committee 2010) It was noted that over the decade from 1997 NHS productivity had been flat or slightly negative (Appleby, Ham, Imison, and Jennings 2010).

The research will focus on perioperative service review. The review will describe the current challenges faced by healthcare institutions offering surgical services. The recommendation designed to reduce surgery cycle times will need to be monitored for efficacy and sustainability. In light of the continuing austerity programme that the NHS has faced there remain tangible benefits through the inception of projects that target improving clinical efficiency.

The NHS has already endured a £20 billion savings programme since 2010 and has continued to face further financial scrutiny and stricter control from Whitehall with the election of a new government in May 2015. In 2016 Sustainability and Transformation Plans (STP's) were introduced as part of the 'Five Year Forward Plan' NHS initiative by Simon Stevens, Chief Executive of the NHS as set out in the paper 'Five Year Forward View' (NHS England 2014). This initiative covers the whole of healthcare provision in England. The NHS and local councils in 44 areas covering all of England have met to review healthcare provision. Their proposals were published in February 2017 (NHS England 2017). The proposals are set to reconfigure healthcare services with the emphasis on establishing better care in the community. This proposal suggests hospital closures and centralisation of services such as Accident and Emergency and Stroke Care to fewer sites. The rationale behind these plans is to reduce the NHS budget deficit (£900 million April – December 2016) and ease the pressure on front line services. The Kings Fund has responded to the publication stating that community services are already stretched whilst reducing the number of hospital beds may lead to destabilisation of services after a challenging 2016/17 winter period.

The Royal College of Surgeons commented on a preliminary report from NHS Improvement in February 2019. The report suggested that 300,000 more surgical procedures per annum could be achieved in the NHS through improved patient scheduling in Operating Theatres. The College highlighted that although this was a challenge for all local healthcare institutions throughout the UK, the problem was being compounded by bed capacity management on a general scale. The OECD reported that the UK has the second lowest total number of beds for each 1,000 patients in the whole of the European Union (OECD 2019).

It is clear that scheduling and delivering surgery in UK hospitals remains challenging and is compounded by bed capacity management and staff shortages (NHS Improvement 2019)

1.2 Justification for the Study

Research from the last ten years shows that there is considerable potential to improve patient safety by collaborative team working, for example the work carried out by the Clinical Board for Surgical Safety established in 2008 to advise the National Patient Safety Agency (Royal College of Surgeons 2010).

Effective teamwork and communication lies at the heart of providing safe, efficient surgical care. By paying greater attention to human factors in perioperative practice, significant improvements in outcomes for patients as well as a better and more efficient working environment for staff may be realised.

The operational pressures on the NHS continued to unfold in 2014 as the European economy failed to recover and the traditional winter pressures faced in UK healthcare became a persistent year round challenge.

The BBC reported in November 2014 that the government had released an extra £300 million to address the pressures (Triggle 2014). However the Kings Fund suggested a more appropriate figure required to be in the region of £2 billion. The head of the British Medical Association stated that the extra sum of money was simply a 'sticking plaster'. The same BBC report revealed that that by November 2014 there were 90,000 more patients waiting for an operation than at the same time in 2013.However by the end of November 2014 the government has revised this initial figure of £300 million to £2 billion in line with recommendation from the British Medical Association and the Kings Health Fund.

This upward trend has continued with 18,393 patients cancelled at the last minute for non-clinical reasons in the quarter ending December 2015 and 21,249 patients in the same period ending December 2016 (NHS England 2017).

There remains clear evidence of inefficiency in the NHS operating environment. The Department of Health reported that during the quarter ending 31st December 2019 23,503 operations were cancelled in the NHS. In the same period in 2018/19 there were 20,166 such cancelled elective operations. This represents 1.1% of all elective activity in the quarter compared to 1% in the same period in 2018/19 (NHS England 2020).

The effect of cancellations and postponement of surgery for patients is marked. There will be stress and disappointment for patients and their families associated with cancellations along with issues relating to work timetables, loss of earnings, rescheduling issues, and family arrangements.

This impacts on the strain felt by the service and in its delivery of its goals. This research aims to support stability in clinical provision by improving the surgical patient pathway and contributing to operational efficiency targets. Any reduction in the unsolicited cancellation of operations for non-clinical reasons will be of value to national budgetary management.

Another important factor in driving change has been the effect of the world-wide economic recession from 2008. In 2010 the NHS declared that £20 billions of efficiency savings were required by 2014 as part of the 'Nicholson Challenge'. This challenge was set through a series of mandates by the NHS chief executive David Nicholson (2006-2012) in response to the effects of the global economic crisis and the introduction of government budgetary prudence to counteract the global economic downturn. These mandates focused on asking the healthcare service to find better ways of working as against expecting more funding. Although the annual healthcare budget is ring fenced in the UK the impact of the economic downturn was responsible for this unprecedented request from the chief executive to its workforce

1.3 Research Question

The justification for the research has been to explore the operational process of the theatre environment and describe recommendations for a more efficient approach to perioperative patient preparation and operating session utilisation in a NHS university hospital with the production of recommendations for clinical intervention and audit for review by the wider healthcare research community.

The main research question to be answered is

How can efficiency be improved in an Operating Theatre environment?

1.4 Research Approach

Clinical data from 18 months of Theatre activity which was released to the research team by the Trust. It became evident that there were issues with underutilisation of planned operating time.
A comprehensive literature review was conducted to justify the research and to identify the published work featuring the same issues and projects to tackle the problem. There is a wealth of international published work featuring improvement projects with the Operating Theatre environment. Upon conducting the literature review it became evident that projects undertaken were largely focused on single areas within the surgical patient pathway. There was also evidence that sustainability of projects was challenging. There was also evidence that healthcare is delivered by teams working in 'silos' with reduced understanding and awareness of other teams' contribution to the service.

Our research will take a broader position by looking across the whole surgical patient journey and all the stakeholders responsible for providing the service. This is undertaken to promote a more cohesive service through service review with recommendation of clinical intervention to move away from 'silo' working.

In conducting the literature review we have identified gaps and research problems which have allowed access to the research arena. It has also allowed the research team to construct a conceptual framework which underpins the work presented within this body of work. The conceptual model and process map are presented as a separate chapter. Along with the literature review and methodology chapters the conceptual model and the process map combine to form the foundation of the presented research. By promoting a cohesive service as opposed to the silo working currently practised in healthcare provision this research takes a unique stance in both its recommendation for service improvement and the field work employed to support the evidence.
The research has been approached through the case study medium.

1.4.1 Case Study

Case study has been defined as an intensive, systematic investigation of a single individual, group or community in which the researcher examines in-depth data relating to several variables (Woods 1980).

Researchers describe how case studies examine complex phenomena in the natural setting to increase understanding of them (Heale 2018).

Delivering surgical services in a busy healthcare facility is challenging. It combines strategic planning with clinical delivery using several stakeholders. This complexity is scrutinised by the research team. It will be reported on using research triangulation in the data collection.

Triangulation is a method used to increase the credibility and validity of research findings. By combining methods of data collection the single observer can help ensure that fundamental biases are overcome. Triangulation is also an effort to help explore and explain complex human behaviour using a variety of methods to offer a more balanced explanation to readers. Triangulation enables validation of the data in both quantitative and qualitative studies (Noble 2019).

Central to triangulation is also the notion that methods leading to the same results give more confidence in the research findings (Rothbauer 2008).

1.5 Key Findings

All the data used in this research is anonymised. This has been acknowledged as not eligible for ethical approval by the Trust's research department. Ethical approval was obtained from the Research Ethics committee in Dublin City University.

The 18 months of clinical data from the operating theatres activity provided the preliminary quantitative data set which justifies the research question and position.

Qualitative data collection using the triangulation approach offers the main data set for this research which is supported by the quantitative contribution. The qualitative data has been collected using stakeholder interviews and structured observations of the patient journey from the surgical wards to the operating theatres. In using this triangulated research approach it is intended to present a

broad perspective of managing and delivering surgical services in the challenging environment that healthcare facilities function in.

The clinical data was reviewed and modelled by colleagues from the Centre for Statistical Science and Operational Research at Queen's University Belfast. The data highlighted three main areas in the clinical activity to focus upon. These were late starts, delayed turnaround between patient's on the operating list and unplanned, unfunded overruns. These recurring issues provided the impetus to conduct the research to analyse why these elements of the surgical patient journey were problematic and to formulate clinical interventions to address and improve the efficiency of the service. In speaking with stakeholders from a broad section of operating theatre users it is apparent that most would say their contribution is effective in delivering safe, evidence based practice. However the efficiency and utilisation of the session time available is more challenging for the stakeholders due to the multi-factorial processes involved in the preparation and movement of the patients around the hospital site along with the delivery of the surgery in the operating theatre.

The research team felt that the surgery to concentrate on was intermediate procedures lasting up to one and a half hours conducted in a high volume low variety manner.

Examples of High Volume Low Variety Surgery

- Hernia Repair
- Arthroscopy
- Cataract Surgery
- Laparoscopic Cholecystectomy

The team recognised that there would be little impact on addressing complex surgeries due to the extended time for the surgery involved and the intricate nature of the operations. The stakeholder interviews included surgeons, anaesthetists, operating theatre managers and staff, ward managers and ward staff. There were common themes in the interviews identified by the coding undertaken. These are presented in the Results chapter. These themes identify recurring issues experienced in the preparation, transportation and delivery of surgery with the clinical setting. The literature review undertaken for the research consolidates this position. There is presented evidence in the literature review of the factors that contribute to inefficiency within the operating theatre

environment. These recurring issues have been reflected in the field work undertaken for this research. These common elements that contribute to delays in service provision are presented in the Results chapter.

The structured observation exercise allowed the research team to accompany the operating theatre orderlies around the hospital as they carried out their duties. The research team saw first hand the processes and challenges of preparing, collecting and transporting the patients to the operating suite. It also allowed the research team to engage with the orderlies for their perspective on the service and for recommendations to improve the transportation process.

Central to the key findings have been the production of a conceptual model and also a process map detailing the processes involved in preparing and initiating an operating theatre surgical session and the process of requesting and collecting a patient for the operating theatre from the surgical wards. The use of conceptual models in healthcare has been defined as the abstraction and representation of complex phenomena of interest in some readily expressible form, such that individual stakeholders' understanding of the parts of the actual system and the mathematical representation of that system, may be shared, questioned, tested and ultimately agreed (Tappenden 2012).

The conceptual model and a process map designed specifically to support this research project will demonstrate how these research tools allow the stakeholders involved in providing surgical services to understand the wider concept of the patient flow process and aid the recommendations offered for an improved cohesive service.

The key findings of this research project reflect upon the operational challenges experienced by healthcare practitioners working in silos. The key findings also support the clinical intervention recommendations offered in the project to encourage practitioners to work inclusively and in cohesion whilst moving away from disparate service provision that silo working often affords.

The clinical intervention recommendations that support cohesive working focus on the three main areas of concern experienced by healthcare institutions in delivering consistent surgical services. The published literature featured in the literature review of this research supports this hypothesis.

1. Late starts

2. Delayed turnarounds between patients
3. Unplanned unfunded overruns

The clinical recommendations are

1. Introduction of a Surgery Link Practitioner.

The Link Practitioner will ensure that patients are fully prepared for their surgery and are transported to the Operating Theatre Suite in a timely manner. The preparation will include ensuring patient consent and body marking has taken place, clinical test results are available, they are admitted to the clinical portal (PICS) so that all stakeholders involved in their surgery have access to the patient's medical records and the patient has the correct name band in place and is in a hospital gown ready for transportation to the Operating Theatre Suite.

Link Practitioners in other specialities have proven to support and draw together all the stakeholders involved in the service. This allows delivery of the service to patients in a more controlled cohesive manner. It has been particularly effective for the specialities of Infection Prevention, Health and WellBeing, Chronic Pain and Safeguarding.

Link Practitioners provide support, education and problem solving for the specialist teams. They also assess and manage the patients their speciality is responsible for. They also signpost patients to other supporting agencies and services where necessary. They ensure patients access the best route to the services they provide (Woodger 2012).

In Infection Prevention the link practitioner acts as a link between their own particular area and the Infection Control Team. Their role is to increase awareness of infection control issues in their own clinical areas and to motivate the other practitioners to improve practice. Link Practitioners receive regular specialist training for the teams they are supporting to ensure that they are delivering up to date evidence based practice. They have been shown to be of value to hospital trusts by providing clinical ward audit scores, helping nurses implement policies and by collecting and auditing data (Dawson 2003).

The establishment of a Surgery Link Practitioner to facilitate better surgical patient preparation and timely transportation to the Operating Theatre is modelled on the well established practice and

benefits that link practitioners in other clinical specialities bring to their services. The initial extra resource required to establish the role would need robust audit to monitor for efficiency and effectiveness. The extra resource may be offset by the improvement and financial benefits to the service the link practitioner brings in the long term.

2. Dedicated Turnaround Team

The Theatre Turnaround Team will be responsible for preparing the Operating Theatres between patients. This will involve initial set up for the first patient on the list (surgical trays, theatre furniture). When the first patient's surgery is complete and they have left the Theatre for the Recovery room it will be the Turnaround Team's responsibility to clear away the instrumentation and clean down the furniture from the first case and prepare the Theatre for the next case (new instrumentation and repositioning of furniture if applicable).

This will allow the theatre practitioners working with the anaesthetists and surgeons to focus on their own preparation for the next case rather than having to dispose of the previous instrumentation and clean down and prepare the furniture. It is expected that the Turnaround team's support in the delivery of the operating sessions will reduce the time between patients and the surgical activity and contribute to increased efficiency.

This is not a new initiative; there are European healthcare institutions that already have these teams in place (Beaumont Hospital Dublin Ireland). This project seeks to consolidate this practice and widen their inclusion as a standard feature of the operating team format.

Both these clinical intervention trials require extra resources and audits for sustainability. The research team has undertaken a unique research approach for this project in reporting the operational issues that affect surgical patient flow. These recommendations are available to future research teams for further field work and analysis.

1.6 Thesis Outline

This thesis contains seven chapters.

- Chapter One introduces the research objectives together with the research question and scope of the project.

- Published literature covering the research topic is reviewed and presented in Chapter Two in order to identify the gaps in prior projects addressing patient flow efficiency in the Operating Theatres environment and to consolidate the research methodology and position.
- Chapter Three presents the conceptual model and process map detailing the complex process of surgical patient flow which provided the platform to consolidate the chosen case study methodology and field work undertaken for the research.
- Chapter Four addresses the methodological approach chosen for the research and discusses the philosophical assumptions underpinning this research and provides a detailed overview of the data collection techniques used followed by an explanation of the process used to analyse the data using a case study approach.
- Chapter Five presents the qualitative data analysis findings across the case study underpinned by the quantitative data set from the 18 month clinical data which acted as the preliminary catalyst for the research.
- Chapter Six discusses the main contributions and findings of the study. There are clinical intervention recommendations to reduce patient flow delays. The similarities and differences to previous projects are also reviewed. In comparing and contrasting prior research projects the differences have supported the theoretical assumptions and contributions of the study. There is also discussion on the limitations of the study alongside directions for future research teams to trial the clinical intervention recommendations in the Operating Theatre environment.
- Chapter Seven offers the conclusion of the project and highlights the contribution and novelty of the research along with the recommendations, limitations and direction for future research.

Figure 1: Thesis Chapter Outline

1.7 Conclusion

The first chapter of the thesis has provided information about the research topic by introducing the background of the research area along with the research question and the research approach. There is also a resume of the key findings of the research. A thesis outline detailing the structure of each of the chapters to follow concludes the chapter.

In the following chapter a review of the current literature will be set out. The literature review will provide evidence of the existing research conducted around improving perioperative patient flow. This evidence will be critiqued for validity and project sustainability. Gaps in the published literature will be identified and provide the opportunity for new research and critical thinking. The literature

review remains the gateway to a project's progression as it provides a solid platform from where the project's chosen focus will grow and unfold into a doctoral body of work. It is expected that researchers undertake this literature review as the acknowledged starting point for projects in recognition of the traditions of the academic community.

CHAPTER 2 LITERATURE REVIEW

2.1 PURPOSE OF THE LITERATURE REVIEW

A literature review is defined as both a summary and an explanation of the published knowledge of a chosen limited topic (Royal Literary Fund 2019). A literature review is a search and evaluation of the available literature in a given subject or a chosen topic area. The Royal Literary Fund state there are four main objectives of a literature review:-

1. It surveys the literature in a chosen area of study
2. It synthesises the information in that literature into a summary
3. It critically analyses the information gathered by identifying gaps in current knowledge by showing limitations of theories and by formulating areas for further research
4. It presents the literature in an organised way.

Hence, this literature review is required to allow readers to access high quality research relating to the chosen subject for review that is relevant, meaningful and valid to the research and be contained in a complete report. This literature review provides a starting point for the research by focusing on the summary and evaluation of past and present original work. The review highlights key findings and sets a direction for future research. It also identifies inconsistencies and gaps in the literature which prompts new and novel research to be conducted. Further, it ensures that research will not be duplicated. Additionally, it provides an opportunity to analyse the methodologies and approaches of other researchers in a constructive manner.

Articles relating to past research into perioperative operational performance and patient throughput were selected and evaluated. By using established medical databases such as PubMed and the Cochrane Library with specific keywords to identify suitable papers, the review adopts an international perspective. The selected papers have been organised by identifying patterns and developing subtopics. The key feature of a good literature review is to focus on analysis rather than being descriptive. In consequence, after each theme in this literature review there is a critique of the published work included.

In conducting the literature review it was apparent that although there have been many operating department improvement projects undertaken, too few have looked at the problems from a global perspective. Many projects have focused upon a particular clinical area or section of the surgical patient journey. The emergent facts concerning the previous research from the published literature have identified a gap in the knowledge base. Thus, this project provided an opportunity to undertake the research over a wider scope by looking at the whole patient journey commencing from the point of admission within the healthcare facility. By adopting a broad approach to the methodology and data collection this research project identified a gap that allows clinical recommendation and intervention to promote a robust cohesive service.

Literature reviews are traditionally 'open' throughout the period of the research study. This allows the researcher to remain familiar with the pertinent professional literature on the chosen subject and allows for new important papers published during the lifetime of the research period to be included. Accordingly, continuing to assimilate emerging knowledge within the literature review served to consolidate the platform for this new research project.

The themes of the literature review were chosen to offer an overarching view of the main challenges in establishing a cohesive surgical service.

The review contains four generalised themes and two more specific themes related to the research topic.

Productivity in both the private and public sector with additional review of productivity in the healthcare sector served as the opening generalised theme (Theme 1) of the literature review. Following on from this, Theme 2 is a generalised review of change management with particular focus on people, processes and technology. Theme 3 focused on specific systems for introducing change and reviewing papers that have engaged in individual clinical interventions and testing of their hypotheses. The final theme (Theme 4) reviews specific LEAN processes both in Industry and the Healthcare Sector and offers an evaluation of further clinical projects that concentrate upon improving perioperative efficiency and patient throughput.

As a result, the literature review was conducted to report on the published professional research surrounding perioperative patient flow and operational efficiency in surgery. There was little

evidence of previous research reviewing the whole surgical patient pathway or of mentoring the stakeholders involved in the pathway to work as a cohesive unit. This legitimate gap in the literature gave access to the new research delineated in this work.

2.2 INTRODUCTION

The literature review follows on from the introductory objectives of the opening chapter, featuring the abstract and chapter delivery of the project, and will provide evidence of the existing research conducted around improving perioperative patient flow. This evidence will be critiqued for validity and project sustainability. Gaps in the published literature will be identified and provide the opportunity for new research and critical thinking. The literature review remains the gateway to a project's progression and provides a solid platform from where the project's chosen focus will grow and unfold into a doctoral body of work.

2.2.1 Search Strategy

The review examined the main constructs around improving productivity in the private and public sector as well as the outcome of interchange initiatives. The papers selected for this literature review demonstrated projects that introduced clinical interventions into perioperative practice that have been evaluated for review.

The review also set out the academic disciplines required for the research to be established. The systematic literature review was conducted using a structured thematic literature search plan.

The key search words and phrases initially used were: 'surgical scheduling' 'perioperative efficiency' 'The Productive Operating Theatre Initiative' 'process mapping' 'productivity' and 'patient flow'. Others were added as the review took place, these included 'private sector efficiency programmes' 'public sector operational processes' 'operational transfer initiatives' and 'attitudes towards organisational change'. The medical databases PubMed.gov and MeSH (medical subject headings), the Cochrane Library, Clinical Key and Science Direct were used to undertake the initial review. Web based institutions were accessed. The NHS Institute for Innovation and Improvement supported by NHS Improving Quality, which assists the NHS in transforming healthcare for patients by developing and promoting new working practices and the introduction of technological advancement, was much used. News agencies were regularly reviewed for current issues in health including the BBC, Sky News and ITV reports on the latest health initiatives. The research librarian at QEHB assisted in accessing medical journal databases. A regular compendium of articles were received from all the

selected journals via email. Titles selected included The Lancet, The New England Journal of Medicine, The British Medical Journal and the Health Service Journal.

2.3 THEME 1: PRODUCTIVITY

In the context of underpinning this research we established a strategy to present a literature review that covered the global manufacturing perspective with particular focus on productivity. Healthcare systems are widely recognised as more complex than manufacturing, banking and education (Braithwaite 2014). This complexity presents operational challenges that are experienced across all these sectors both in the private and public setting.

Private sector initiatives have brought about profound change in organisations and their operational capabilities since the global recovery post World War II (Bohanon 2012). In North America production continued in unaffected factories unscathed by war. This was a geographical advantage, due to Europe and Russia being the main arenas of World War 2, that North America fully exploited. Bohanon substantiates the claim that this growth was unprecedented in North America despite warnings from economists Paul Samuelson and Gunnar Myrdal that the surge in the post war labour market after demobilization would lead to mass unemployment and industrial dislocation. Moreover Bohanon verifies that these fears were unfounded as the factories previously designated to produce munitions reverted to producing domestic appliances (e.g. toasters) to meet increasing demand.

Europe and the Far East however were hampered in their economic recovery by the ravages of the war campaign. Japan in particular endured several years of strong negative balance of trade. Japan was supported by the USA in returning to a positive trade balance. Dr Deming was invited to speak to Japanese engineers about improving quality and productivity across their manufacturing processes. Dr Deming's philosophy inspired the Total Quality Management (TQM) initiative used in the 1970's and 80's by both the USA and Japan as the global economy emerged. He also offered 14 key principles to managers for transforming business effectiveness (Deming 1982).

Influential public sector productivity initiatives have been witnessed in the Apollo space programme of the 1960's (Loffs 2019) and the NHS Plan of 1990 (BBC 2002). British Aerospace also demonstrated innovation in the 1990's before it became part of the BAE Empire (Wikipedia 2019). Lean and Agile ideology developed from Toyota's manufacturing principles of the 1950's drives e-commerce institutions such as Amazon in current business trading (Intelligent Node 2016). The

productivity of a manufacturing business or service sector describes the productiveness of the individual institutions' outputs. Productiveness is a measure of the institution's state of being productive. Productivity is generally considered to be the institution's capacity to produce.

2.3.1 What is productivity and how is it measured?

Productivity is defined as the efficient use of resources, labour, capital, land, materials, energy and information in the production of goods and services. Improving productivity means accomplishing more with the same amount of resources or achieving higher output in terms of volume and quality from the same input. This is usually expressed as Output/Input = Productivity (Ministry of Employment, Immigration and Civil Status Republic of Seychelles 2019).

The following statements represent how the effectiveness of the productive effort can be influenced

1. If more labour is hired more output is achieved (increasingly competing with advances in automation and miniaturization)
2. However the original labour group may be used more efficiently
3. New technology adopted that increases the amount of output per labour

Source: Business Dictionary

Improvements in productivity through innovation are crucial in maintaining market share and survival in a competitive world market. Innovation may be achieved through improved working practices which are often supplemented by the introduction of new technologies. Tucker (2009) validates the priority of innovation driving growth by reporting the results of a survey of 399 global executives by PriceWaterhouseCoopers who ranked innovation as their top strategic challenge. Engaging in innovation by both private and public sector institutions remains paramount in achieving robust trading and survival in the harsh global economic environment. (Tucker 2009). In 2020 as the global economy treads carefully away from years of austerity the primary focus for competitive businesses remains innovation.

The OECD Oslo Manual 2005 defines the following

1. “Product Innovation – introduction of product or service that is new or significantly improved
2. Process Innovation – implementation of a new or significantly improved production or delivery method
3. Organisational Innovation – implementation of a new organisational method in business practice, workplace organisation or external relations”

(OECD 2005)

This framework extracted from a leading authority on innovation activities in industry clearly demonstrates the need for institutions to remain resolute in their business activities. There is no longer room for complacency for enterprises, if indeed there ever was. Business practices from previous decades bear this out; the UK motorcycle industry is a graphic example. Japanese bike makers overtook the world market with innovative motorbikes that surpassed the UK models for design, cost and performance (Alexander 2008).

There is also little agreement between the business community, politicians and the media on what productivity growth actually is. The term is frequently promoted as the solution to improving living standards. Economists see productivity in its rawest sense as the efficiency that the economy converts inputs into outputs. However productivity does not reflect how much we value the outputs. It only measures how efficiently we use our resources to produce them (Productivity Commission Australia 2015).

For the purpose of this research the following definition of productivity is being used

> ‘Productivity in Industry is recognised as the measurement of the productive effort. The labour force, machines, workplace and systems within an organisation combine to convert inputs into useful outputs measured as values. This productivity value is calculated by dividing average output per period by the total costs and resources consumed.’
>
> (Business Dictionary 2019)

Productivity is a critical determinant of cost efficiency. Public sector cost efficiency in health is paramount in maintaining control of the health budget. Productivity contributes to the long term

objectives of an organisation. Long term objectives for organisations are seen as performance goals intended to be achieved over a period of five years or more and also include specific improvements in the organisation's competitive position, technology, leadership, profitability, employee relations and corporate image (Business Dictionary 2019).

Although there are many commonalities, business models function differently when comparing private and public sector provision (Mazzucato 2015). Private sector business aims to achieve profitability and return on investment. Public sector business is conducted from central funding and must provide guarantees for service provision and values. Profit versus Value for Money needs to be considered. In both sectors there is pressure on managers to continue to deliver results. Productivity initiatives are regarded as essential in maintaining performance and results (Hvidman and Andersen 2013). The core recommendations of this project focus on initiatives to improve productivity for a public sector service. In these austere times with ever increasing demand for services, it makes perfect business sense to provide value for money whilst ensuring customer satisfaction.

2.3.2 Private Sector Productivity Improvements

United States of America

Field (2003) comments in the American Economic Review on the productivity improvements witnessed in the United States of America from 1929 to 1941. He calls this period the most technologically progressive decade of the 20th century. This period is virtually aligned to the Great Depression (1929 – 1939) which began with the sudden devastating collapse of the US stock market in October 1929. Field puts forward the view that during the depression government contractors and businesses had opportunity to introduce new technologies and practices resulting in the 'highest measured peacetime peak to peak multi-factor productivity growth in the century' Field also suggests that this period enabled the US to expand and replenish unexploited technologies which served as the platform for the labour and multifactor productivity improvements witnessed in the 1950's and 1960's.

Gongloff (2002) reported that the 1950's and 1960's saw the US increase its productivity by an average 2.8% per annum in the private sector. The newly developed interstate highways of the 1950's were principal drivers in this sustained growth. From 1970 - 1995 productivity dropped below 2%; however it rose again above 2.5% from 1996 as fibre optic technology and the rapid expansion

of the Internet influenced the US global position. The paper reports that the increased productivity resurgence in 1996 allowed companies to make goods using fewer resources which keep consumer prices lower. This means consumers buy more goods and improve their living standards. When even more goods are sold, the companies will need to hire more labour to produce more goods and this in turn increases demand which creates a very positive economic landscape. However with the global population approaching 8 billion there remains concerns and contradiction between capitalism and its effect on limited natural resources (Movahed 2016).

United Kingdom

The United Kingdom suffered a period of stagnation during the 1920's after an initial boom in 1919 to 1920 post World War I. Without mass production facilities and still reliant on gold standard, which made UK exports expensive, the UK struggled to match their American counterparts. Production and productivity remained at the lower threshold due to a lack of consumer demand (Baten 2016). The intervening years, 1930 to century end, witnessed an undulating economic performance in the UK. In the 1950's and 60's successive governments were influenced by 'Keynesian' economics after the wartime coalition government paper in 1944 'White Paper on Employment' committing future peacetime governments to stabilising income at its full employment level. Over the following thirty five years 'discretionary' fiscal policy helped the economy to maintain a permanently high level of employment. This discretionary approach saw frequent changes to government spending and taxes (Healey 1993).

Periods of growth and improved productivity, between 1945 and 1960 as the UK recovered from the devastation of World War II, were matched by periods of economic malaise in the 1970's with rising unemployment, frequent strikes and severe inflation (Healey 1993). The downturn experienced in the UK economy demonstrates that there is not necessarily a correlation between productivity and the public good.

The 1980's and 1990's saw the Tory government increase the number of service providers whilst reducing the power of trade unions. They also introduced a privatisation programme for some sections of the economy. They also reduced manufacturing and heavy industry. Thus began a period of outsourcing the manufacturing of 'British' products in foreign locations which continues today. However despite these changes the intervening years witnessed a period of sustained growth and prosperity. This has been attributed to the stability achieved via revenues from North Sea Oil (Healey

1993). However this was unsustainable due to limited reserves and revenues from the oil fields of the North Sea.

This rise in productivity and growth was continued by 'New Labour' from 1997 onward in an unchecked global economy culminating in the 2008 global recession from which the fall out is still reverberating in 2020. It is clear that the elected party of the day (Tory 2010 – present) have many challenges to face (Matthijs 2011).

Productivity and the return to a strong manufacturing base will be essential for the UK as it faces up to Brexit in 2021 when it will conduct its business outside the European economy for the first time since January 1973 (Ries 2017).

Global Economy

The last thirty years have seen the rapid development of far eastern economies and their increasing position and share of the global markets. China and India in particular have been at the forefront of this challenge. The emerging markets of Brazil and Singapore are also influencing market share. The increasing potential of the African states Angola, Nigeria and South Africa should also be factored into the distribution of the global economy players.

The traditionally affluent west has seen a re-balancing of the world economy driven by global communications, multinational companies and a shift in production from traditional bases to countries with cheaper labour and production costs. China and India have been at the forefront of this economic revolution. This phenomenon has driven down production costs and allowed more competitive pricing. Increased sales due to availability and price of goods have had a positive effect on the profitability and stability of the private sector players. The UK has been instrumental in this phenomenon. When the Tory government re-balanced the economy in the 1980's and reduced the country's manufacturing base a large number of companies realised the potential of producing their goods abroad in a more competitive manufacturing environment. Large employers in the UK automotive industry experienced factory closures and production moves abroad. Even UK economy stalwarts Marks and Spencer closed factories producing their quality clothing in the UK and moved their production base to the far east (Kimura and Obashi 2016).

Productivity Improvement Methods

Using change management practice to streamline organisations with guidance to perform more efficiently is a common business tool. However what appears straightforward in the planning room does not always transfer successfully into operational practice. There have been many programmes designed and introduced to tackle efficiency and improve productivity. Introducing new ways of working for workforces in organisations is complex. Success of change programmes are reliant on a good leadership team who are able to motivate their teams through the change process. There also must be regular and relevant audits of new programmes to reassure teams and to monitor whether progress is being achieved.

Change can be the foundation of competitive advantage but, to be effective, a change management programme must identify areas of potential conflict, address the needs of everyone in the organisation and, crucially, bridge the gap between the aspirations of executives, technical project teams and the people affected by the change (Managers.org.uk 2015)

Productivity in the private sector, often thought as time and motion, is all about using resources effectively and efficiently as possible. The resources of an organisation can be considered to be divided into three categories

1. Time, people, talent and knowledge
2. Information, systems, finance and energy
3. Land, buildings, equipment, space and materials

Productivity improves for organisations when they get more out of their existing resources or the same out of fewer resources thereby increasing capacity, reducing cost, improving response and eliminating waste. Organisations need to be both effective and efficient. Being effective means doing the right thing whereas being efficient means doing things right. Being productive means doing the right things well all the time (Scott Grant 2019).

Paul Krugman, Professor of Economics and International Affairs at Princeton University, shares a widely held view about the importance of productivity

> ‘Productivity isn’t everything, but, in the long run, it is almost everything. A country’s ability to improve its standards of living over time depends almost entirely on its ability to raise its output per worker’
>
> (World Bank Blogs 2019)

Key Performance Indicators (KPI's) are a common measure used to monitor productivity. KPI's are a measurable value that demonstrates how effectively an organisation is achieving key business objectives. High level KPIs focus on the overall performance of the business, while low level KPI's focus on the processes in areas such as sales, marketing and human resources (Klipfolio 2019).

Only by accurately measuring work can organisations begin to improve activity and processes. Any business needs to have measures that together point towards an improving, static or worsening situation. To assess performance in business organisations need to review various measures – no single measure will suffice. Performance can be measured at several different levels (cars per year, cars per week, man hours per car). Most importantly performance should be measured and monitored over periods of time that are appropriate to the business (Scott Grant 2019).

Sahdev offers examples of both outstanding change management programmes alongside those initiatives that had poor delivery. Barclaycard's efforts to downsize in the light of increasing competition utilised research on survivor syndrome. However there was too much focus on those leaving the company as against those who were retained. Although the underlying theme was to protect future jobs by downsizing, this proactive measure by Barclaycard was met in a negative fashion by the 'survivors' (Sahdev 2004).

In contrast SKF UK, a leading engineering company managed their enforced change programme effectively by adopting a 'Lean' initiative. This involved shifting the operational responsibility down to blue collar workers giving them the empowerment to take action to eliminate waste and improve quality. Management supported this by investing in an education programme for all staff to enable engagement in new skills. The acquisition of these new skills was rewarded with extra pay. Compared to the survivors of Barclaycard, the workers who remained at SKF UK were more committed to the company (Sahdev 2004).

2.3.3 Public sector change management

Greenwood and Hinings argue that an organisation's institutional context can limit the possibilities for change especially when an organisation is embedded in a wider system that has tightly coupled relationships (Greenwood and Hinings 1996). The effect of the tightly coupled relationships is felt both in the private and public sector. Healthcare centres contain communities consisting of specialities that interact in their daily business. These specialties are typically established through

individual clinical and managerial needs. This can deter change programmes when individual speciality administration and equilibrium is challenged.

The public sector has also contributed to innovation and change over the last fifty years which has witnessed the development of transferable relationships with private sector businesses. The United States Apollo space program conducted in the latter half of the 20th century was instrumental in driving forward technological advancement with considerable economic significance. These advances included the further development of integrated circuit technologies, telemedicine, cordless power tools, and vacuum packed food. (Dick 2016)

2.3.4 Health Sector Productivity Improvements

The Brookings Institution is a non-profit public policy organisation based in Washington DC USA. They conduct in-depth research to solve problems facing society at local, national and global level. From the Brookings Institution, Sheiner and Malinovskaya's (2016) review of the literature concerning productivity in healthcare leads them to conclude that productivity is generally seen as improvements in quality rather than reducing costs. They argue that analysts believe productivity growth is perceived as lower than in the rest of the economy as a whole due to measurement problems. Innovations such as moving in-patient to outpatient care are not captured in the standard measures.

Other analysts believe that even when properly measured productivity growth in the health sector is low because it is a service sector and therefore has limited scope for efficiency improvements. This is indicative of Baumol's cost disease argument from the 1960's based on string quartets playing Beethoven. They argue that it takes the same amount of musicians to play the musical piece regardless of the era. However the remuneration of the musicians has greatly increased since the 1900's. The health sector workforce falls into this category. The time it takes to apply a bandage to a patient's arm is fairly constant as it relies on the movements of the human body which cannot be engineered to perform more efficiently as is the case with computers and machinery.

They termed the phrase 'cost disease' to describe the phenomena of rising salaries in jobs that have experienced no increase of labour productivity. This is in sharp contrast to industries and organisations that have experienced labour productivity growth. Baumol has enlarged his theory with an updated report on why computers get cheaper and healthcare does not. He argues that

there should be a shift of resources from goods produced by the progressive sector to services produced by the stagnant sector. This is regarded as a huge political challenge (Baumol 2012).

The Skills for Health Foundation state that measuring productivity in healthcare in the UK is problematic and complex. Crosswaite, Hall and Lawson's (2011) report states that this situation is prevalent in healthcare as outputs are varied and not easily reduced to a single outcome or indicator. This means the traditional methods used in the private sector to measure productivity do not always transfer over to the public sector organisations. Also institutions are difficult to compare and contrast as there is little standardisation across the UK and Europe in general. With the workforce accounting for 70% of the cost in the UK healthcare sector, there should be a greater emphasis on increasing the skill set and efficiency of its members.

This can be achieved by practitioners delivering their core skill set in a consistent manner and through positive workforce planning. With focused planning, each group of practitioners will work better as a unit if they focus on delivering their core skills rather than over reaching their performance which diminishes the group's impact. Successful planning will deliver improving outputs as long as the groups are regularly reviewed for efficacy and adjustments are made to address issues that arise from the incorporation of the programme.

The report looks at turnover and wastage in the healthcare sector and also explores understanding productivity and performance. Further, the report makes valid points about the difficulties faced in measuring performance and with introducing a re-balancing of labour when improvement programmes are introduced by organisations.

2.3.5 NHS Plan

The NHS Plan of 1990 was a significant milestone in the NHS business model. The plan introduced an internal market to increase competition for services and drive up quality of provision.

Prior to this a monolithic bureaucracy ran all aspects of the NHS. By the fourth decade of the NHS (1978-1987) there was growing acknowledgement of the clear financial bounds within which the NHS operated. The NHS had become a victim of its own success. It could no longer even pretend to do everything medically possible. More people were being treated in more complex ways which led to rising expectations of the health service in an increasingly elderly population with all its attendant needs. Beginning in 1978, the winter of discontent, the service's financial problems were worsened by the oil crises. NHS management tried to improve efficiency and there were continued attempts

to set priorities between the sectors of the NHS, the elderly, the mentally ill and the acute services. In 1982 restructuring occurred to simplify the organisation. 192 District Health Authorities became responsible to Regional Health Authorities. 7 Special Health Authorities continued to manage London postgraduate teaching hospitals whilst the 90 Family Practitioner Committees persisted unchanged. (Rivett 2019).

The NHS Modernisation Agency set up in 2001 typifies the new focus on improving healthcare provision and engaging with the organisation's users. Their goal was to introduce a sustained change where 'new ways of working and improved outcomes become the norm' (NHS Modernisation Agency 2002). The introduction of the Plan had a significant impact on treatment delivery and waiting times.

'Improving Working Lives' 'Work Life Balance' 'Agenda for Change' 'The Productive Ward' 'The Productive Operating Theatre' 'LEAN' are a sample of initiatives introduced within UK healthcare practice since the introduction of the 1990 Plan. Although the Modernisation Agency promoted sustained change, in real terms some of these initiatives were too short lived and ineffective. These initiatives were perceived as 'change for change's sake'.

A colleague working in the NHS worked diligently with his staff to achieve the 'Improving Working Lives' accreditation only for it to become an obsolete initiative a few months later. Buchanan suggests that inconsistency in project completion or change of delivery agents with different agendas will produce organisational 'churn' and will undermine change (Buchanan 2007).

Changing governments contribute to the 'churn' effect. The responsibilities for funding the NHS shift too. In 2015 the main NHS budget holders became the General Practitioners and Clinical Commissioning Groups (CCG's). This new wave of administration introduced in 2013 saw the disbandment of the Primary Care Trusts after 12 years of service.

Healthcare think tanks and specialist level consensus perceive the NHS as suffering from a prolonged 'change fatigue' phenomenon compounded by a failure to settle (Buchanan 2007).

Ham reported that the introduction of the NHS five-year sustainability and transformation plans (STP's) in late 2016 face major challenges in transforming care and balancing budgets. The King's Fund paper reported that their assessment of the draft plans for STP's reveal a financial gap running into hundreds of millions by 2020/21 in the absence of eye–watering efficiency programmes. This stark warning reflects the severity of the challenges faced by the NHS in achieving its improved efficiency whilst managing its budgetary restraint. (Ham 2016)

2.3.6 SUMMARY OF THEME 1- PRODUCTIVITY

Despite fears from leading economists in the western economy regarding the immediate post-war period circa 1945, the USA witnessed sustained growth. Europe and the Far East took longer to re-establish their positions in the global economy due the devastation caused by six years of military action. The USA had remained largely unscathed due to its geographical position and its late entry into the campaign.

With Japan struggling to improve their manufacturing base, the USA provided expertise from leading businessmen to support their recovery. Through initiatives led by Toyota's business models they established a manufacturing base through prudent use of LEAN processes. With productivity at the helm of manufacturing models, Japan is an exemplar of tackling the economic challenges of the second half of the 20th century. Its motorbike industry is a prime example. It overtook the UK motorbike manufacturing industry by producing innovative performance bikes at competitive prices. In comparison the UK, previously the market leaders, were slow to respond to the competition and lost ground.

NASA engaged in an extensive space programme during the same period which led to many innovations that are in common use today. Solar panels, LED's, cordless vacuum cleaners, memory foam and vacuum packs for food are examples of the technological advances delivered through the NASA space program. There are many more.

This US government funded agency in tandem with the private sector has invested in science to drive global innovation forward.

In the public sector setting, productivity and a competitive approach to operational performance has been promoted in the UK healthcare sector since the early 1990's. This approach has improved service delivery and reduced waiting times through increased investment achieved by individual institutions' performance. However there have been well documented failures too where healthcare institutions have focused purely on achieving targets at the cost of providing best patient care. Too many short lived local and national healthcare initiatives have also contributed to imbalanced service provision.

The demands for health services in the UK from an increasingly elderly population are putting pressure on the finite budget. With the increasing pace of medical research and innovation

providing better treatments for people there is a persistent pressure on the annual health budget. There has never been a more appropriate time for the health sector to review its processes and practices to incorporate improvement strategies.

The Model Hospital programme was introduced in 2018 by NHS Improvement. Model Hospital is a strategic data and information tool to support improvement. It is a digital information service designed to help NHS providers improve their productivity and efficiency. The Model Hospital provides the broadest and most comprehensive view of NHS operational productivity to date (Ashby 2018).

Measuring productivity effectively in healthcare provides challenges. These measuring challenges in productivity require researchers to gauge the value of services provided, but this poses special challenges in health care. The consumption or utilization of health care services and the market price of those services (two easily-measured quantities) offer only limited information as to the value a patient receives from medical care. Many services don't have a clear relationship with improved health, and many expensive treatments are no more valuable than low-cost care. For example, medical (drug) treatment for stable angina (chest pain) is, for most patients, just as effective at relieving pain as medical treatment plus angioplasty, a surgical procedure – and the surgery is both invasive and expensive. Using the amount spent as a metric for value when comparing an angina patient who received medical management alone to one who had medical management plus angioplasty would incorrectly suggest that the patient who underwent angioplasty enjoyed better health. And even when researchers measure patients' actual health, it's difficult to attribute improvements to a particular treatment. The problems inherent in measuring the value of health care have prevented markets from providing effective signals to clinicians or patients about which treatments to use and which to avoid (Brownlee 2013).

Do productivity initiatives work in UK publicly funded universal health care institutions? Is it just a case that healthcare practitioners are known to be effective in the care they deliver and do not need to address being efficient as their services and care are free at the point of entry for patients.

The USA healthcare model is very different to the UK and their healthcare institutions are largely privately run. 58% of community hospitals are non profit, 21% are government owned and 21% are for profit. Access to the health facilities are through private insurance schemes or through government based programs (American Hospital Association 2016). It is a very unequal service where emphasis is on rationing by exclusion (uninsured and underinsured), out of pocket costs for

the insured, fixed payments per case to hospitals (resulting in very short stays) and contracts that manage demand instead (Wikipedia 2019).

These two different approaches to delivering healthcare provide confirmation that not only do healthcare systems lack standardisation across the global setting but the care itself is of variable quality. The NHS Plan of 1990 served to emulate the USA model by encouraging competition for health provision whilst retaining the public funding of the service. The plan was designed to stimulate the health service and improve patient waiting times and outcomes. It was a bold move by the then Conservative government.

The World Health Organisation ranks the UK as 18th and the USA as 37th in their 2018 World Health System rankings. San Marino, Andorra and Malta make the top five with France and Italy as the top two rankings (Patient Factor 2019). These lowly rankings for the UK and USA would suggest that there is still progress to be made in providing cost effective, efficient healthcare in these G7 countries.

2.4 THEME 2: CHANGE MANAGEMENT– PEOPLE, PROCESS, TECHNOLOGY

At the heart of initiatives to improve efficiency and productivity there will be an element of change management. Change management is seen within business communities as any project that realises progression for individuals and teams as well as whole organisations. The level of change can affect resources, business processes and budgets and can significantly redefine a company or whole organisation.

Change is multifaceted, evolves fluidly and is never linear (Slater et al 2016). Change projects introduced into organisations are challenging. For the teams introducing the change there is the task of inspiring colleagues to readjust working practice. For the workforce asked to accept the change there is the challenge of adapting to the new model both individually and collectively.

Slater, Evans and Turner (2016) also comment on the social psychological paradigm known as ‘the social identity approach’. This refers to the psychosocial mechanisms that influence an individual's cognitions and behaviours in collaborative contexts. Psychological bonding between colleagues is seen as an important factor during times of change.

2.4.1 People

Those tasked to deliver change management projects must encourage individual members of their teams to develop meaningful attachment to the whole group. When this occurs, their thought processes and actions attune to their social identity (AdarvesYorno, Postmes, & Haslam, 2006). Employees will think and act for the group cause. The organisational change will become aligned and individuals will make decisions for the benefit of the group. Those members who do not feel an attachment to the group will typically think and act for their individual cause. Their perspectives can be based on unchallenged hypotheses and their conceptualisations do not factor in the importance of group dynamics.

Willis et al (2016) reviewed sustaining organisational culture change in health systems. They identified six guiding principles:

- align vision and action;
- make incremental changes within a comprehensive transformation strategy;
- foster distributed leadership;
- promote staff engagement;
- create collaborative relationships;
- continuously assess and learn from change.

These principles interact with contextual elements such as local power distributions, pre-existing values and beliefs and readiness to engage. Mechanisms influencing how these principles sustain cultural change include the activation of a shared sense of urgency and fostering flexible levels of engagement.

However there is evidence that many change management programmes are internally contradictory and confusing, and often lack empirical evidence. This has resulted in poor outcomes for projects (By 2005). Slater suggests both the planned (Bamford & Forrester, 2003) and emergent (Kotter, 1996) approaches to change management focus primarily on leaders developing a strategy, rather than engaging with the groups involved at the outset of the project. The social identity approach seeks to develop the psychological connections between groups involved in change.

There needs to be a global approach to projects that involve groups of workers within organisations. Developing a strategy, whilst failing to engage the recipients of that strategy, demonstrates a top

down managerial style. This top down style of management has its critics but has been widely witnessed in modern business practice. Both the private and public sector has felt the impact of this style of practice across many professions (Ladds & Gray 2017).

In the NHS there have been many initiatives piloted since the NHS Plan of 1990 introduced by the conservative government. The Plan attempted to convert the provision of health into a marketplace group of providers who would compete for 'customers' (patients) with their services. While there were improvements, the Plan ultimately ended up as a performance-led service with the focus on achieving targets rather than delivering the best of clinical care. There were catastrophic events for patients and their relatives as a result of the campaign, most notably at Stafford Hospital. Due to concerns of poor patient care the hospital was investigated by the Healthcare Commission in 2008 after they were alerted to the apparently high mortality rates in patients admitted as emergencies (Healthcare Commission Mid Staffordshire Hospital Enquiry 2009). This led to a full public enquiry called for by the new government in 2010. The subsequent Francis report in 2013 stated that the Healthcare Commission 2009 report was based on mortality statistics which was an unreliable measure of avoidable deaths. The report did make 290 recommendations and Mid Staffordshire Trust was de-authorised by Monitor, the NHS national moderator. The public enquiry highlighted examples of the poor care within the Trust that were well documented in the national press (Francis 2013).

Several reviews ordered by the government revealed the failings of ill-guided organisational performance. This evidence suggests that the continual desire to invent and introduce new strategies into healthcare has left the organisation in a state of 'change fatigue'. This has evolved from projects being abandoned as staff move throughout the organisation due to promotions and also projects being re-structured by staff stepping into other peoples roles as they rise in the hierarchy. For the recipients of these projects and for those expected to deliver the new ways of working there exists a degree of complacency. This has developed due to the large volume of projects across the whole of the organisation coupled with scepticism from the 'shop floor' to the top down approach and repeated change. Introducing change can also be seen throughout an organisation as protection of individual positions rather than as a strategy for improvement.

A good commentary on change management in healthcare and its effect on the practitioners at the receiving end appears in the book 'Dismantling the NHS?: Evaluating the Impact of Health Reforms' (Exworthy, Mannion & Powell 2016) with particular reference to the change management programme introduced by the coalition government of 2010 -2015. David Nicholson, the chief

executive of the NHS in 2010, is quoted as suggesting that the healthcare reforms pending in the Health and Social Care Act of 2012 'would be seen from space' (Greer, Jarman & Azorsky 2014). These claims certainly bring attention to a pending project launch. The reality that follows the introduction of reform can be less grandiose than asking the occupants of the international space station whether they have noticed anything different in their observations of earthly healthcare provision in England. This Act became known throughout the service as the 'Nicholson' effect. There have been chief executives both before and since Nicholson's era who have marked their tenure with new legislation that the NHS must adopt.

Whether all this legislation and change serves to drive the service forward is debatable. Think tanks and commissioning groups rarely agree on what is the best policy. There is a line of argument that suggests that the politicians at the head of the NHS use their position to consolidate their own strategies and reputations rather than serving for the good of the public (Greer 2016).

2.4.2 Business Models

Alongside change management for organisations there has been a large number of groundbreaking business models introduced in recent times. In particular the private sector has engaged in delivering new ways of operational agility with their new approaches overturning 'old school' business models. The book 'Business Model Generation' is a collection of these new models with 470 contributors from 45 countries. It explains the building blocks employed by private sector companies that are required to succeed in competitive world markets. The design and strategies of a selection of the recent top performers is demonstrated in the book. It provides a concise record of how these companies have restructured the traditional business models to maximise their share of the world markets. Unbundling, Long Tail and Multi-Sided Platform models are described in the book and show the benefits of creating a new approach to commercial ventures.

Google, Apple and Skype are all featured to demonstrate their ability to create and deliver new ways of working and challenge established business models. Alongside these young companies older institutions such as Lego (established in 1949) are featured to show how they keep their business model evolving and effective. This has been achieved by utilising online access to its customers to allow bespoke Lego kit ordering.

Free and Freemium business models are described. Free business models are where a product is freely distributed and financially supported by advertisers for its revenue streams. Metro

Newspapers from Sweden is one of the quoted examples in the book. This approach has been adapted by Facebook who target its users with tailored advertising through recognising online activity. At the end of 2016 there were 1.86 billion users on Facebook. This market share represents huge opportunities to connect and advertise to consumers across the globe.

Freemium models offer free basic products or services with additional subscription to paid premium services. Flickr the photo sharing website and Skype are examples of the Freemium approach where a small percentage of paying customers support the larger customer base using the free basic product. The success of this model is due to the balance between the average cost of supporting free use and the rate at which free users convert to premium paying customers.

There is a description of the organisation centric versus customer centric approach to business models. The value of shifting from the business to the customer perspective is explained. This is relevant in both private and public sector organisations and is something the NHS has worked towards in recent years. However competitiveness implies winners and losers. This is neither ethical, pertinent or desirable in the provision of healthcare.

How do organisations know how the public perceive their products and services? There are a variety of methods available for organisations to capture and gauge the response to their business model and product/service delivery. Customer surveys, text messaging, comparison websites, online customer reviews and secret customer reports are representative of the methods used by organisations to maintain a customer centric approach.

These methods have delivered useful information from customers that shape future company activities and delivery of products and services. Both the private and public sector evaluate their performance in this manner and reap the benefits of gathering this type of data.

In the private sector the use of secret customers has evaluated a product or service in a discreet and unobtrusive manner. This allows an objective rating for the quality of a product or service to be recorded. When the customers are incognito within the chosen organisation the products, services and employees reveal a snapshot of performance that can be reviewed and rated by the management team.

It works well for all manner of businesses, in particular the service sector, restaurants, public houses, theme parks and leisure franchises. Data covering food and beverage choice, favourite clothing, holidays and even energy suppliers is captured and analysed by organisations to remain customer savvy. In such a competitive global market it has become essential business practice.

In 2014 Zuboff warned that surveillance capitalism is now a novel market form that underpins the digital world. This new form of capitalism uses digital technology by providing free services that are used worldwide. The providers of these services can monitor the behaviour of the billions of users in astonishing detail and often without their explicit consent. This allows the providers to customise and shape the services offered to users of digital platforms (Zuboff 2019). One broadsheet reported upon this phenomenon with the headline 'The goal is to automate us'

The technological ability to understand people's likes and dislikes promoted by social media platforms such as Facebook and WhatsApp shifts the market playing field away from traditional sources of advertising and revenue. These platforms now possess the ability to sway and influence product placement to millions of users. This development was not foreseen upon the introduction of these platforms and is something the directors of these companies have been reluctant to discuss openly (Zuboff 2019).

This degree of public scrutiny is not suitable for the healthcare sector for obvious reasons. Private medical records are indeed private and only accessible by those delivering care with authorised access. Heavy penalties are in place for those accessing medical records of patients who do not have explicit permission.

In the public sector there are methods available to review customer's opinion on the quality of the services experienced. The phrase 'How well did we do today?' is ever more part of the culture of gathering public opinion. There needs to be caution and the right balance in collecting and reviewing the information in this manner. This avoids customer complacency which can result in a reduced information stream.

In healthcare, the patients can give feedback and review services. They are supported by the Patient Advisory Liaison Service who will advise and manage complaints regarding the delivery of care. The local advisory service plays an important role in acting in the best interests of both the healthcare facility and the patients.

Duty of Candour was introduced in the NHS in 2014 which is a contractual obligation for healthcare institutions and practitioners to provide service users and other relevant persons all the necessary support and information if a patient safety incident occurs. This is further supported by the obligation to report the incident and to allow investigation to occur. Patient safety incidents are varied and unique to individual service users and relatives (National Health Executive 2015).

Some incidents are categorised as 'never events' and include wrong route administration of medications, wrong site surgery or insertion of wrong implants and retained foreign bodies post-surgery.

Duty of Candour is an important addition in the patient liaison service provided by healthcare institutions. There is now an improved formal process in place for meetings and discussions between healthcare practitioners and patients with their relatives to discuss the care received.

It is clear that there are different business perspectives in the private and public sector setting. However relationships with their respective customers have a similar focus. Increasingly both sectors are engaging with their customer base to identify performance and value across the services they provide. Accountability and redress are increasingly seen to build confidence for customers in both sectors (Smoje 2016).

2.4.2 Silo Working v System Led Service

Silo Working – Silo Mentality is a mind-set that occurs in organisations, which is inward looking and resists sharing information and resources with other people or departments within the organisation. This leads to inertia in service delivery.

System Led Service – The delivery of individual healthcare packages for patients from several different providers within the hospital setting should be cohesive, timely and effective.

Removing silo working within UK healthcare remains one of the great challenges for improvement teams to address. Despite the drive to improve healthcare provision in a sustained way since the introduction of the NHS Plan in 1990, there remains an isolation culture within healthcare where the focus of clinical delivery is narrowed down to either individual practitioner responsibility or as a small group initiative. What is required however is for clinical services to be delivered as a collaborative package of care within a 'whole system' approach. Dr Atul Gawande stated in his Reith Lectures that healthcare practitioners are very adept at working as individual specialists but where health services in general falter is when these specialists fail to work together as part of a cohesive system (Gawande 2014).

2.4.3 Change Management Process

A review of the processes involved in a change management programme is key to understanding how manufacturing and the service sector improvements unfold. The final step in the change management process should be an after-action review. It is at this point that those involved in the change process can stand back from the entire program, evaluate successes and failures, and identify process changes for the next project. This step should be part of the ongoing, continuous improvement of change management for the organization and ultimately leads to a change in competency.

These elements comprise the areas or components of a change management program. Along with the change management process, they create a system for managing change. Good project managers apply these components effectively to ensure project success, avoid the loss of valued employees and minimize the negative impact of the change on productivity and a company's customers

A recognised technique for discovering the production process is to map the process. This mapping exercise will break down the whole performance of an operation into individual segments. These segments are interlinked with each other and combine for the overall effect of the production process.

Reviewing the relationship between each segment becomes a chain of events culminating in the whole process. The skill of mapping is to understand the segmental relationships and identify areas to target for revision and improvement which will impact on the whole process. Scrutinising these segments in processes has successfully demonstrated the value of enquiry. Enquiry promotes exploitation of segments to encourage efficiency by remodelling established process behaviour.

The technological advances in industry, healthcare and communications over the last fifty years have transformed the economic and social landscape. There still exist many inequalities between developed and underdeveloped nations but in general there has been a shift in the distribution of power and wealth toward nations that adopt the sophistication of the developed ‘West’. China and India are two nations who have experienced rapid expansion in economic growth supported by the West’s appetite for quality products at an affordable price and Western companies relocating to the Far East to take advantage of cheaper labour and materials costs.

The advances in communication and transportation have supported this migration. Global business performance is now a crucial factor in modern commerce. Failure to compete at this level will run a risk of hampering a secure business model. However we must consider if globalization is an

inevitability or the only model available. Anti-Globalization is supported by the neo-liberal anti-globalization movement. The movement is opposed to large multinational corporations having unregulated political power exercised through trade agreements and deregulated financial markets.

Specifically, corporations are accused of seeking to maximize profit at the expense of work safety conditions and standards, labour hiring and compensation standards, environmental conservation principles, and the integrity of national legislative authority, independence and sovereignty. As of January 2012, some commentators have characterized changes in the global economy as "turbo-capitalism" (Edward Luttwak), "market fundamentalism" (George Soros), "casino capitalism" (Susan Strange), and as "McWorld" (Benjamin Barber).

Many anti-globalization activists do not oppose globalization in general and call for forms of global integration that better provide democratic representation, advancement of human rights, fair trade and sustainable development and therefore feel the term "anti-globalization" is misleading (Bowles 2016) (Wikipedia 2019).

How does technology support change management? There are certainly a great many informative online tools to assist businesses in preparing process maps. These maps can be prepared for review by the employees of companies with clear instructions as to what they reveal and what options are available for positive change.

There is a large volume of published literature on change management from different sectors of the business community. Both the published books and papers chronicle past projects and provide support for future engagement in change management work. They also provide commentary on project failures and the reasons for these failures. The importance of this literature needs to be acknowledged. Projects that focus on improving the whole process by intervening at a particular stage may ignite unforeseen issues with another stage of the process. This leads to further complications and may add to the addressed problems rather than solving them.

The success of any intervention is reliant on the engagement of good change management within the organisation. Once the clinical intervention to be introduced is identified, its success will depend on ‘buy in’ from the clinical teams along the interface pathway. Projects do fail in healthcare. There are many contributing factors; a common reason is the failure of stakeholder collaboration toward the project which leads to poor outcomes in the intervention phase. There can also be issues with project complexity and poor measuring systems.

Change management is challenging. Alongside the perceived benefits exist reservations and threats both to individuals and specialities. The intervention recommendation needs 'buy in' across all the stakeholders involved in surgical services. The intervention would need to be assessed for relevance and impact at regular intervals during its inception. Sustaining any improvements made during the intervention is vital for the long-term success of the project and is the most demanding aspect of change management culture. The recommendation of an intervention provides opportunity for further research in this field

2.4.4 Technology

There needs to be close scrutiny of any changes introduced in the production process to review efficacy and sustainability. The experience in the UK healthcare sector is of projects either failing to deliver their intended benefits or of incomplete maturation due to managerial team movement (Albliwi, Anthony, Lim & Van der Wiele 2014).

Technology can assist those involved with managing change. Academics from Business Schools in the global educational community relate and offer advice on their experience of change management programmes (Martin & Siebert 2016). These academics have access to a huge bank of material and data available via their online library facilities. Webinars also support the process. These take place over the internet and may take the form of presentations, lectures or workshops that can be viewed over the web. This allows a broad worldwide audience to engage in the broadcast and presents an excellent teaching and learning environment.

The technology selected to assist with change management needs to be suitable for the requirements of the project. Above all it would be appropriate for the technology to be peer reviewed for suitability within the context of the change project proposal. During the change process there should be room for review and adaptation if required. This will assist in overcoming unforeseen issues with the change programme. The management of the change should involve the whole community of workers who will be affected by the change (Martin & Siebert 2016).

Theme 3 presents published projects conducted specifically to improve surgical services provision. The selected reviews support the aims of this research. It is also evident that there are gaps within the published work allowing for new research into the establishment of system led healthcare provision.

2.4.5 SUMMARY OF THEME 2 – CHANGE MANAGEMENT

The commentary in Theme 2 of this Literature Review underscores the validity of the research question. If efficiency in patient flow through the operating theatre is to be achieved then practice must be reviewed and redirected. It is evident in the literature covered that past projects have achieved improvement. However the consensus remains that these projects have targeted single areas of the patient pathway. This presents gaps in the research and an opportunity for this project to explore the impact made by the stakeholders responsible for the surgical services working as a single unit rather than as separate isolated specialities. The intellectual progression of the project will build upon this body of published literature. This new and relevant research will establish the currency and novelty of the project along with the introduction of new interpretations of past operational innovations.

Slater comments upon the complexity of managing change processes. Change in working practices requires determination from the team driving the change and 'buy-in' from the workforce it affects. Organisational reshuffling is required in modern commerce to remain ahead of competitors. In the 24/7 global economy there is little space for complacency in business performance. Competition remains fierce at every level. The protection and development of business territories is experienced both in the private and public sector domains. Slater (2016) in his commentary is precise and serves to enlighten those entering into change management policy of the challenges ahead. In the UK, healthcare operational process management has suffered from 'churn' due to the continuous introduction of initiatives driven both by a fluctuating managerial structure and individuals protecting their domains. This is well documented in the literature (By (2005), Ladds & Gray (2017), Exworthy (2016)).

It has been regularly experienced by the author over the 30 years in post.

Osterwalder and Pigneur (2010) produced a book titled 'Business Model Generation'. It is a book compiled by 470 business practitioners from 45 countries. It reports on new ways of conducting commerce in the 'digital' age. Today's commerce is increasingly processed and delivered via technology and increasingly Artificial Intelligence (AI). An MIT Technology Review from April 2018 reports that organisations that are engaging with AI are increasing operational efficiency, making faster, more informed decisions and innovating new products and services.

Consumers are increasingly engaging in digital 'online' shopping for goods and services as opposed to traditional methods and are able to pay in virtual money through apps and platforms i.e. Apple Pay, PayPal, Google Pay.

Skilton (2017) substantiates that AI is driving what is known as the fourth industrial revolution – the development of new technologies that bridge the physical, digital and biological worlds.

However despite being at the leading edge of innovation, the reliance on these new technologies present their own shortcomings for businesses and consumers alike. Fraud, cyber crime, fake goods, theft of business and personal details such as account details and pin numbers along with the spread of 'fake news' over the internet are the precautionary consequences of opening up world commerce to digital platforms. The 'dark' internet has grown in tandem with the worldwide web and created sophisticated opportunities for criminal activity.

Silo versus System working is one the main themes that drives this research. Gawande (2014) reiterates the belief that healthcare practitioners work well as individual specialists but not necessarily well as teams in a cohesive approach to healthcare provision. The same can be said of the bigger health systems too. Hospitals and Social Care in the UK have been criticised in recent years for not working together to provide the best opportunities for patients to leave hospital after treatment in a timely manner and benefit from social care (Triggle 2017).

2.5 THEME 3: SYSTEMS FOR INTRODUCING CHANGE IN SURGERY

2.5.1 Planning Surgical Activity

The planning of operating room activity is an important phase of delivering surgical services. A study from Belgium by Van Reit and Demeulemeester from 2014 reviewed the literature on operating room planning featuring both elective and non-elective patient categories. They identified the principal sources of variabilities that impact on clinical productivity in surgical care. These range from late arrivals of patients, medical staff and medical notes and test results, variability in anaesthetic times, surgical duration and turnaround times between cases. These issues are well documented throughout the literature surrounding perioperative operational process and efficiency (Van der Lans 2005) (Tancrez 2013) (Wullink 2007) (van Essen 2012).

Also it must be stressed that this work has been done in many different settings e.g. by surgical speciality, single centre and multicentre institutions. This large differential in the setting of the reviewed papers impacts significantly on comparing like for like inter-institution comparison. (Van Reit et al 2014).

The basis of surgical provision is to provide both the effective and efficient delivery of procedures to patients. The project management triangle of good, cheap and fast refers to the quality, cost and delivery schedule of an institution's operational projects. Although they are all interrelated, it is not usually possible to optimise all three during the establishment and delivery of a new product or project. One aspect of this triangular relationship may well be neglected in favour of the chosen operational viewpoint.

2.5.2 Fast Track Surgery in Latin America

Betancur looked at Fast Track surgery programmes to optimise time in low complexity procedures in Latin America using failure modes and effects analysis with before and after process measurements and comparison of surgical times. At a single healthcare institution, their study and implementation produced a positive effect on clinical provision. The scope of the project targeted realistic areas of non complex surgeries to address the efficacy drivers whilst preserving patient safety. Prior to the study 50% of all activity started 23 minutes late on average. Throughout the programme, this improved to see anaesthesia induction time reduce by 50% and surgical skin to skin time reduced by 28%. The scope of this research is limited to the operating theatre suite, however their interventions produced a positive impact on both anaesthesia and surgery timings. (Betancur 2015).

2.5.3 Operating Room Initiatives

In UK operating rooms, these initiatives have included Six Sigma, LEAN and TPOT (The Productive Operating Room). These initiatives have looked at improving performance through four areas of quality – safety and reliability of care, team performance and well-being, value and efficiency and patient outcomes and experiences.

Whilst these projects made tangible improvements to clinical efficiency and patient safety, a paper from 2016 independently examined LEAN's influence on healthcare. Moraros et al critiqued over 1,000 peer reviewed papers on LEAN that included quantitative data. After a screening process only

22 papers met the researchers' criteria. This was based on a review of the selected papers' methodological criteria. All the papers reviewed were judged to be of low quality design using before and after studies without control groups. The paper reports no long-term studies have been conducted. Furthermore, the evidence indicates there is no statistically significant association with patient satisfaction and health outcomes using LEAN processes. The paper recommends further research using more rigorous higher quality research methods. (Moraros et al 2016).

2.5.4 Single Centre Study, Rome, Italy – Barbagallo

A single centre study was carried out by a multidisciplinary team based at Bambino Gesu Children's Hospital, Rome, Italy. Barbagallo et al looked at the optimization and planning of theatre activity suggesting that OR activity and resource contributed up to 40% of total costs in a modern healthcare facility. Therefore, the optimization of activity should inherently be a universal objective. Their paper focused on cost effectiveness whilst maintaining patient care. This was achieved by concentrating on optimizing planning and scheduling of OR activity. There was also prudent comment on the variability and unpredictable nature of surgery. The team used a process model configuration to capture activity with scrutiny of flow, timings and resource involvement. An increase of 30% in scheduling patients was achieved with an additional 20% increase in OR activity seen when the model was tested in the clinical setting. Defining the scheduling operation into a standard pathway which accounts for all the variables is desirable for optimal planning of clinical provision. Their conclusions suggested that precise scheduling improved waiting list management. More significantly they identified that this management is both interactive and a bi-directional dynamic process (Barbagallo et al. 2015).

2.5.5 Academic Medical Centre Amsterdam Study

An extensive study on multidisciplinary teamwork in operating room practice was published in June 2015. Van Veen-Berkx et al conducted an eight-year study at eight intuitions in Holland looking at how encouraging multidisciplinary team-working impacted upon improved use of the operating room. The paper focuses on poor inter-professional collaboration and the teams' project to improve on this. The project implemented cross- functional teams to encourage multidisciplinary working which focused on improved scheduling practices and use of operating room time. The cross-functional teams included theatre staff and ward representatives and met on a weekly basis (Van Veen-Berkx et al. 2015).

An accompanying paper by the same authors in the Health Organisation and Management Journal from May 2015 consolidates the progress of their project and provides commentary to reaffirm that the cross-functional teams improved clinical efficiency by abandonment of functional silos. The paper stresses the predicaments that face modern healthcare institutions in that they must continue to seek ways to simultaneously improve the quality of care, efficiency and patient safety. The Dutch healthcare growth in costs is reported as being driven by medical advances detecting disease at an earlier age so the population are treated earlier and for longer (Bitter et al 2015)

2.5.6 Block Scheduling

A combined European study from France and Italy introduced block scheduling operating sessions. These are fixed surgical speciality sessions and are not interchangeable. The term 'block' in the scheduling process refers to a fixed amount of time per operating session defined by hour of day. These blocks are assigned to the surgical specialities by request. The Addis et al paper describes the two main sources of uncertainty in surgical scheduling as identified in the literature; these are surgery duration and patient arrivals. They advocate a rolling horizon approach to scheduling patients into the blocks. This utilises Integer Linear Programming for the scheduling and rescheduling of patients to combat surgery time variance and disruption during the sessions. It is a flexible approach in establishing good utilisation of available operative time. The paper concludes that coordination of surgical scheduling and bed management are optimised. This research presents a sophisticated approach in addressing the variability and uncertainty of scheduling. Managing bed capacity in healthcare institutions directly correlates to the challenge of proficient surgical scheduling (Addis 2016).

2.5.7 Systems Approach in Surgical Services

This literature review covers a range of implementation projects from an international perspective. However, it remains evident that the research into a system led approach is restrictive. This is due to projects being undertaken in isolated areas, theatre suites and admission units.

This research project is reviewing the whole surgical journey from admission onto the surgical wards to the Theatre reception. By looking at the relationship between the contributing clinical departments that engage in the surgical services the research will identify where interventions can be introduced. Upon review of the interventions and their impact on the service, any positive

findings may provide robust recommendations for improving the cohesion between the clinical departments.

Pandit, JJ and colleagues have written several papers about theatre utilization and its measurements. In response to the generally recognized light-hearted paper 'Operating theatre time, where does it all go? A prospective observational study',Travis et al, published in the seasonal edition of BMJ in December 2014, they advocate a total theatre time when addressing efficiency. This time is defined as the start of the anaesthetic to arrival of the patient into the recovery room. This represents the core indivisible unit for scheduling operations (Pandit JJ 2014). This is a very pragmatic acknowledgement of the multifactorial issues surrounding theatre list scheduling when considering overall utilization. In this research, expansion to a system led approach extends further from the perioperative phase to include patient admission and preparation. The core proposal of this project is to unite the individual components of the patients' surgical journey with a better-connected delivery.

There are many examples of published theatre improvement papers that scrutinize operational performance and provide guidance on intervention to increase productivity.

A study from Worcester Massachusetts looked at the activity of the UMass Memorial Medical Center (UMMMC). The centre has 17 operating rooms that deal with 10,000 patients per annum. Against an external benchmark of 70-80% utilization, the UMMMC was achieving 65% at the start of the study. The research team addressed this by introducing a linear programme to improve case duration estimates and thereby improve the utilization of the block scheduling system employed by the hospital. This was used in conjunction with a binary integer programme which challenged 'slack' time. Slack time is the difference between total block time available and total operative time scheduled. By reducing this time, the centre would move towards the external benchmark figure for utilization and match the industry standard. Optimisation of the scheduling process realised a 13% increase in utilization for the chosen surgical specialities. This paper demonstrates the benefit of service review with intervention recommendations. Service improvement based on the success of intervention is dependent on managing constraints and sustainability (Carroll et al 2014). Whilst the paper recommends a strategy to increase utilization it remains insular in observing activity within the operating room only, without addressing the contributing external factors that influence overall OR performance.

A study by Cardoen et al reviewed the literature on planning and scheduling in the operating room. They suggested that managing theatres is a complex process due to conflicting priorities and stakeholder preferences. As operating rooms are the largest cost and revenue centres in hospitals, the authors stress the need for adequate planning and scheduling. This will cope with an increasing demand for surgical services and improve efficiency. Their review of the papers identified that the majority looked at elective surgery planning. Little emphasis is placed on unscheduled emergency patient provision. This patient group exerts a large influence on overall planning and utilization. An ageing population creating increasing demand for services will need to be considered. Stochastic activity and its impact on theatre practice are also singled out for future review (Cardoen et al 2010).

A paper from University College London Hospital looked at the timings of certain tasks within orthopaedic arthroplasty surgery. With the median cost of theatre time in the UK calculated as £16 per minute it remains vital to the financial integrity of healthcare institutions that surgical services are cost effective. This was a single centre study covering 20 patients. Although this is a small population, the recommendations of the paper are transferable to larger cohorts of patients. The tasks included surgeon hand washing, patient preparation and transfer for positioning alongside administrative duties (checklist and note writing). The study also assumed there will be two surgeons present per case to facilitate the recommendations of the paper. This is another limitation as the presence of two surgeons may not be feasible in other institutions. Two surgeons will allow parallel processing of tasks required to undertake the surgery thus reducing the time taken to complete the procedure. This paper uniquely looks at the overall contribution of the surgeons to the team dynamic. More participation from surgeons in the overall performance of tasks is critical in improving surgical efficiency (Volpin et al 2016).

Van Riet and Demeulemeester (2014) reviewed the existing literature published on planning elective and emergency surgery from 1990 to 2014. Whilst they substantiate the variabilities that affect patient flow through the operating rooms, there is little evidence offered on stakeholder ‘buy’ in to promote cohesive working. This omission relates and drives the focused research undertaken in this thesis by exploiting the gaps in the theory.

These variabilities include late arriving patients, missing medical notes, delays in support services and equipment preparation, duration of surgery and duration of upstream and downstream activities (length of stay).

Given these listed variabilities it is evident that one step to improve surgical service provision would be the promotion of stakeholders working together to achieve common goals. This hypothesis formulates the foundation of the research question and its focused aim.

Van Riet and Demeulemeester searched the Web of Knowledge (now known as the Web of Science) for papers relating to non- elective surgery which is the main focus of their research. They highlighted the different scheduling processes used in healthcare institutions to manage their surgical services workload.

Their review focused on the OR literature that directly impacted or explicitly considered non-elective surgeries. They reviewed the means that the non-elective patient category should be taken into account in the operational or tactical decision making. It included both research on tactical allocations (capacity) as well as operational patient scheduling. Mainly papers that used (technical) operations research techniques (mathematical modelling, simulation) were discussed. Papers reporting on data-analysis were included if the focus was on a comparison between (the implementation of) different policies. Other managerial papers were not classified, but are mentioned when they provided specific insights. Papers that deal exclusively with non-electives in the up- and downstream resources such as the ED and the ICU were not included in the classifications. Disaster management was also considered to fall outside the scope of their review.

Only a few papers made an enhanced comparison between a flexible and a dedicated policy. Van der Lans (2005) looked at anticipating urgent surgery. Tancrez (2013) reviewed the randomly determined nature for sizing operating theatre capacity. Wullink (2007) questioned whether closing emergency operating rooms would improve efficiency. Van Essen (2012) proposed minimizing waiting times for emergency surgery.

In the patient scheduling literature, they noted a lack of consistent designation of patient categories. The following terms were all used to describe patients who cannot be scheduled well in advance: emergent, urgent, add-on, work-in and semi-urgent.

In the UK, some institutions still have to juggle their elective work with presenting emergency surgeries. The required access to an operating room that emergency surgery patients need will impact on the scheduled elective patients and may cause delays and cancellations. At QEHB there are dedicated emergency theatres to manage the non-elective patient flow. This is similar for other large institutions across the UK. Alongside the 24/7 availability, increasingly consultant surgeons have a work plan that incorporates a commitment to emergency surgeries. Typically they will be ‘on

call' for a week's duration where they will be free to perform emergency surgery without any commitment to elective work. At smaller hospitals this may not be the case as they manage their emergency patients on and during elective surgery sessions. This may mean that surgeons are not available to complete their elective surgery commitment and elective patients may be cancelled on the day. There are more small hospitals than larger institutions in the UK so cancellations are commonplace for elective surgical patients. Waiting times for surgery have returned to 2007 levels. Investment in sharper practice and commitment to on time surgery is paramount for these ever increasing waiting times.

Bentancur (2015) looked at fast track surgery. However in a single healthcare institution there is little evidence offered as to its potential for transferability to other domains. 50% is reported to be reduced from anaesthesia induction times. There is no clear indication of how this was achieved and no appraisal for the patient safety considerations during a shortened induction period. Sustainability of the improved times is not reported. It is too isolated in its format and delivery. No impression of its impact in the wider context is offered by the authors. However it provides impetus to inspire future researchers to broaden the scope of enquiry.

Moraros (2016) reviewed LEAN systems in healthcare. He concluded that only a very small proportion of the papers reviewed met the required standard. A large proportion of projects suffered from poor design and lacked control groups. As there were no long-term project reviews or statistically significant improvements in patient satisfaction or health outcomes, Moraros recommended using more rigorous higher quality research techniques to report on future projects. This paper provides opportunities for future researchers to employ robust techniques in their research methodologies. In respect of the research described in this thesis it has allowed access into the operational process research arena through contemporaneous field work and data synthesis.

In recent times there has been a drive by researchers to introduce better planning of scheduled operations by involving multi-disciplinary approaches from stakeholders responsible for delivering surgical services. Papers from Barbagallo and the work conducted at the Academic Medical Centre in Amsterdam clearly define the tangible benefits achieved by advanced planning of scheduled surgical activity through engagement of the various agencies responsible. Bitter (2015) confirms the improvement of establishing cross functional teams in the Academic Medical Centre whilst moving away from functional silos. These operational process initiatives have served to inspire this research project by offering a platform to continue to improve the surgical patient throughput. The intention

of this project is to continue to broaden the working relationships of the stakeholders to work in unison and move further away from the silo environment.

There are a small proportion of papers dealing with the introduction and promotion of 'system' led surgical services. Of those papers reviewed for this literature review the work conducted at Worcester Massachusetts at the UMass Memorial Medical Centre saw a linear programme of scheduling pitched against a binary integer programme monitoring 'slack' time to address productivity. (Carroll 2014).

Cardoen (2010) focused on reporting that the majority of the published work focused on elective surgery with little consideration for the emergency surgery provision. This is especially valid with an ageing worldwide population who will require more emergency surgery access. By moving away from functional silos toward stakeholder cohesion, the management of the complexities and fluctuation of surgical services provision will be less challenging.

Volpin (2016) conducted a small project looking at the advantages of two surgeons per operating room engaging in dual processes. This is a worthy contribution to the published research. However it requires extra resources in providing extra surgeons. Not all healthcare institutions have access to funding to allow for the expansion of their surgeon cohort.

2.5.7 SUMMARY OF THEME 3 – SYSTEMS FOR INTRODUCING CHANGE

Theme 3 reviews international projects that have introduced change and new ways of working to perioperative practice. These projects address the underutilisation of both elective and emergency surgery operating theatre session times. This review has produced a broad spectrum of published work on improving operating theatre practice. Key findings from the review are the clinical areas and processes involved in the improvement programmes along with commentary on project audit and sustainability pressures.

This review has confirmed that further investigation into the processes involved in delivering surgical services is legitimate by widening the scope of the clinical research to produce an overarching representation of the processes and practitioners involved in the service and recommendation for more cohesiveness.

2.6 THEME 4: LEAN IN INDUSTRY AND HEALTHCARE

2.6.1 ORIGINS of LEAN

Although the origins of LEAN can be traced back to the 1450's and the Venetian Arsenal it was the early part of the 1900's that witnessed an expansion of its capabilities. Henry Ford is credited as the first to truly integrate an entire production process in 1913. His 'Flow Production' technique married interchangeable parts with standard work and moving conveyance. His process sequencing in the fabrication of car parts directly to line side using special purpose machines broke away from the general purpose machines widely used at the time in the shop practices of the American System. Ford however only offered one type of car, the Model T. When clearly there was consumer demand for more models and options, other manufacturers responded. This led to faster machines producing the components but longer throughput times as the processes were not linked or automated. The time lags between process steps and car part routings required ever more sophisticated information management systems culminating in the computerised Materials Requirements Planning (MRP) system (Lean.org 2017).

Private sector initiatives have influenced profound change in organisations and their operational capabilities since the global recovery post World War II. North America production continued in unaffected factories. The ravages of the war however hampered Europe and the Far East. Japan in particular endured several years of strong negative balance of trade.

The Toyota car company in the 1930's and again more intensely after World War 2 reviewed the Ford approach to production. The Toyota Production System was developed featuring simple innovations to the Ford way of manufacturing. These innovations were designed to provide both continuity in process flow and a wide variety in product offerings. Their innovations consisted of shifting the focus of manufacturing from individual machines and their utilisation to concentrating on the flow of the product through the total process. This shift looked to right-sizing the machines for the actual volume needed with self-monitoring built in for quality control. Together with lining the machines up in the process sequence and pioneering expeditious set-ups so each machine could make small volumes of many parts, each process step would notify the previous step of its materials requirements. The combination of these simple interventions introduced a process that was able to produce goods that were low in cost, of high variety and quality with rapid throughput times that responded to changing customers' needs. Information management also became simpler and more accurate (Lean.org 2017)

Japan was supported by the USA in returning to a positive trade balance. Dr Deming was invited to speak to Japanese engineers about improving quality and productivity across their manufacturing processes.

Dr Deming's philosophy inspired the TQM initiative used in the 1970's and 80's by both the USA and Japan as the global economy emerged. The LEAN philosophy had spread in manufacturing by the 1980's with the likes of the General Electric Company making progress. 'The Machine that Changed the World' gave an account of the history of LEAN. The book also gave rise to the term 'LEAN Manufacturing' (Womack, Jones, Roos 1990). The scope and benefits of adopting the LEAN initiatives into the workplace was taken on by manufacturing enterprises across the world.

LEAN principles have successfully transferred into the service sector and healthcare settings. The Food, Airline, Financial and Education sectors have all introduced LEAN. Influential public sector productivity initiatives have been witnessed in the Apollo space programme of the 1960's and the NHS Plan of 1990.

2.6.2 LEAN Cataract Surgery

The Rotterdam Eye Hospital in Holland engaged in a LEAN programme to increase efficiency in their cataract surgery service in 2010 in the light of growing demand.

Van Vliet et al reported on the programme in their paper published in the BMJ Quality and Safety journal. 616 patients formed the prospective group and 591 patients were included in the historical group. The service provision underwent a streamlining exercise with initial patient consultation and pre-assessment for surgery becoming a one stop event. Nurses conducted telephone reviews with the patients which reduced visits to the hospital and did not impact on the surgeons' schedule. Improvements in efficiency were measured by recording how many times the patients visited the hospital and by how many more patients could access the pathway due to improved processes. In the LEAN group, patient visits decreased by 23% and patient access to the pathway increased by 42%. Due to the standardisation of surgical approach in cataract surgery, the Rotterdam Eye Hospital continues to be an exemplar of best practice in surgical provision (Van Vliet et al 2010).

2.6.3 LEAN and SIX SIGMA in Surgery

Mason et al reviewed 124 papers on LEAN and Six Sigma interventions in surgery in 2014. Of these 23 papers were suitable for inclusion demonstrating the use and utility of both methodologies in

surgery. There was a broad range of outcomes which the paper collated into six common themes which included operating theatre efficiency and reduction of costs and length of stay. The authors reported high levels of systematic bias and imprecision within the selected data sets although 88% of the papers demonstrate improvement. The authors suggest more high quality studies into LEAN and Six Sigma are required with less systematic bias to further understand their role in improving surgical efficiency. This further supports the work of Moraros et al in reporting the limited effect these initiatives have made on healthcare (Mason et al 2014).

2.6.4 Scheduling Anaesthesia Time

Another study by van Veen-Berkx et al in Holland focuses on the impact that anaesthesia time has on the overall surgical patient journey. A new method of scheduling anaesthesia-controlled time (ACT) was introduced in 2012. Seven predetermined time frames (0-6) constructed from historical data were introduced into an academic hospital setting to consider the varying combinations of anaesthetic techniques. This information was included in the patient pre–op electronic care plan. It was a large study of 35,000 cases. The ACT time involves both induction and maintenance of anaesthesia up to surgical positioning and emergence time from anaesthesia when dressings are in place. The intervention proved beneficial in the preparation of equipment for each of the seven types of anaesthetic and in promoting parallel processing. It was also valuable to trainees and students who could now identify in advance where certain procedures would occur in a busy medical centre. The study is limited to one intuition and emphasises that clinicians are not good at predicting scheduling times. The surgical-controlled time (SCT) remains the area to deliver better standardisation of process and greater utilisation of session time, however the study does show that predictable ACT time in conjunction with SCT leads to fewer case cancellations and a lower rate of prediction errors. A smoother workflow has emerged from the project whilst challenging existing scheduling methodology (Van Veen-Berkx 2016).

2.6.5 Patient Changeover Times

A single institution study from Australia in 2012 looked at reducing turnaround times between patients. The study was conducted at the Wagga Wagga Base Hospital in New South Wales. This was achieved by improving preparation of the team prior to surgery and by the surgical registrar becoming more actively involved with the theatre team to ensure a faster turnaround and patient throughput. This improvement strategy focused on the surgical registrar directly assisting the

theatre team in preparing the equipment for the procedures and helping with patient transfer and positioning. Turnaround between patients was reduced from 27.7 minutes to 15.7 minutes. However, the sample size is low at 42 patients and as the programme was conducted at one facility only the robustness of the data is limited. However, their results were encouraging – each 12 minutes saved between cases gave an hour of extra session time each day (Soliman et al 2012)

2.6.6 Efficiency in the Operating Room – Chicago Study

This study from the University of Chicago Operative Performance Research Institute systematically reviewed papers focusing on the published efforts to increase intra-operative efficiency and the influence surgeons can have on procedural agility. This is particularly important in US healthcare with regard to surgical billing. There were 39 papers that met the authors' inclusion criteria. These were divided into single operative teams, multi-operative teams and large institutional interventions. This paper demonstrates that the post-recession pursuit of high quality low cost healthcare is a top priority for global healthcare institutions. Fong et al reported that intraoperative studies have received less attention than the wider perioperative period. Within the studies reviewed they focus on the impact surgeons can bring to improving efficiency by standardising tasks, collecting and using actionable data and maintaining effective team communication. Parallel task completion and the benefit of process mapping confirm reductions in procedure times. This paper reviews a narrow field of the surgical patient journey, however it reveals the good effect that simple adjuncts bring to clinical practice. There are recommendations for standardising the reporting of future papers (Fong et al 2016).

2.6.7 BBC Investigation into 'Wasted Time' in UK Operating Theatres

In October 2017 the BBC's health editor Hugh Pym published data from a 2016 study that found more than two hours were wasted each day on the average operating list. The data was collected from operating theatres from 100 NHS Trusts in England. The study suggested that 280,000 more non-emergency operations could be carried out per annum if the time was better utilised. One of the contributing factors is late starts. However the report also highlighted that the capacity management of hospital beds in general was contributing to the cancellation of surgical patients. This occurs when medically fit patients are unable to be discharged from hospital due to unavailable

support in the community. This hampers bed availability in the hospitals which leads to cancellation of patients awaiting routine surgery.

Older patients are now being considered suitable for surgery due to medical advances that would have not been listed for surgery 20 years ago. The processes required before these older patients are taken to theatre take longer due to their co-morbidities and do not fall into the finite time slots associated with the younger patients. Obese patients also require longer preparation for surgery too and historically are more vulnerable to complications during surgery. (Pym 2017).

This report further highlights the complexities of managing and delivering surgical services in modern healthcare institutions.

2.6.8 SUMMARY OF THEME 4 – LEAN IN INDUSTRY AND HEALTHCARE

The published papers on the origins of LEAN substantiate the gains that private sector manufacturers made upon engagement of its principles. By focusing on process and product flow, manufacturers were able to produce their goods more quickly and offer variety in product choice. Toyota has been recognised as a leading exemplar of using LEAN principles.

The public sector has engaged in LEAN too and has benefited from innovation and improved operational processes. The Apollo space program was influential in developing leading edge technology during its missions. LEAN has been influential too in the service industry and healthcare focusing on targets and performance indicators.

The papers reviewed here report on different projects designed to utilise LEAN principles in the operating theatre setting.

Van Vliet (2010) and Mason (2015) reported on progress achieved. Cataract surgery is a prime example of high volume low variety surgery which is appropriate for the introduction of streamlined processes. The paper assisted in narrowing the focus of the research presented in this thesis toward achievable outcomes. Targeting intermediate surgery that has little variety in technique or delivery will aim to make tangible gains in the amount of procedures performed per operating session. Complex surgeries that can become unpredictable in length of duration and procedure are not suitable for assimilating LEAN principles.

Van Veen-Berkx (2016) introduced parallel processing in anaesthesia scheduling in Holland to good effect whilst Soliman (2012) reported that better engagement from the surgical registrar improved

patient throughput. The original term ‘registrar’ applied to the doctor responsible within the healthcare institution for holding the patient register. This register logged the admissions and discharges from the institution on a daily basis. It is therefore appropriate that this role of responsibility for the registrar is being reprised albeit in a more pragmatic setting.

Addis (2016) advocates block scheduling and emphasises the most important correlation between bed capacity management and its effect on surgical service provision. In the UK bed capacity management is one of the top challenges that NHS managers face with an ever increasing demand for services by an increasingly older population with more comorbidities.

The paper from the University of Chicago reflects the landscape in the USA where their model of healthcare is insurance led. Access to healthcare in the USA has also shifted direction in recent times with the Obama Care Act from 2009 challenged by the Trump administration. The Obama Care goal was to make access to healthcare affordable for more people in the USA and for those who did not have access to healthcare insurance via their work.

Fong (2016) promotes parallel processing and standardisation of tasks to improve patient throughput. It is a valid overview of a small proportion of the patient’s journey that would benefit from expanding its horizons beyond the doors of the operating theatre. This gap in the literature was made evident by the literature review and will be examined and expanded upon through the field work and data synthesis prepared for the project’s submission.

Pym (2017) reported on wasted time in the operating theatres and its impact on waiting lists for surgery. As the NHS spends 40% of its total budget, currently £50 billion, on providing surgery these wasted hours are continually impacting on the ability for healthcare institutions in the UK to perform to their optimum efficiency. This scenario is confirmed through the clinical activity data analysed from QEHB as part of this project’s quantitative data set. This data revealed delays and late starts and correlates with the findings released by the BBC in their report from 100 hospital trusts in the UK.

In conclusion the Pym report on BBC in 2017, which is substantiated by the data from QEHB, provides opportunity for teams to research why clinical time is lost on such a regular basis in the operating theatres. The analysis of the contributing factors that cause delays will lead to researchers seeking to promote new thinking and processes by using trials, clinical interventions and audit to support their work. As the provision of surgical services in healthcare institutions is so cost intensive

it is in the best interests of both the hospital's financial position and the patients' awaiting surgery to make full use of the allotted surgical session times with more consistency.

2.7 CONCLUSION – GAPS and RESEARCH PROBLEMS

This literature review has been conducted to support the credibility and viability of the project and the validity for further research within this speciality. It covers a broad range of improvement programmes.

What is drawn from the literature is recognition of the global work undertaken to improve efficiency in the surgical services setting. It is evident that the papers demonstrate many examples of introducing intervention to tackle under-utilisation. Some have been successful whereas other projects have failed. It is clear from the papers that projects have focused on specific clinical areas only in their endeavours to introduce change. It is recognised that there needs to be a wider focus for intervention to provide lasting impact.

Each individual area and team that collectively provide the whole 'system flow' need to be involved to give the intervention a realistic opportunity of success. This 'system led' approach is not apparent in the reviewed literature. The 'System Flow' approach toward perioperative patient throughput is a decisive move away from current silo working practices that are deeply embedded in healthcare provision. This 'system led' gap in the literature has allowed access for this research project to be proposed, structured and delivered.

It is also evident within this literature review that one of the key research problems in addressing efficiency in perioperative patient throughput is the sustainability of any perceived improvements in operational processes. This sustainability is key to the success of any intervention where there is a positive effect. As demand for surgical services increases it is vital that institutions take responsibility for ensuring efficient practice is one of the key performance indicators through thorough audit and review. Identifying these research challenges has also consolidated the foundation of the research question underpinning this research project.

The published papers demonstrate the value of both private and public institutions tackling efficiency improvement and the challenges that were met in the process of introducing interventions. The reviewed published work around efficiency improvement has acted as a driver for delivering this project.

During the progress of this project the prospective literature published throughout the duration of the project will be reviewed. If appropriate will be featured in this literature review as an addendum to further support the field work and data presented in the final project submission.

Following on from the literature review, Chapter 3 will identify the relationships of the literature review to the main project and will be further developed through establishing a conceptual model.

The goal of the conceptual model is to provide a practical framework on which an organized research, policy, and operations management agenda can be based to improve perioperative patient flow (Asplin 2003).

A process map will also accompany the conceptual model in Chapter 3. A process map will guide organisations and businesses towards improving efficiency. Mapping operational processes will provide insights which will allow teams to develop ideas for process improvement and increased communication. Process mapping will identify bottlenecks, repetition and delays and will encourage teams to guide their improvement programmes towards the specific areas affected by the operational issues.

CHAPTER THREE: CONCEPTUAL MODEL AND PROCESS MAP OF SURGICAL PATIENT FLOW

3.1 Introduction

This chapter outlines the purpose of constructing a conceptual model and a process map focusing on perioperative patient flow. The general approach to conceptual model and process maps will be defined alongside their validity in supporting service improvement in healthcare. Examples of a published conceptual model and process map will be included to demonstrate the research strategy. A conceptual model and a process map designed specifically to support this research project will be presented with particular focus on how these research tools allow the stakeholders involved in providing surgical services to understand the wider concept of the patient flow process and aid the recommendations offered for an improved cohesive service. The goal of the conceptual model is to provide a practical framework on which an organized research, policy, and operations management agenda can be based to improve perioperative patient flow (Asplin 2003).The purpose of using a process map is to guide organisations and businesses towards improving efficiency. The mapping exercise provides insights into processes which will allow teams to brainstorm ideas for process improvement, increase communication and provide process documentation. Process mapping will identify bottlenecks, repetition and delays. This allows teams to target their improvement strategies towards these specific areas (LucidChart 2019).

The literature review covered in the previous chapter was conducted to support the credibility and viability of the project and the validity for further research within this speciality. The review covers a broad range of improvement programmes. To advance the foundations of the project as described in Chapter 2 this next chapter initiates and formulates the components of a conceptual model and a process map which will be used to underpin the focus of the research methodology, data collection, synthesis and the project's findings and recommendations

Conceptual models represent ways of thinking about a study or a problem and of how complex things work the way they do. Different frameworks will emphasize different variables and outcomes, and their inter-relatedness (Bordage 2009).

The use of conceptual models in healthcare has been defined as the abstraction and representation of complex phenomena of interest in some readily expressible form, such that individual

stakeholders' understanding of the parts of the actual system and the mathematical representation of that system, may be shared, questioned, tested and ultimately agreed (Tappenden 2012).

In broad terms, conceptual modelling is the process of developing a graphical representation (or model) from the real world. In the context of collaborative problem-solving it provides an easily understood representation of the system for the different stakeholders involved. The process of conceptual modelling requires decisions to be taken regarding the scope and level of detail of the model. (Powell-Morse 2017).

It also requires assumptions to be made about the situation concerned. The conceptual modeller has to determine what aspects of the real world to include, and exclude, from the model, and at what level of detail to model each aspect. Conceptual modelling describes the objectives, inputs, outputs, content, assumptions and appropriate simplifications required for the stakeholders to better understand their situation (Allen 2019).

Modern healthcare facilities are widely recognised as complex adaptive systems. These systems' performance and behaviour change over time and cannot be completely understood by simply knowing about their individual components (Braithwaite 2014).

Braithwaite also suggests that healthcare systems are more complex than banking, education, manufacturing and even the military. No other sector has the equivalent range and breadth. No other industry has such intricate funding models, multiple moving parts, complicated clients with diverse needs, and at the same time with so many options and interventions for any individual's needs (Braithwaite 2014).

Braithwaite's position on the position of health care within complex systems is arguable if we consider the multifaceted nature of the manufacture of all products and the development of the materials that underpin their manufacture.

In the last century the global manufacturing industry has been shaped by economic, technological and socio-political progress, socio-environmental regulations, heterogeneity, and above all globalisation of markets and increased competitiveness (ElMaraghy 2012).

To meet production targets of increasingly complex products with higher quality requirements and reduced times to market the manufacturing industry employs highly automated production systems. An increase in manufacturing systems complexity has been reported to negatively impact on all aspects of manufacturing in terms of production, quality, reliability, throughput and

production times. It also disturbs the system's efficiency at design, operation, maintenance and management levels (Schuh 2015).

This manufacturing complexity and its impact on the system key performance indicators (KPIs) should be identified and quantified to remain profitable and competitive, and to respond rapidly to the volatile markets and rising product variety (Mattsson 2011). In order to achieve this, an analysis and assessment of complexity identifying its impacts is vital (Gotzfried 2013). This highlights critical managerial aspects, and thus enables the development of strategies to manage system complexity (Alkan 2018).

However in the healthcare setting the complex environment strongly influences the surgical patient flow to and from the Operating Theatre suite. There are so many stakeholder interactions involved in the simple process of transferring patients for surgery that it is seen as an inevitability that delays and inertias will occur. These interactions are detailed in the process map.

3.2 Example of use of Conceptual Models in health care – ED Crowding

A conceptual model paper from 2003 focuses on crowding in the ED (emergency department) from a number of healthcare institutions in the USA. Published by the American College of Emergency Physicians the conceptual model used for the project partitions ED crowding into 3 interdependent components: input, throughput, and output (Asplin 2003).

The goal of the conceptual model used to address the crowding issue is to provide a practical framework on which an organized research, policy, and operations management agenda can be based to alleviate ED crowding.

Their research focuses on patient groups seeking emergency care in the USA who experience long waits to be treated and even longer waits for an inpatient hospital bed.

Because ED crowding is a reflection of larger supply and demand mismatches in the healthcare system, the researchers stress that the problem cannot be solved by examination of the ED in isolation. To find solutions, they must examine ED crowding in the context of the entire delivery system by using reliable methods to understand, measure, and monitor system capacity.

The research team presented their conceptual model of ED crowding to help administrators, researchers, and policymakers understand its causes and develop potential solutions. Their conceptual model partitioned ED crowding into 3 interdependent components: input, throughput,

and output. They also suggest factors that originate in many parts of the health care system contribute to ED crowding, however their model focuses on this problem from the perspective of the ED. Their intention is not to describe all the potential causes of this complex issue. Rather, their goal is to provide a framework that will facilitate a systematic understanding of the problem. The conceptual model used in this paper guides research and operational and policy solutions.

Their conceptual model contains three main elements

Input Component

The input component of ED crowding in the conceptual model includes any condition, event, or system characteristic that contributes to the demand for ED services.

Throughput Component

The throughput component of the model identifies patient length of stay in the ED as a potential contributing factor to ED crowding. This part of the model highlights the need to look internally at ED care processes and modify them as needed to improve their efficiency and effectiveness, especially those that have the largest effect on length of stay and resource use in the ED.

Output Component

Inefficient disposition of ED patients contributes to crowding for admitted and discharged patients. The most frequently cited reason for ED crowding is the inability to move admitted patients from the ED to an inpatient bed. This forces the ED to board admitted patients until inpatient beds are available, effectively reducing the ED's capacity to care for new patients.

The input-throughput-output conceptual model of ED crowding (Asplin 2003)

These factors are :

1. **Input**
    a. Emergency care • Seriously ill and injured patients from the community • Referral of patients with emergency conditions
    b. Unscheduled urgent care • Lack of capacity for unscheduled care in the ambulatory care system • Desire for immediate care (eg, convenience, conflicts with job, family duties)

c. Safety net care • Vulnerable populations (e.g., Medicaid beneficiaries, the uninsured) • Access barriers (e.g., financial, transportation, insurance, lack of usual source of care)

2. **Throughput**

   a. Patient arrives at ED

   b. Triage and room placement

   c. Diagnostic evaluation and ED treatment

   d. ED boarding of inpatients – lack of available staffed inpatient beds

3. **Output**

   a. Patient disposition

   b. Leaves without treatment complete

   c. Ambulatory care system

   d. Lack of access to follow-up care

   e. Transfer to other facility (e.g., skilled nursing, referral hospital)

   f. Admit to hospital

By constructing a conceptual model to demonstrate the contributing factors to ED crowding the research team have highlighted the issues using a clear format offering hospital administrators and policy makers an opportunity to alleviate the problems and introduce effective solutions (Asplin 2003).

3.3 Conceptual models and process maps

The natural scientific attitude that modellers bring to the research and studies is positive: typically they try to demonstrate the relevance, utility, benefits and other positive impacts and applications of conceptual modelling. While this is perceived as a healthy and fruitful attitude, scientific progress also benefits from a critical attitude that pursues and explores potential failure as a means to better our understanding (Gray and Cooper 2010).

By trying to understand where the limits of application and utility of conceptual modelling lies, and by studying the areas where conceptual modelling potentially yields negative rather than positive impacts, this in turn develops a much better understanding of how conceptual modelling actually operates and how it might be used most effectively. In fact, through trials of failure researchers may find out more about the success of conceptual modelling as well as its boundary conditions than by pursuing success directly (Reker 2015).

3.4 Modelling in Healthcare

Many interventions found to be effective in health services research studies fail to translate into meaningful patient care outcomes across multiple contexts. Health services researchers recognize the need to evaluate not only summative outcomes but also formative outcomes to assess the extent to which implementation is effective in a specific setting, prolongs sustainability, and promotes dissemination into other settings (O'Sullivan & Uijtdehaage 2013).

The conceptual model described here forms the central focal point of this research to which all the submitted research data is converging.

The model provides an outline of both the barriers and facilitators to perioperative patient flow. This chapter will also make an argument for addressing the challenges involved in changing how a large organisation like the NHS thinks about and delivers healthcare improvements.

Hence, the conceptual model forms the nucleus of this research and will facilitate and bound the overall structure of the thesis.

The research objective to improve the efficiency in an Operating Theatre environment directly influences the establishment of the framework for the Conceptual Model. The specified aim of the research is to improve cycle times for surgical patient flow using lean processes. The conceptual model will be a means of testing the achievement of this aim.

Surgical patient flow (often known as perioperative patient flow) remains one of the principal influencers of Operating Theatres efficiency. This phenomenon is witnessed throughout the worldwide healthcare environment and this is verified by the published literature.

For this research project the conceptual model forms the representation of the surgical patient flow alongside the barriers and facilitators that influence efficient patient flow during operating sessions.

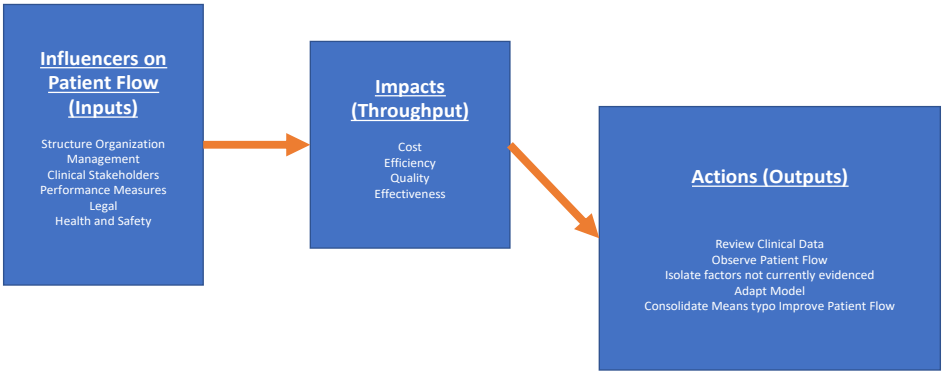

Figure 2: Conceptual Model of Patient Flow Influencers and Impacts and Proposed Actions

3.5 Justification of model

Influencers of surgical patient flow begin with the structure of the organisation and the managerial performance of their operational processes. Clinical data which is widely collected and collated by healthcare institutions supports audit of surgical patient flow and quantitative confirmation of both efficacy and delays. Stakeholders who are responsible for facilitating the surgical patient flow are central to delivering their services sequentially. These stakeholders include pre assessment outpatient departments, admission units and surgical wards, surgeons, anaesthetists, operating theatre staff, radiography and sterile services.

Performance measures are mined directly from the clinical data activity capture and allow the management to review performance and identify areas of concern. Any under-utilisation should be investigated and an action plan formulated by the managerial team to address the issues and to rebalance the clinical activity. In reality, this rebalancing is achievable but not necessarily sustainable due to the complex and dynamic nature of the healthcare environment involved. Projects are introduced and often achieve an early influence on their targeted processes. However resistance

can be experienced from clinicians and practitioners who are reluctant to change direction in response to a top down approach and have the power to resist or reject. The project may also encounter entrenched bureaucracy and a multiplicity of existing policy impediments, particularly in public funded hospitals (Braithwaite 2014).

Legal and Health and Safety law also influence operational processes. These evolve and adapt to the technology driven 21st century and form part of the legal requirements in service provision that healthcare institutions must adhere to in their daily business.

Whilst this group of influencers are seen as facilitators of the surgical services they may, due to poor operational performance, revert to being barriers of the service. This patient flow process as outlined in the Process Map requires inputs from several stakeholders to ensure the flow of patients is effective and that all the preparations for surgery are completed in time order. If there are any issues along the surgical patient pathway this will lead to a delay and threaten a reduction in the predicted clinical activity.

Consequently, patients further down on the operating list may be cancelled at short notice and postponed for a future date. This becomes an unfortunate consequence of poor performance by the stakeholders involved in the service. For the patient who faces a last minute cancellation there is undoubtedly unwanted anxiety for both themselves and their family in terms of delayed treatment. It also means undergoing the inconvenience of rearranging a new date and all the practicalities of organising leave from work, arranging care for family and children in order to be available to commit to a future date for surgery. Common risks of delay sourced through the literature review are incomplete patient preparation, missing clinical notes and test results, and delay whilst appropriate staff are sourced to transfer the patient from the ward to the theatre.

Lack of skills in the theatre teams (including clinicians) contributes to delays as well as the problems ensuing from the availability of appropriate surgical instrumentation and equipment. Anaesthetists may not be able to commence anaesthesia on the next patient due to spending unexpected time recovering their current patient if they are working without a trainee to support them. Likewise, the skill set of the surgeon must match the proposed surgery on the operating list. If this is not compatible then an alternative surgeon with the experience required must be sourced. All these issues will impact on the assured running and delivery of the planned activity of the operating list.

If all the stakeholders perform in a timely efficient manner, then the barriers are not experienced and facilitation of the planned activity is achieved.

As all the stakeholders responsible for the flow of patients for surgery work in a nonlinear fashion the process is reliant on each stakeholder delivering their contribution in time. If there are issues that occur at any point along the pathway then this will result in the chain of events stalling.

The net effect of the process stalling impacts the costs, efficiency, quality and effectiveness of the service. As it is generally acknowledged that 40% of hospitals total annual budgets are spent on delivering surgical services in the UK, these impacts produced unwanted strain on tight financial margins. In 2015 this figure was calculated at £58 billion (Mendick 2015).

The model also maps out an action plan. Through observation of patient flow and review of clinical data there is opportunity to pinpoint areas of concern. These can be addressed by managerial teams and interventions can be introduced to facilitate change and improvement. However sustainability of any perceived improvement is key to the success of change management projects.

Reviewing the data and observing the clinical activity allows researchers to isolate the factors that are not already evidenced. These non-evidenced sectors in operational processes permit access for new research and additions to the published literature.

3.6 Process Mapping

3.6.1 Introduction

A conceptual framework can guide research by providing a visual representation of theoretical constructs (and variables) of interest.

'Theories present a systematic view of phenomena by specifying relations amongst variables using a set of interrelated constructs/variables, definitions and propositions' (Kerlinger 1979) (Creswell 1994).

The primary objective of the conceptual model constructed for this research is to convey the fundamental principles and functionality of the perioperative patient flow.

Processing mapping is defined as the structural analysis of a process flow such as an order to delivery cycle. Process mapping is therefore both an acceptable method to use in addressing the research question inquiry and in forming one of the main constructs of the conceptual model.

Process Mapping works by distinguishing how work is actually done from how it should be done, and what functions a system should perform from how the system is built to perform those functions. In this technique, main activities, information flows, interconnections, and measures are

depicted as a collage on a large sheet of (commonly brown) paper, with different coloured 'Post-it' notes or slips of paper. This graphic representation allows an observer to 'walk-through' the whole process and see it in its entirety. (Business Dictionary 2019)

3.6.2 Research Problem

In modern hospitals, and in particular in the modern operating theatres, effective delivery of services depends on the execution of a complex sequence of tasks. Understanding this sequence, and the particular details of the sequence for a given service and a given setting, is a necessary first step in the analysis of service performance. Process mapping is a tool increasingly used for this purpose in health care although there is little empirical evidence of the benefits of this (Antonacci 2018).

If operational agility in organisations is thwarted by unforced delays and unanticipated inertia there are a number of tools available for management to address the problem and construct a solution strategy.

3.6.3 Process Mapping Background

A process map is widely recognised as a planning and management tool that visually describes a flow of work. Increasingly process mapping software is used to facilitate the map and to analyse the results of the plotted workflow. The purpose of process mapping is for organisations and businesses to improve efficiency. Process maps provide insight into a process, help teams brainstorm ideas for process improvement, increase communication and provide process documentation. Process mapping identifies bottlenecks, repetition and delays (Lucidchart.com 2019).

Process mapping is a structured way of mapping and critiquing the existing New Product Introduction process, in order to examine its effectiveness along a number of dimensions. It encourages a multi-functional team to identify critical elements in the process and locate potential areas for improvement. This approach is also suitable to review the introduction of a new service (Moultrie 2016).

Mapping activity has allowed organisations to reconfigure and streamline their activities with the premise of becoming more efficient whilst reducing waste (Cooper 2017). The mapping exercise pinpoints all the contributing tasks within a chosen process. The exercise allows organisations to

understand how each task relates to the other tasks within the process and how those interactions impact on operational effectiveness.

There are several process analysis techniques available for organisations to use to represent their working processes. These include mapping end-to-end processes which will break down the silos for the workforce and allow them the visibility of what they deliver and how it impacts on other areas of the business and ultimately their customer base (Cooper 2017). Goldratt introduced his theory of constraints (TOC) in his book The Goal (1984). TOC is a management paradigm that uses a focusing process to identify constraints which allows restructuring of the rest of the organisation around them. These constraints (bottlenecks) are exploited to make their throughput more efficient by changing processes, training, policies and equipment maintenance. Process mapping is a central part of this process (Goldratt 1997).

On receiving eighteen months of clinical activity data from the QEHB Theatres we entered into a collaboration with statisticians from Queen's University Belfast to analyse the data. The information provided in the data clearly defined real time operating list start times, turnaround times between patients and operating session finished times. This data could then be assessed against the scheduled operating list start times, turnaround times and scheduled session end times. This process revealed broad issues with scheduled operating lists starting late, delayed turnaround times between patients and unplanned, unfunded overruns. The findings of this preliminary quantitative data served to reinforce the research question. The research question was designed to challenge the operational difficulties involved in achieving timely session start times, prompt turnarounds between patients and scheduled session finish times.

The researcher decided to utilise a process map in the pursuit of the recommendations for a clinical trial to improve surgical patient flow from the wards to the operating theatre suite. Constructing a process map offered the researcher an opportunity to understand the processes involved in the surgical patient journey and also define the healthcare practitioners involved. The map was tested and revised during the structured observation exercises which saw the researcher accompany the Theatre orderlies onto the surgical wards to collect the patients for Theatre.

A role activity diagram was used to convey the processes involved in the transportation of the patients from area to area. It was felt that by using this format the focus would concentrate on healthcare practitioner roles and interactions rather than specific titles and job functions.

3.6.4 Problems Identified through the Clinical Data Analysis

The preliminary quantitative data identified repeated inactivity during scheduled operating list sessions. As surgery is one of the most cost intensive services provided by healthcare institutions the researcher felt this needed investigating to identify the problems and to recommend solutions to improve on the utilisation of the scheduled sessions.

This inactivity was due to a number of different reasons documented by the operating theatre staff on the clinical activity data capture system. These reasons included lack of patient preparation on the surgical wards, late surgeons, late anaesthetists, communication issues, incomplete consent forms, pre assessment results not available, patients not marked for surgery (where appropriate), availability of escort staff, skill mix of Theatre teams, issues with surgical trays in Theatres and lack of staff in Theatres reception to check the patients in for their procedure.

The multitude of reasons contributing to delays in the planned activity was noted by the researcher. It soon became clear that it was not an isolated issue through the literature review process undertaken for this project. The literature review confirmed an international perspective of the issues associated with delivering efficient surgical services and the research programmes undertaken to address the problems. A gap in the literature was identified to exploit. The published literature largely focused on single clinical areas to introduce clinical trials and change management. There were also issues with audit and sustainability of projects.

By using a process map and a role activity diagram we have been able to take an overarching view of the whole patient journey. This has allowed the promotion of a cohesive service provision involving all the stakeholders and clinical areas that contribute to the service.

3.6.4 Solution

To demonstrate the various stages of perioperative patient throughput and to suggest an improvement strategy we have engaged in a process mapping exercise supported by a role activity diagram.

3.7 Role Activity Diagram

For the mapping exercise conducted for this research project the decision was made to use the Role Activity Diagram (RAD) method. Role Activity Diagrams present the activity of the roles in a given process and how they collaborate. In the context of revealing the stakeholders involvement in the delivery of surgical services, using a RAD is a logical step in discovering and understanding how the collaboration works. It will also allow identification of areas to target to promote cohesive working practices.

Using role activity diagrams in conjunction with process mapping both simplifies and speeds up projects looking at operational processes. They do this because they: create and speed up the project design. Provide effective visual communication of ideas, information and data. Help with problem solving and decision making. (Lucidchart 2019)

To understand the value chain of an organisation with the intention of improving it organisations must be able to visualise their processes. Process mapping offers this visualisation. A Role Activity Diagram highlights the roles that play a part in the process. It shows the activity of the roles in the process and how they collaborate. Role Activity Diagrams are used in conjunction with process mapping to define the activity and process the flow.

The methodology of process mapping focuses on three concepts:

The roles that people, teams or departments play in the process

The activities that players fulfil during the process

The interaction between one activity to another

(Clayton 2014)

The patient journey from the surgical ward to the operating theatre is reliant on the activity interaction of several stakeholders. This linear process functions as well as its weakest link in the chain of events required to consistently transport patients from one area to the other. We chose to use RAD's to report this activity. By breaking down the patient journey through roles and role interactions RAD's move away from how operational processes are achieved and focus on what interaction is required for consistent practice.

RAD's are adapted from Petri net theory (Ould 1993) and are constructed using the concept of role, activity, interactions and entities to represent models of the workings of organisations in the achievement of certain goals. The focus is on roles and role interactions looking at the 'what' element of a process rather than the 'how'.

Petri nets are based on the work of Carl Adam Petri (Petri 2008). Petri nets were specifically designed to model large complex systems that contain many interacting components. Petri described these interacting components as having their own state which would change over time. Individual component activity may occur simultaneously with other component activity. Therefore, these systems need to be able to synchronise concurrent activity. A Petri net is composed of four parts; places, transitions, inputs and outputs (Petri 2008).

Roles are independent of the titles traditionally associated with job functions. They comprise a set of activities which must be performed to achieve an identified goal. A role may be equated to a class or type which may have associated instances of that type. A role instance exists independently of an actor to perform the role. A role instance may cause the creation of new role instances in other roles to do new tasks which may be active concurrently. Activities within a role may all share the available resources (entities) whereas role instances have to interact to share resources.

Activities are performed by either humans, machines or a combination of both and are not described in great detail. Rather they are represented by 'what' is done together with representation of the inputs and outputs that have occurred. This is deemed sufficient in the context of RAD's.

Interactions between role instances form the overall process. This may involve only two roles (two-party) or many roles (multi-party). Interactions are synchronous where all involved parties are ready for the interaction to take place. Interactions may include the transfer of an entity or the facilitation of an agreement.

Entities within RAD's consist of Plans, Reports and Documents. These form the input to and output from activities. Entities are often considered the reason for an interaction happening i.e. delegation of a task where information is sent and results are received.

RAD's take no account of individuals and their titles and responsibilities in reporting activity. The ability to show 'what' is done together with representation of the inputs and outputs that occur which is deemed sufficient. RAD's do not show inputs, transitions or outputs. They show a sequence of activity according to time and interaction that occurs with other roles. They provide a series of states to be identified for the achievement of a goal. (Maull. R et al 1995)

RAD's will complement the anonymised presentation of the clinical data within this research project. The focus is not on individual specialists but on the collective activity conducted by the various practitioners to initiate and complete the surgical patient's journey.

Patel (2000) advocated the introduction of a socio-technical role activity diagram modelling language approach to NHS information systems requirements engineering using a process approach.

By using a role activity process approach rather than data driven methods the research team were able to identify systems development problems. The RAD's offered a process based approach in capturing workflows and their associated information flows allowing intuitive communication between analysts and users. In particular, they elicit the important roles in a process and the interaction and collaboration required to achieve the goals of the process.

Their approach identified the NHS as a complex and vast organisation that requires understanding to implement projects successfully. This understanding focused on people and technology at one level and technology and organisation at a different level. Traditional data driven techniques used to develop information systems use decomposition of wholes into sub-parts. This approach suits hierarchically structured application domains. The researchers argue that in such a large and complex human organisation such as the NHS this singular approach is difficult to achieve and even unproductive. Rather than engaging in hierarchies and hierarchical solutions the NHS functions via a web of interactions amongst individuals through purpose and value. Even more complex interactions occur between clinical specialities and various supporting administrative teams. This observation by the research team has been vital in support of their chosen research methodology.

Published research on RAD's as demonstrated by Patel's paper supports the validity of adopting this approach in the clinical setting. Process mapping using RAD's allows teams to review the efficacy of service provision and agree on areas within the operational processes to target intervention and facilitate change.

Marsh (2016) describes the utilisation of process mapping in his paper on streamlining breast reconstruction surgery. His research team included 3,000 patients in one service, and describes how the interventions incorporated into their surgical practice via a process map were able, over time, to reduce operative time without compromising patient safety.

Their mapping exercise segregated all the components of the patient's journey which were then available for review and process improvement. These improvements saw the patients having a CT

during the pre-assessment to select the most suitable perforators required for the free flap reconstruction. This perforator selection process prior to the patient attending for surgery was seen as key to reducing procedure time, as traditionally the perforators are selected intra-operatively. The CT selection is confirmed by Doppler when the patient is marked for the procedure on admission to hospital.

The anaesthetic technique has also been revised due to the process map. Instead of the traditional invasive monitoring techniques (arterial line and/or central line establishment) an oesophageal Doppler is placed alongside the airway device to facilitate haemodynamic monitoring. This reduces time in the anaesthetic room by 18 minutes per patient. The cumulative effect of these interventions was to reduce mean operating time to 248 minutes per patient. With an operating session of 08.30-21.00 hours the team are now able to complete free flap surgery on three patients per session. This is an achievement that incorporates straightforward clinical improvements across a broad range of the elements that make up the patient's journey. This mapping exercise provides a benchmark for other institutions to consider adopting (Marsh et al 2016).

3.8 Methods

A process map is intended to allow organizations to drill down into their operational processes to understand their workings. The maps also provide an indication of how well their resources and workforce are being utilized.

A map will comprise a breakdown of all the components and actions required to produce a determined outcome. In the case of this project the map will depict the patient's journey from admission to the hospital for surgery to the end point of transfer back to the ward area post procedure. The map was constructed by mapping the various stages of the patient's journey from the point of admission to the surgical ward to transfer to the operating theatre reception. This involved us physically following a number of patients from their surgical ward admission to their arrival in the operating theatre suite reception. It also involved us working closely with the theatre teams to observe and document their preparation undertaken to receive the patients into their care for their surgery.

This allowed us to plot and determine the most important phases of this journey and also identify the main players in the process.

3.9 Findings

The following extract represents a small section of the conditions that need to be met to proceed with the intended clinical work. The whole map would be constructed by expanding this representation to include all the steps involved in the patient journey. The completed map would then be presented for review.

3.9.1 Topics for Constructing the Map

1. Has the patient's pre-assessment and admission date letter been sent?

    Yes – Proceed to schedule patient on operating list

    No - ?Cancellation and delayed treatment and operation date

2. Is the operation list available?

    Yes – Proceed

    No – ?Delay whilst it is found

3. Theatre Staff arrive – All present with appropriate skill mix ?

    Yes – Proceed

    No - ?Delay whilst staff replacements sought

4. Surgeon and Anaesthetist arrive - All present –

    Yes - Proceed

    No - Delay whilst shortfall addressed

5. Prepare Theatre – All surgical instrumentation, equipment and furniture present?

    Yes – Proceed

    No - ?Instrumentation Required ?Delay whilst outstanding items sourced

6. Team Brief – First patient in and prepared?

    Yes – Proceed

    No – Change order of list if possible – if not possible ?Delay

From this small extract taken from the whole process it can be deduced that there are many conditions to be met to successfully deliver an operational process within an organization. Within the perioperative patient throughput process there are so many variables that impact on efficient transfer and timely surgical procedure of patients and use of allotted session time. It is clear in modern healthcare provision that effective use of time and resources is vital to deliver affordable, safe care to patients. Without a system led approach to operational delivery many institutions continue to work inefficiently. This becomes a source of huge frustration to both clinicians and patients. During the stakeholder interviews conducted for this research project surgeons have reported delays requiring rescheduling of the operating lists, often on the day. Cancellations due to administrative error and resource failure are also noted. Patients are subject to last minute cancellations due to bed pressures or unavailability of skilled staff or equipment.

The result is lengthening waiting times for patients and Trusts failing to meet national targets. In the first quarter of 2018 over 18,000 patients due for surgery were cancelled for non clinical reasons. During the same period there were over 211,000 patients waiting longer than six months for surgery. These figures have not been seen since 2007 (NHS Statistics 2018). This may result in Trusts moving into special measures after review by the Care Quality Commission. External agencies that specialize in improving operational performance are increasingly employed by challenged Trusts. This does not represent good value for the taxpayer or reflect well on Trust senior management performance.

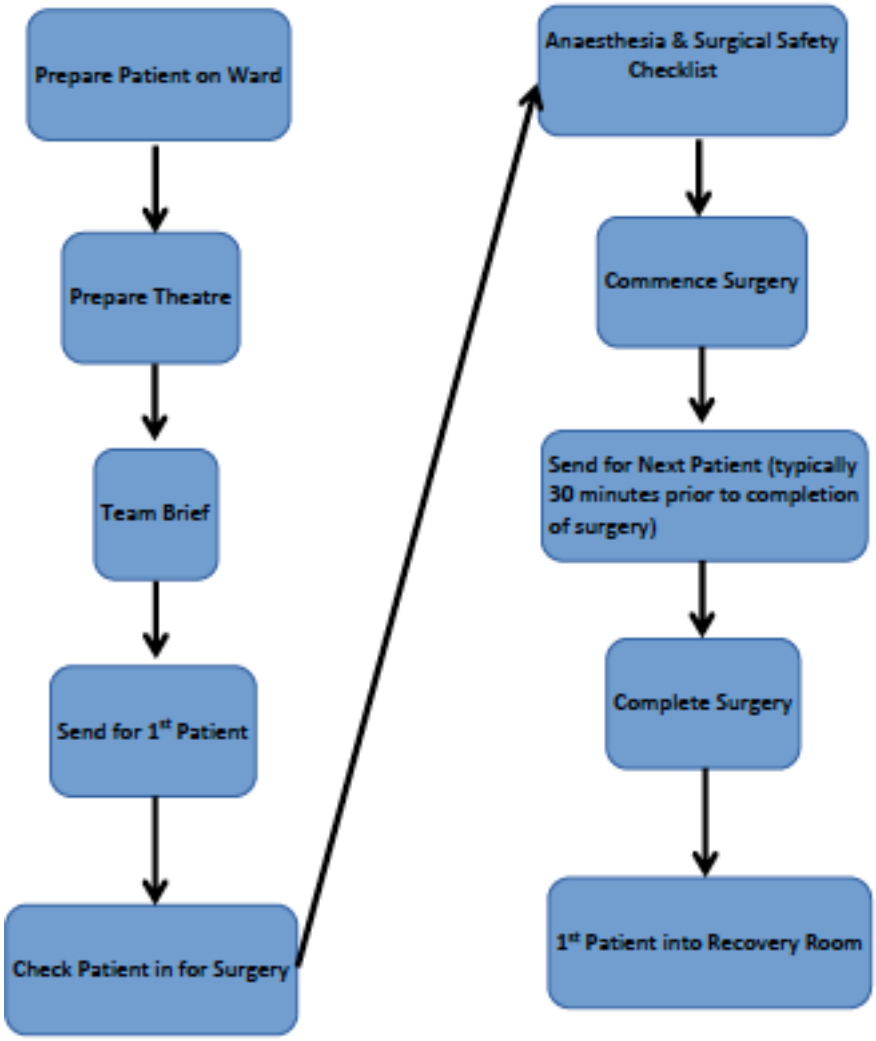

Figure 4: Process Map of Surgical Patient Flow Through the Operating Theatre

The Process Map details the association between all the conditions and steps that need to be met in the surgical patient's journey. If any of the steps are not completed there is a strong possibility that it may lead to delays and disruption of the planned activity. Dividing the patient's journey into individual steps allows clearer understanding of the whole process. Those responsible for operational performance can then look at challenging specific steps if there is an underperforming trend associated with them. Through innovation and new ways of working, process mapping assists with supporting improved, effective practice.

Figure 3 represents a snapshot of the process map. A more detailed map is presented in Figure 4 along with a process map summary.

The detailed map begins by asking whether the administrative tasks have been completed to assign a date for surgery for the patient. This includes whether the letter has been sent out with both the dates for the pre-assessment clinic and for the surgery to the patient.

On the day of the operation the process map firstly asks whether the operating list is available. If the list is not available then a delay is anticipated whilst it is sourced. Once the Theatre practitioners assemble to undertake the scheduled work the map asks whether the correct skill mix for the requirements of the list are present. Again if the answer is no then there is potential for delays whilst staff able to carry out the planned procedures are located.

Any answer that is **no** on the process map will potentially lead to delays and even cancellations for patients lower down on the operating list.

The surgeon and anaesthetist teams arrive in the Theatre. Do they have the appropriate skills to undertake the planned procedures?

The Theatre is prepared with surgical instrumentation, equipment and furniture. All present then the list may commence. If there are omissions then there is further potential for delay.

The team brief between the surgeon, anaesthetist and the theatre practitioners then takes place. Is the first patient ready and is the planned procedure printed on the operating list still the intended procedure? If the procedure has changed does the team have the resource to deliver the new surgery? Is the patient consented, marked (if appropriate) and in a hospital gown? Are the medical notes, laboratory results and X-rays available? Has the patient been admitted onto PICS? (part of the patient's Clinical Portal required for reviewing patients notes and prescribing medication).

The first patient of the list is sent for if all the criteria is met and a theatre orderly is available. Once the orderly arrives on the ward the patient's preparation is re-checked. If all is in order an escort from the ward must accompany the orderly to the Theatre with the patient. Is an escort available?

On arrival in Theatres reception the orderly informs the Theatre team that the patient is in and ready for check in. Is there a trained member of the Theatre team available to check the patient in? Again a possible delay if there is no one available.

Anaesthesia begins and once the patient is positioned for surgery in the operating theatre and the WHO surgical safety checklist has been completed the surgery commences.

Towards the end of the surgery (typically 30 minutes) the surgeon will ask the staff to send for the next patient. Is there enough session time left to accommodate the next patient? If the answer is yes, proceed. If no, then consider cancellation and a rescheduled date for surgery.

Is the theatre orderly available to collect the 2nd patient? Yes – continue with the list No – potential for delay.

This process pattern is followed until the end of the session whereby the whole operative team undertakes a time out to review their performance. What went well, what went not so well, were there any issues and strategy for future improvement.

The process map described here clearly demonstrates the process complexities associated with running a scheduled operating list. In the context of this research the process map has assisted in plotting the patient pathway and identifying the stakeholders required to deliver the surgery. It has also allowed the researcher to pinpoint recurring bottlenecks and to recommend clinical trial interventions to reduce the delays and encourage a cohesive 'system led' approach to the service as opposed to silo working that is well documented in the healthcare literature.

3.10 Role Activity Contributions to Facilitate an Operating Theatre List

These role activities have been identified by the researcher through direct observation of the whole surgical patient journey within the delivery of a typical operating list.

1. Patient Preparation for Surgery on Surgical Ward
2. Preparation of the Operating Theatre to facilitate the surgery
3. Surgical Team Brief Prior to Start of Operating List (All Members of the Theatre Team)
4. Transfer of Patient from Surgical Ward to the Operating Department
5. Induction and Maintenance of Anaesthesia to facilitate surgery
6. Surgical Safety Checklist (individual to each patient)
7. Surgery Commenced and Completed
8. Surgical Time Out (review of surgery undertaken and post operative instruction)
9. Patient Emergence from Anaesthesia and Recovery from Surgical Intervention
10. Safe Return of the Patient to the Surgical Ward

11. Surgical Team Debrief upon completion of the Operating List (All Members of the Theatre Team)

3.11 Conclusion

This conceptual model and process map represent the major theme of this research. Cohesion, through a 'system led' clinical provision of surgical services via all the stakeholders involved, would tackle the delay issues in a unified approach where all contributors work seamlessly to deliver the clinical commitment of the planned surgery. As widely reported in the literature, silo working by stakeholders is all too common (Hignett 2018). This research project seeks to promote a cohesive service with a unique global review of the operational processes of a large healthcare institution.

The Royal College of Surgeons commented on a preliminary report from NHS Improvement in February 2019. The report suggested that 300,000 more surgical procedures per annum could be achieved in the NHS through improved patient scheduling in Operating Theatres. The College highlighted that although this was a challenge for all local healthcare institutions throughout the UK, the problem was being compounded by bed capacity management on a general scale. The OECD recently reported that the UK has the second lowest total number of beds for each 1,000 patients in the whole of the EU.

It is clear that scheduling and delivering surgery in UK hospitals remains challenging and is compounded by bed capacity management and staff shortages (NHS Improvement 2019)

The Process Map of surgical patient flow developed to underpin this research will form the central focus of this conceptual model. The potential usefulness of the model to the healthcare community will be discussed. The conceptual model and the process map will initiate process modelling through discrete event simulation. Discrete event simulation models the operation of a chosen system as a discrete sequence of events in time. Each event occurs at a particular instant in time and marks a change of state in the system. Between consecutive events no change in the system is assumed to occur; thus the simulation time can directly jump to the occurrence time of the next event, called the next-event time progression (Robinson 2004).

The job of the modeller is to understand the real system that is the subject of the simulation study and to turn this into an appropriate simulation model. The chosen model could range from a very

simple single server and queue, through to a model that tries to encapsulate every aspect of the system (Robinson 2011).

In recent years some attention has been paid to conceptual modelling in order to overcome Discrete Event Simulation process lacuna. Process lacuna has been described as “the lack of concern in operational research (OR) with the processes that are associated with the work of analysts” (Keys 2007).

The conceptual model and process map will support the operationalization of the research model (the overall framework used to look at the ‘subject’ of the research) in terms of research concepts (a conceptualization of the local environment this research is conducted in). These concepts are then converted into a series of research constructs. These constructs are constructions developed by researchers to describe and investigate the whole or part of research phenomena in the context and in line with the objective of the research.

The conceptual model and process map developed for this research will be evaluated through the constructs and by both the impact and potential the recommendations for improved clinical practice have on the service provision.

Chapter 4, The Research Methodology, follows on and builds upon the conceptual modelling and the construct of the process map by confirming both the empirical and theoretical contribution to the research via the chosen methodological approach. The following chapter will reveal the philosophical pathway and intellectual traditions that guide this research. There is also acknowledgement of the range of philosophical perspectives available to researchers. The chapter will provide an accurate and detailed description of the research approach taken.

Process Map

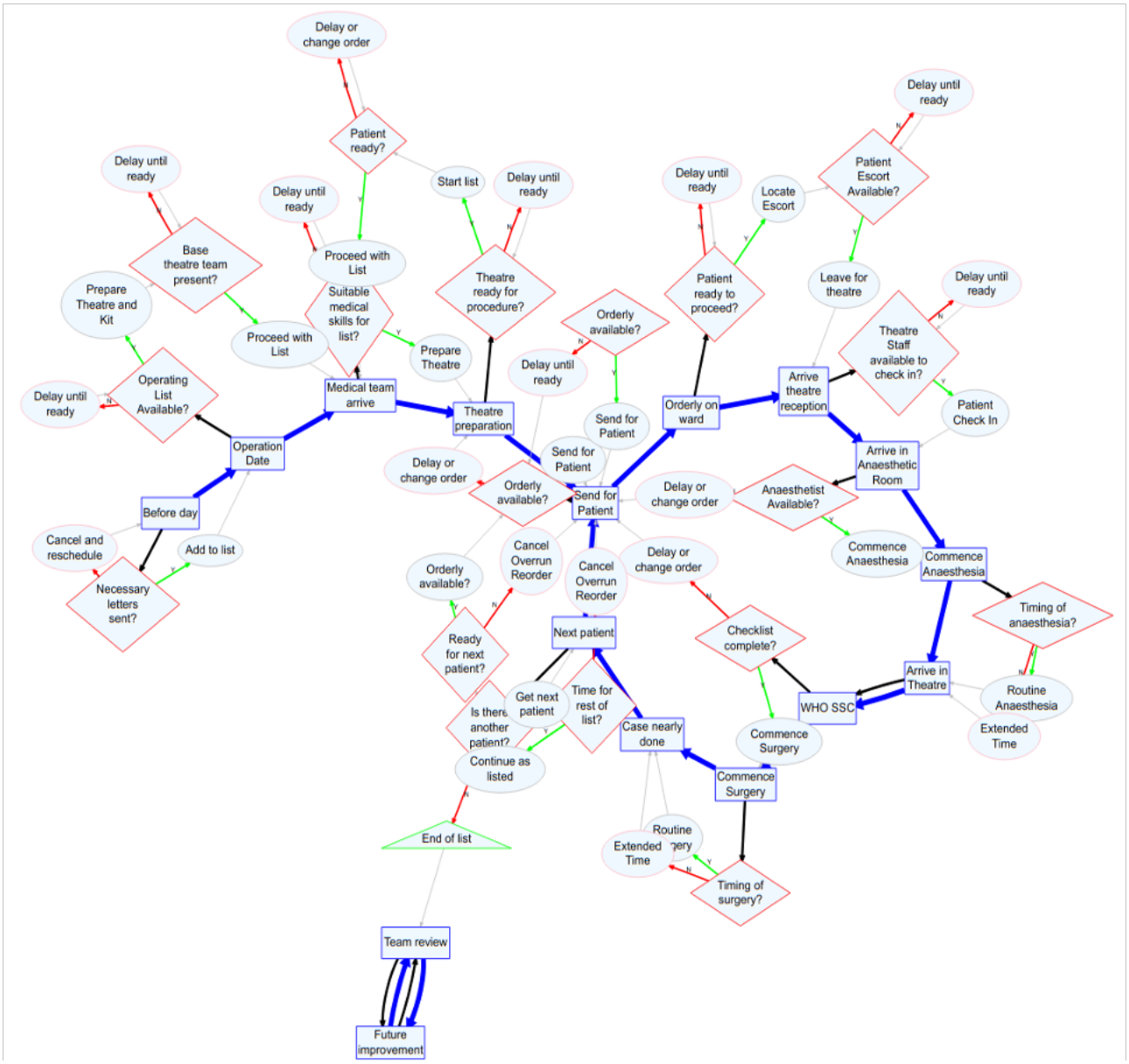

Figure 6: Process Map

PROCESS MAP SUMMARY

CONTENT	YES	NO
Has Patient's Pre Assessment and Admission Date Letter been Sent?	Schedule on Operating List	Cancellation and Delayed Treatment Reschedule Patient
Operation Date Is the Operating List Available?	Prepare Operating Theatre and Surgical Equipment	Delay whilst Operating List is Sourced
Appropriate Theatre Team Skill Mix present?	Proceed with List	Delay whilst appropriate Skill Mix sourced
Surgeon and Anaesthetist Team arrive Appropriate skills for complexity of the List?	Proceed with Anaesthesia and Surgery	Delay whilst appropriate Skill Mix sourced
Prepare Theatre – Surgical Instruments, Equipment, Furniture all present?	Proceed with List	Source outstanding equipment ?Delay
Theatre Team Brief – Patient Ready? Consented, Marked, Hospital Gown, Medical Notes, Lab Results, X-Rays	Commence Operating List	?Change Order of the List ?Delay
Send for the First Patient – is there a Theatre Orderly available?	Send for Patient	Source Alternative Theatre Staff to Collect Patient ?Delay
All Patient Preparation Complete on Ward?	Source Patient Escort to take the Patient to Theatre	Request Completion of Patient Preparation - Delay
Patient Escort Available	Depart Ward for Theatre Reception	Source Escort - ?Delay
Arrive at Theatre Reception – Theatre Staff available to check in Patient?	Patient Check In	Source Theatre Staff - ?Delay
Arrive in Anaesthetic Room Anaesthetist Available?	Commence Anaesthesia	Delay to Start of List
Anaesthesia Commenced	Routine (within timeline)	Complications and Extended Time in Anaesthesia – Delay
WHO Surgical Safety Checklist and Commence Surgery	Routine (within timeline)	Complications and Extended Time in Surgery – Unexpected Delay
Can the Rest of the Planned Surgeries be Completed in the Session	Continue with the Running Order	?Cancellation of Remaining Patients or Unplanned Overrun
First Case Nears Completion – Send for Next Patient – Is Patient ready?	Proceed to Send for Patient	?Reason ?Change the Running Order of the List ?Delay
Send for the Next Patient – is there a Theatre Orderly available?	Send for Patient	Source Alternative Theatre Staff to Collect Patient ?Delay

Continue with Scheduled List as per Running Order until Operation List is Completed

Time Out involving all the Theatre Team (Performance Review) – What went Well? What went not so well? Issues?

Strategy for Future Improvement

CHAPTER 4 RESEARCH METHODOLOGY

4.1 Introduction

Chapter 2, the literature review chapter, identified the extent of the published research concerning perioperative efficiency initiatives. It has also confirmed the scope for further study in this area of research. Chapter 3 outlined the conceptual model and the formulation of the process map that underpins the research. Next this research methodology chapter explains the processes used to direct the research in this study.

This chapter confirms both the empirical and theoretical contribution to the research. It also identifies the philosophical approach and intellectual traditions that guide this research. There is acknowledgement of the range of philosophical perspectives available to researchers. The chapter will provide an accurate and detailed description of the research approach taken.

The chosen position adopted by researchers is a prerequisite for original research. This position allows readers to establish an understanding of the researcher's viewpoint and their methodological bearing within the written text.

4.2 Research Question

The objective for the research has been to explore the operational processes of the theatre environment and describe recommendations for a more efficient approach to surgical patient flow in a large NHS university hospital. This will involve recommendations for clinical intervention trials with audit for review by the hospital and the wider healthcare research community.

The main research question to be answered is :-

How can efficiency be improved in an Operating Theatre environment?

The research question was proposed through the experience of the research team. It was formulated in response to the researcher's exposure to the daily issues affecting efficiency in surgical patient flow through the operating department. This was substantiated by the review of eighteen months clinical data released by the hospital to the research team. This data was analysed by colleagues in the statistics department at Queen's University Belfast. It revealed regular late starts, delayed turnarounds between patients and unplanned unfunded overruns. This regularity provided the focus for the research team to address why these issues were so common. The

literature review confirmed that the issues were being experienced on a world wide setting and also provided gaps in the knowledge base for the research team to exploit. This chapter on the methodology will explain how the research team chose to guide the research and both the methods and philosophy commissioned to create and deliver the core research objectives.

4.3 RESEARCH FRAMEWORK

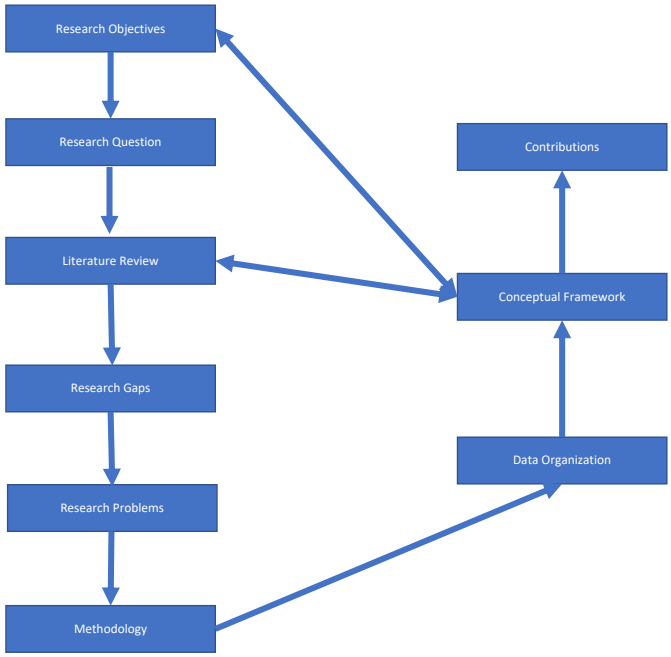

Figure 8: Research Framework

The overall research programme is composed of the following main constructs

Research Topic – Underutilisation of Operating Theatre sessions

Research Objective – To review throughput data and identify a suitable bottleneck to target for improvements

Research Question – How can efficiency be improved in an NHS Operating Theatre environment

The research question clearly states the focus of the research topic. By inquiring how efficiency can be improved in operating theatres the research explores the published literature. This identifies an

approach for new research as gaps in the literature are identified. The researcher then selects a methodological position to justify and develop the research.

There is a clear need to clarify the terms 'methods' and 'methodology' used in this research. The methods refer to the tools used to collect and analyse the data that supports this submission. Tools vary in complexity, interpretation, design and administration. Researchers must select those tools which will provide the data required for testing hypotheses.

Different tools used for data collection may be

1. Questionnaires
2. Interviews
3. Schedules
4. Observation Techniques
5. Rating Scales

Source :- Pandey & Pandey (2015)

The tools used to collect the data for this research project are a structured observation exercise directly observing both the processes involved and the patient flow from the surgical wards to the Operating Theatre suite reception.

This data was supplemented via stakeholder interviews from a selection of clinical specialities and users of the surgical services at QEHB. They were interviewed for their perspective on the efficacy of the surgical service provision.

Raw clinical data from the QEHB Operating Theatre database was analysed and used as preliminary evidence to support this research.

The methods chosen collect the supporting evidence for the research topic. The methodological influence refers to the researcher's chosen perspective. There are several methodological views available to researchers. These include Ontological 'What there is to know', Epistemological 'How can we know' and Axiological 'Philosophic study of values'. Researchers can also take an Ethnographic position where researchers observe society from the point of view of the subject of the study. A Phenomenological approach is the philosophical study of the structures of lived experience and consciousness. From this wide choice of methodological options researchers are expected to choose a viewpoint that both supports and justifies their topics of inquiry.

The methodology confirms the reliability and validity of the research and allows readers to follow how the study unfolds and importantly form their own opinion as to the credibility of the work and whether it contributes to new thinking and paradigms.

4.4 RESEARCH PHILOSOPHY

4.4.1 Research Paradigm

The research paradigm and the theoretical contribution within this research refers to the introduction of a cohesive healthcare pathway for surgical patients. This is a move away from 'silo' working by healthcare professionals which are prevalent in modern UK healthcare institutions (Meneses & Caseiro 2018).

The recommendations within the paradigm are to support new working practices and encourage a speciality 'system' for surgical patients. This 'system' provision will unite all the contributing stakeholders responsible for delivering the service to surgical patients. It is believed that this shift from 'silo' to 'system' can allow greater clinical efficiency and increased patient throughput (Meneses & Caseiro 2018). A buy-in from all the stakeholders is essential to drive the project forward. Further, the challenge needs to undergo robust audit to review and adjust the impact of the changes introduced to sustain a measured effect.

This choice of paradigm manages the selection of methodology used to justify the paradigm which in turn directs the methods used to collect and analyse the data. These fundamental elements of research will be supported by the appropriate literature to complete the final thesis.

4.4.2 Ontological View

Ontology is a part of the philosophical branch of metaphysics. Ontology relates to the nature of being and becoming. Its associated viewpoint is 'what there is to know' and deals with the nature of reality. The central question asked from an ontological stance is whether social entities need to be perceived as objective or subjective.

Research philosophy Ontology: the researcher's view of the nature of reality or being

- Pragmatism: External, multiple, view chosen to best enable answering of research question

- Positivism: External, objective and independent of social actors
- Realism: Is objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning (critical realist)
- Interpretivism: Socially constructed, subjective, may change, multiple

4.4.3 Epistemological View

Epistemology deals with the sources of knowledge in the field of study.

Research philosophy Epistemology: the researcher's view regarding what constitutes acceptable knowledge

- Pragmatism : Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
- Positivism : Only observable phenomena can provide credible data, facts. Focus on causality and law-like generalisations, reducing phenomena to simplest elements
- Realism : Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism).Focus on explaining within a context or contexts
- Interpretivism : Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions

4.4.4 Axiological View

Axiological methodology studies judgements about the value. In particular axiology deals with the assessment of the researcher's own value on all stages of the research process.

- Axiology: Popular data collection techniques

- Positivism: Research is undertaken in a value-free way, the researcher is independent from the data and maintains an objective stance ; Highly structured, large samples, measurement, quantitative - can also use qualitative
- Realism: Research is value laden; the researcher is biased by world views, cultural experiences and upbringings. These effect research findings Methods chosen must fit the subject matter, quantitative or qualitative
- Interpretivism: Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective ; Small samples, in-depth investigations, qualitative
- Pragmatism : Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view ; Mixed or multiple method designs, quantitative and qualitative
- Axiology primarily refers to the 'aims' of the research. It also is engaged specifically with the assessment of the role of the researcher's own value on all stages of the research process (Research Methodology 2019).

4.4.5 Research Design

Social scientists are expected to take one of a number of traditional positions when conducting research. These viewpoints are epistemological - 'how can we know' or ontological - 'what is there to know' and are implicit. These positions are confirmed within their methodology and application. These positions are vital to social scientists as the research and the underlying position guides the approach to methods and theory (Marsh, D. Stoker, G 2010).

Saunders et al (2007) constructed a philosophy map called the Research Onion. It describes the stages that researchers must consider when selecting an appropriate methodology. A chosen philosophy justifies the research methodology which in turn is informed by the nature of the observed phenomena.

There are several approaches available for researchers to select their methodological position. Deductive methodology develops hypotheses upon existing theory and then develops a question to test it. In inductive methodology observations are the starting point and patterns are looked for in

the data. A thorough understanding of the research process is a fundamental requirement for social scientists when conducting their studies at doctoral level.

Where ‘methods’ in this paper refer to the techniques used to collect and analyse the data, ‘methodology’ involves the research theory used to deliver the project. The methods used are the raw data set of clinical activity and its modelling, process mapping, stakeholder interviews and structured observation. These processes give both a quantitative and qualitative input to the presented data and findings. A ‘methodology’ chosen for research will attempt to explain how things work and specifically how things work under certain conditions. The development of theory through research produces a group of reports that collectively unite, expand and broaden ideas that previously had been isolated. These reports become the foundations of the project.

4.4.6 Research Onion

The ‘philosophy map ’ known as the Research Onion as described in 2007 presents a pragmatic description of the research theory process. Onion layer analogy has been used in various professional capacities to describe and explain theory. It is a particularly useful tool to demonstrate the choice of research theory and to assist researchers in their methodological choice. The onion describes the six stages required for research – philosophies, approaches, strategies, choices, time horizons, techniques and procedures (Saunders, Lewis, Thornhill 2007).

The literature review confirmed that the appropriate selection of a research methodology is vital in collecting evidence to support project principles.

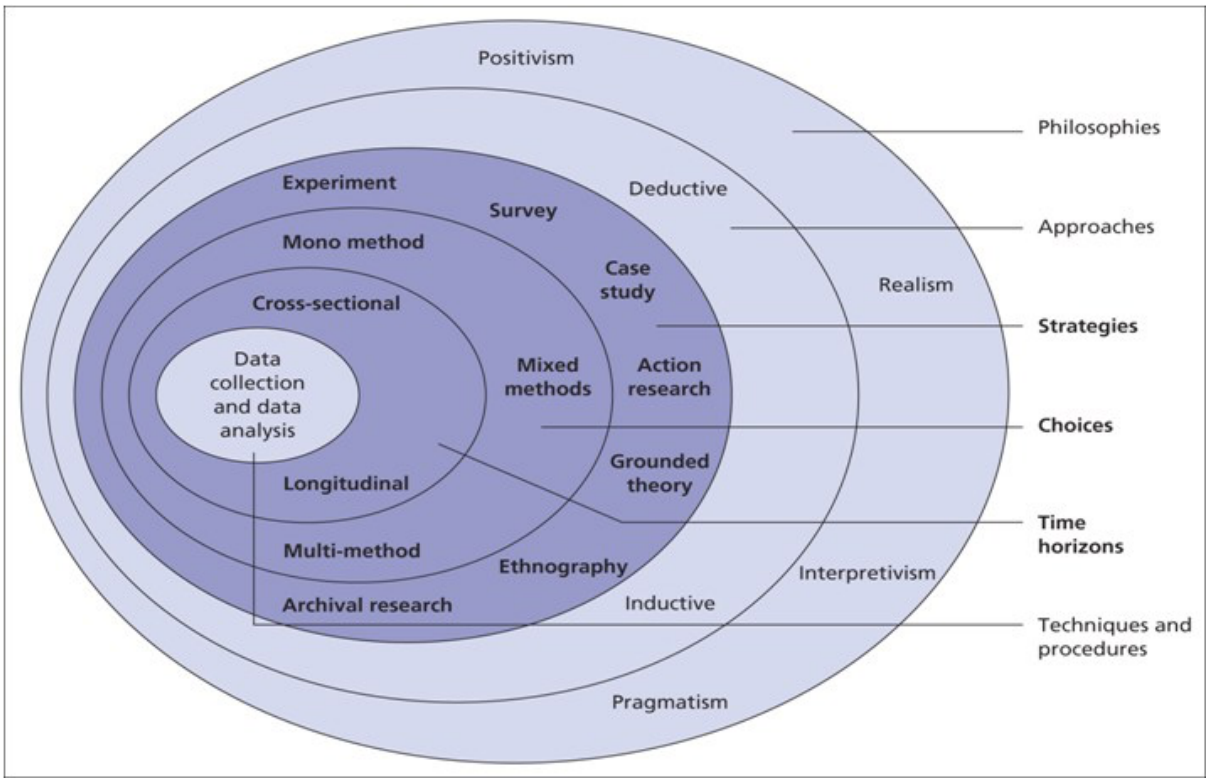

Figure 10: Research Onion (Saunders, Lewis, Thornhill 2006)

Based on the philosophy onion this research takes the following approach in the six stages of methodological table

1. Philosophies – Realism – focusing on states in their relations with one another
2. Approaches – Deductive – hypothesis to prove assumptions
3. Strategies – Case Study
4. Choices – Mixed Methods
5. Time Horizons – Cross Sectional
6. Techniques and Procedures – Stakeholder Interviews, Structured Observation, Secondary Clinical Data

The analysis of the data and its preparation for presentation becomes a sequential process that follows on from the study of the problem and the chosen objectives. The research design is also vital in setting a clear explanation of the project's intention. The design should feature

1. An overview of the aims and objectives arising from the research question
2. Clear description of the data sources
3. Constraints – access to data, time, financial, logistics, organisational access
4. Ethical Issues and Permissions

This sequence has been used for the preparation of this research project. Together with the research methodology the research design forms the focus toward the delivery of the main body of work. The philosophical foundations of the research lead toward a research paradigm. Research paradigm concepts were first described by Kuhn in 1970. The elements of a paradigm revolve around the integration of a group of associated concepts, variables and problems which are in close association with methodological approaches and research processes. (Kuhn 1970).

The reliability and validity of the reviewed data is crucial in terms of producing an effective strategy to address the research question. The justification of the researchers chosen methodological position will endorse the integrity of the project. It will be reviewed for a suitability as a contribution to social science within the academic community.

There are acknowledged limitations in applying the methodology to research, data collection and analysis. Researchers must be aware of these limitations and avoid subjectivity. Regular peer review during project development will confirm both the strengths and weaknesses of the work and serve as an aid to researchers as to the value of experienced opinion.

In formulating a methodological position, researchers must be confident of achieving access to the population and the statistical data required to support the project's core themes. Limitations involving scope, sample sizes and subjectivity need to be considered during the field work. Writing up the data would also benefit from independent review and opinion.

The study put forward in this thesis confirms that the research methodology chosen is case study. This approach has been selected to formulate an effective methodology.

A qualitative approach has been selected for the methodological presentation within this research. Quantitative data from secondary clinical sources will support this research.

The data presented in this project will be both qualitative and quantitative.

4.5 Research Strategy

4.5.1 Qualitative

The qualitative data will be collated by field work undertaken at QEHB. This work will consist of interviews with the stakeholders who use the surgical services alongside a structured observation exercise which will collect data for the research team directly accompanying the theatre staff who collect the patients for surgery.

The data collected from both streams will combine to support the findings and recommendations of the research. This contribution to the main thesis will underpin the methodology used for the research.

4.5.2 Quantitative

Raw data from the electronic clinical activity capture software used by the Theatres in QEHB will be analysed, interpreted and presented as a flow model. The flow model will be prepared by statistician colleagues at Queen's University Belfast. The analysis and interpretation of the modelling will be my responsibility. The collaboration from the team at Queens will be acknowledged in the final submission. The purpose of this exercise is to highlight recurring delays in perioperative patient throughput. These identified bottlenecks will be reviewed by the research team and an intervention recommendation designed to address a selected bottleneck. To support this work a process map will be designed to demonstrate the involvement of the stakeholders in the patients' journey. These operational processes will be presented in the form of a role activity diagram. The focus will be on 'what' occurs during the process rather than 'how' and by 'whom'. It will highlight how a set of activities are performed to achieve the identified goal. The process map is included in Chapter 3 alongside the conceptual model.

4.6 Methodology

The sequence of research is as follows

1. Research Proposal – overview of the intended research project and construct of programme

2. Literature Review – review published papers on chosen subject and identification of gaps in the literature to exploit for further research
3. Research Methodology – Confirms the chosen approach by the researcher
4. Field Work – Data collection and synthesis (collaboration with Queen's University Belfast) - Interviews with Stakeholders - Structured Observation – Process Mapping – Recommendation for Clinical Intervention
5. Analysis of the Data
6. Synthesis and Project Write Up
7. Conclusions and Contributions

4.6.1. Analytical Approach

Within modern healthcare facilities there are several stakeholders responsible for providing the complete surgical provision to patients. It is for this reason alone that the flow of patients to and from the operating theatre can be less than effective. Each stakeholder performs their tasks in what they believe to be the best. Where the service suffers is from these stakeholders performing as individual units rather than as a cohesive service.

It is imperative to acknowledge this fact when deciding on an analytical approach to this research project. The problems affecting the surgical services must be separated into constituent elements. This process reduces the complex issues into simple terms. The analytical approach taken for this project will be structured rather than instinctive. This will allow systematic analysis and review of the processes and their associated issues in an open manner. This is ultimately a more satisfactory approach than the instinctive 'closed' route. (Jones 1995)

The qualitative data will be collected and analysed from the field work. This will include practitioner interviews combined with structured observation of clinical practice and process mapping.

The quantitative data collated for this project is 18 months of raw data collected from the operating theatre data clinical base at QEHB. The information is anonymised and covers the timings of the patients' journeys from the wards to the theatres and the various processes that occur with the operating theatre suite whilst the patients are being treated. This data has been modelled by colleagues at the Centre for Statistical Science and Operational Research at Queen's University

Belfast. The modelling will identify recurring bottlenecks in the pathway. The identification of the bottlenecks will support the basis of the clinical recommendations included in the project. Sustainability of any improvement via the recommendations in the service will be paramount too.

4.6.2 Case Study

The project is presented through a case study using qualitative data supported by quantitative clinical data. Case study is empirical inquiry that investigates a contemporary phenomenon within its real life context – the boundaries between phenomenon and context are not clearly evident. Multiple sources of evidence are used to support the research in case study (Yin 2014). Case study in qualitative research terms develops a naturalistic method using multiple forms of the available evidence (Gillham 2005). Case study is defined as empirical inquiry that investigates a contemporary phenomenon within its real life context. The boundaries between phenomenon and context are not clearly evident. It is a chosen methodological position adopted by researchers in which multiple sources of evidence are used (Yin 2014).

The literature has been reviewed surrounding projects that have targeted operating theatre performance and effectiveness. These projects have delivered significant improvements. However there is still a requirement to marry up all the contributing clinical areas that are responsible for delivering the surgical services to gain further efficiency of provision. This research project will build upon prior success and promote recommendations to facilitate a 'system' led service.

A single case study design supported through the theory developed by fellow researchers was used to investigate the issues that impact on the effective running of operating lists. A variety of data collection methods were used to validate the case study. Stakeholder interviews, structured observation, process mapping and patient flow modelling using quantitative clinical data from QEHB Theatres database (modelled by colleagues in Queen's University Belfast) has been incorporated. The analysis and synthesis of this data has identified areas within the patient flow to recommend clinical intervention to tackle recurring delays. If intervention is plausible and effective by future researchers then studies around these interventions will report on sustainability via regular audit.

The clinical intervention recommendations will be aimed at high volume low variety surgery. This type of surgery is typified by intermediate day case procedures. Typically these are hernia repairs, diagnostic arthroscopic surgery and laparoscopic cholecystectomy, common procedures of approximately 1 hour duration. By targeting these non-complex surgeries the researchers hope to

achieve the best impact possible from the recommended trial of clinical intervention for improved patient throughput.

It is the intention that by identifying where the common recurring delays occur via the data collected that recommendation for intervention can be introduced to good effect. In future research the effect can be scrutinised for long term durability.

It is generally recognised that hospitals providing surgical services to patients incur a significant demand on their annual budget by doing so. Surgical service provision and in particular operating room time and labour are acknowledged as a cost intensive practice (Macario 2010).

With an ever increasing demand for surgical services across all continents the funding and delivery for the service becomes more challenging. In the United Kingdom with medicine providing better treatments and cures we are now seeing an increasingly larger elderly population with co-morbidities that are impacting on healthcare budgets. Coupled with the rapid clinical advances that the medical profession are delivering this puts further strain on finite healthcare budgets. The same situation is also being felt in Europe. In Holland in 2015 healthcare expenditure was 95.3 billion euros and represented 14% of GDP. The UK spent £185 billion on healthcare in 2015 which represented 9.9% of GDP.

Therefore it is justified to review perioperative performance to identify current practices. Where there is opportunity to introduce new practice to reduce delays and increase productivity this option should be offered to the managerial teams responsible for surgical services delivery. Where budgetary constraints are in place in the UK public sector health service it is in every healthcare institution's interest to consider delivery of a more effective surgical service.

Case study has been selected as the most appropriate study design for this research. The case is the review of the surgical service provision in a large NHS hospital. This qualitative approach will be supplemented by sourced quantitative data also. The quantitative data represents clinical activity within the Theatre suite over an 18 month period.

In selecting a case study design the research offers an opportunity to detail the challenging environment of the Theatre suite and how it manages its activity. It also allows opportunity for introducing change with clear boundaries referred to as bounded. This term originates from Louis Smith, a pioneer ethnographer (Stake 1995).

For the qualitative aspect of the data collection the stakeholders who use the surgical services will be interviewed for their opinion on the current service and asked for suggestions to recommend improvement. Should an intervention be placed within the patient pathway the effect it has should be monitored for efficacy and sustainability. It should be noted that the intervention may have a negative effect elsewhere in the patient pathway. It will also need 'buy in' from the practitioners who will be asked to undertake new working practices. The whole pathway should be carefully monitored by those responsible for introducing the intervention. A detailed process map of the patient pathway should be constructed prior to the introduction of the intervention. This map can be used to guide the delivery of the intervention and to highlight issues that may occur outside of the targeted position of the intervention along the pathway.

Case study affords the opportunity to use a number of data sources which allows researchers to drill down both into the case and the specific area that has been selected for scrutiny. The value of this approach is that it provides data from a number of areas within the chosen environment which can be cross validated with other evidence in the setting (Gillham 2005).

The decision to use case study as the main research design allows this part of the change journey to be mapped as it unfolds. It confirms the factors involved in the implementation and sustainability of the change. It also keeps a tight focus on the change programme which can then be reported in a clear and understandable format.

4.6.3 Description of the Case and Research Site

This case study is being undertaken in the Theatre suites of the Queen Elizabeth Hospital Birmingham. The hospital is one of the largest teaching hospitals in Europe. It is a regional centre for cancer, neuroscience, major trauma and burns and plastic surgery. It provides highly specialised cardiac and liver services and has the largest solid organ transplant programme in Europe. The Trust has an international reputation for clinical education, training and research.

There are 42 Theatres and procedures rooms available for the surgical services to undertake their work. The work undertaken is a mix of complex, intermediate and day case surgeries. It is a busy environment that employs robust management and planning to under-take it's scheduled and emergency activity.

4.6.4 Context

An initial review of 18 months of clinical data captured by the teams working in the Theatres in 2015 revealed regular issues with late session starts, turnaround times between patients and unplanned overruns. This impact was noted as unused session time where no clinical activity was undertaken by the staff within the Theatres. This issue became the impetus for undertaking the research. Discovery of the contributing factors that lead to the inertia has become the primary focus of the research. Case study has been chosen to report on the phenomenon in this busy complex setting. The research will be further supported by the modelling of the clinical data to identify recurring bottlenecks. This work will guide the selection of a clinical intervention for recommendation to trial in the clinical setting. This quantitative aspect of the research was undertaken in collaboration with colleagues from the Centre for Statistical Science and Operational Research at Queen's University Belfast. The overall aim of the research is to promote a cohesive system led surgical service provision with recommendation to achieve this by all the stakeholders working together rather than in 'silos'.

4.6.5 Theoretical Perspective

Adopting a theoretical perspective when conducting research allows researchers to develop a theoretical understanding of a problem by defining what is going on and how it might be understood (Robson 2011). Theories are formed to explain, predict and understand phenomena. They also challenge and extend existing knowledge within bound limits. This theoretical framework then becomes the structure that can support a theory of research study.

It is important to choose the theoretical perspective in advance of any data collection as it will guide researchers in selecting the appropriate data to collect and the methods available to do so. It will also guide how the collected data will be processed and analysed (Yin 2014).

The theoretical perspective chosen for this work is realism.

Theoretical perspective for the purpose of research is perceived to be a belief concerned with the development of the knowledge in which data regarding the phenomenon is collected, analysed and processed (Coolican 2014).

These beliefs form essential assumptions about the way the researcher views the world. These assumptions allow the researcher to decide on a research strategy and a method for the research (Saunders 2007).

There are many diverse versions of realism across the philosophical landscape, but a common feature of the realist position is an integration of realist ontology (there is a real world that exists independently of our perceptions, theories and constructions) with a constructivist epistemology (our understanding of this world is inevitably a construction from our own perspectives and standpoint, there is no possibility of an independent viewpoint). In addition, these versions of realism acknowledge the reality of mental phenomena and the value of an interpretive perspective for studying these.

Realism research philosophy relies on the idea of independence of reality from the human mind. This philosophy is based on the assumption of a scientific approach to the development of knowledge. Realism can be divided into two groups: direct and critical.

Direct realism, also known as naive realism, can be described as “what you see is what you get”. Direct realism portrays the world through personal human senses.

Critical realism, on the other hand, argues that humans do experience the sensations and images of the real world. According to critical realism, sensations and images of the real world can be deceptive and they usually do not portray the real world (Business Research Methodology 2021).

Direct realism has been chosen from the epistemological position as the primary theoretical perspective for this research to access observable phenomena to provide credible data and facts. The ontological position shows us that realism is objective and exists independently of human thoughts, beliefs and knowledge of their existence. Realism from the axiological perspective explains research as value laden. It also primarily refers to the ‘aims’ of the research. It also is engaged specifically with the assessment of the role of the researcher's own value on all stages of the research process (Research Methodology 2019).

By adopting a theoretical perspective this study has followed the tradition of selecting a philosophical position to develop and support the research.

Given the nature of the study and its environment the direct realism philosophical approach is appropriate for the development of the data and knowledge concerned with the phenomena.

Selecting a deductive methodology approach has developed hypotheses upon existing theory and developed a question to test it.

A case study using a mixed methods approach has been selected to examine the research topic objectively.

The techniques and procedures employed to record and analyse the data were also confirmed as part of confirming the philosophical perspective. These are stakeholder interviews, structured observations for the qualitative data and the secondary clinical data providing the quantitative contribution.

The review of the quantitative clinical activity data capture covering 18 months of activity in the Theatres at QEHB provided the initial formation of theory for the research. From this big data it was evident that there were recurring issues with patient throughput and delays. The theoretical perspective was guided from the basis of these issues. Why were these issues recurring and for what reason?

This perspective led to case study being selected to investigate the processes involved in the operational management of Theatres. Interviews with stakeholders have been conducted and transcribed to capture their knowledge and understanding of operational performance of the Theatres. Recommendations for improvements have also been sought as part of the interview process.

Structured observation with practitioners responsible for collecting patients from the surgical wards and admission unit has also been undertaken to understand the processes involved in the preparation and transport of patients for surgery. This theoretical perspective together with a published literature review of previous work in this specific area provides the framework to support a theory of research study.

In choosing to use case study this research investigates perioperative patient flow processes as a phenomena within its real-life context.

4.6.6 Model for Change

Alongside using a theoretical model to guide research it is also useful to use a change model to support and enable the implementation of the change in practice. Using the principles of a change model will empower the researcher in facilitating the chosen change strategy (Peck 2017).

There are several choices of change model available for reference and selection. LEAN and Six Sigma change models have been widely used in healthcare. Their influence has been widely reported in the literature. The fundamental message from these initiatives is that success is secured through 'buy in' from those involved in the process. Robust review of the impact of the programme is vital to ensure sustained progress of the change. This may take years rather than months.

The principles of LEAN have been chosen as the change model for this project. LEAN projects have had a good impact in the private sector. In the public sector however their impact has been less dynamic. This is due to a lack of understanding and commitment by stakeholders and a lack of proper execution of projects (Schilstra 2015).

With perseverance and good leadership LEAN projects can be successfully managed in the public healthcare setting. This project will use LEAN as the driver for change. The restrictions of past public sector projects have been acknowledged. This will allow the recommendation of these clinical interventions to be delivered in a positive fashion by empowering the stakeholders with the understanding and commitment required to fully execute the project.

The model chosen should contain the following four key areas for improvement

1. Aims
2. Measures
3. Ideas for Change
4. Cumulative Testing

The Institute for Healthcare Improvement advocates a Model for Improvement that asks three fundamental questions together with the Plan-Do-Study-Act (PDSA) cycle.

The questions are

1. What are we trying to accomplish?
2. How will we know a change is an improvement?
3. What change can we make that will result in an improvement?

These questions can be asked in any order. The PDSA cycle tests change in real work settings. This cycle guides the test of a change to determine if the change is an improvement

The model also sets out six skills to support improvement

1. Support change with data
2. Develop Change – Understand the process and systems of work – inputs, steps and outcomes
3. Creative thinking – adapting known good ideas sourced from the literature reviewed
4. Testing change- try the change and learn its potential impact
5. Implement the change – aim for permanent inclusion in day to day business operation
6. Distribute the change – to wider audience and locations

4.6.7 Surgical Case Selection

If the model for change is to have a marked effect then the selection of surgical work to target is an important consideration. In terms of process strategy in delivering surgical services the most apparent sector is the high volume low variety category. The surgeries that fall into this sector are typically non-complex day surgeries where the delivery of the surgery follows a set pattern and allows multiple repeat processes during a planned operative session. Low volume high variety surgeries offer little opportunity to introduce change in a robust manner. This type of surgery is commonly complex, unpredictable and lengthy. Typically seen in cardiac, neurological and transplant surgeries these represent the opposite spectrum to the non-complex day surgeries. This makes them unsuitable for the purpose of this research. High volume low variety surgery will benefit from standardisation (i.e. kit, personnel) and quality provision.

4.6.8 Ethics

Ethical clearance for this project has been secured both from my workplace QEHB where the project is registered as a clinical audit (CARM-12239) and from the research ethics committee in Dublin City University.

4.6.9 Conceptual Framework

The conceptual framework for this project covers in the first instance the ‘research problem’. This then supports the ideas and beliefs concerning the studied phenomena that contribute to a

theoretical framework. Developing a conceptual framework informs the research design. This will refine the research goals and allow development of the relevant research questions. It also allows selection of appropriate research methods and identifies potential validity threats. Above all the framework justifies the chosen research. (Robson 2011)

4.6.10 Research Design

This is the blueprint for the adopted strategy to integrate the different components that contribute to this study in a coherent and logical way. The design will oversee the collection, measurement and analysis of the data.

4.6.11 Data Collection

The data contribution to this research will be qualitatively supported by secondary clinical data. This will produce a triangulation of data collection methods across the single research theme.

Stakeholder interviews who provide the surgical services will provide insight into their perception of the service and recommendation for future improvements in service delivery

Structured observation of the clinical activity with particular focus on the patient journey to the theatre suite. Process mapping using the 'role activity diagram' method to demonstrate the individual processes that contribute to the patient cycle time.

Data has been collected from the clinical theatre activity database at QEHB in an anonymised format. It has been reviewed and analysed by colleagues at the Centre for Statistical Science and Operational Research at Queen's University Belfast.

4.7 Review of the Analysis

Synthesis of all the data and recommendations will be included in the Results chapter of this research. It will cover the key challenges, the agenda, the problem and recommendation for a solution.

The following documentation was used to facilitate data collection from the field work for the qualitative research

4.7.1 Topic Guide For Stakeholder Interviews

The guide was written to offer to the stakeholders prior to the interview to prepare them for the themes to be covered.

IMPROVING PERIOPERATIVE EFFICIENCY AND PATIENT THROUGHPUT TOPIC GUIDE for INTERVIEWS

This research project is to analyse the surgical services 'system' at Queen Elizabeth Hospital Birmingham with particular interest in patient throughput and the recurring issues with delays due to late starts, turnaround times and unplanned overruns.

The purpose of the interview is to seek opinion of the surgical services and to discover themes in order to suggest improvement strategies. The interview should take no longer than 30-45 minutes.

Operating Theatre use is one of the most cost-intensive activities hospitals provide. There are recurring themes documented in published literature that delay throughput in theatres. I am seeking the opinion and recommendations from colleagues who regularly use theatres to improve efficiency and increase the numbers of patients operated on. Some of this work has been started by Newton[1].

The published literature primarily concerns single clinical areas of the perioperative patient journey which are selected for improvement strategy. My research aims to overcome the challenges of 'silo' working with recommendations to promote a cohesive service where stakeholders understand the whole process of patient flow and are able to support a 'system' led service.

I will seek consent to record the interview and should consent be given I will transcribe the interview to include in the project. The identity of the participants and information detailed in this process will be completely anonymised. I will forward a copy of the transcription to each participant for review to confirm accuracy of the content and to allow for corrections

When the final report is collated I will again send it to all the interviewees for amendments before final submission to my registered education facility, Dublin City University.

1 During the course of this project Newton consultants carried out a hospital wide review, part of which included the operating theatres.

If you would like any more information regarding the interview process please contact me at geddoyle@uhb.nhs.uk

Thank you for agreeing to participate in this interview. It will be a valuable contribution to the recommendations provided for the final submission.

This generic topic guide was written to inform all the stakeholders approached for interview of the intentions of the research and to confirm that all the data collected from this source would be anonymised.

4.7.2 Questions For Interview

The following sample questions were devised to present to the stakeholders interviewed for this research. They were adapted to suit stakeholder speciality and their contribution to the surgical services. The researcher used his clinical experience of how Operating Theatres function to compose meaningful questions for the different user groups.

Questions For Interviews With Surgeons

- How long have you worked in Theatres?
- How many sessions do you operate on per week?
- Is this enough capacity for your waiting lists?
- Do you have enough Outpatient Clinics? Do they balance? Are there enough Outpatient Clinic slots to furnish your Operating lists?
- Do you complete your operating lists? Most of the time? Sometimes? Rarely?
- Are your patients cancelled due to a lack of beds? Regularly? Sometimes? Rarely?
- What are the common issues that lead to delays in operating times?
- Do your lists experience late starts, delayed turnarounds between patients and unplanned over runs? How often? Why?
- Do the Theatre team have any control/influence over these issues?
- Do patients requiring emergency surgery impact on your planned elective lists
- Do you have any suggestions to reduce unforced delays and improve the effectiveness and patient throughput of your operative sessions?

Questions for Theatre Staff

- What input does your Theatre team have with the management and scheduling of your elective operating list?
- Do you engage in regular stakeholder meetings to schedule the proposed work?
- Have the Theatre Team Briefs made a difference in achieving the planned activity?
- Do you have regular debriefs after each operative session – Effective?
- Do your lists experience late starts – turnaround times between patients – unplanned overruns?
- Would a separate dedicated turnaround team to clean and prepare for the next patient improve the efficiency and throughput of the scheduled work?
- Do your emergency patients impact on the scheduled work? Always? Sometimes? Never?
- Recommendations for improvement?
- Would extra resources improve the service? Ward Link Practitioner
- Would the surgical speciality support the extra resource to provide a link practitioner to improve the efficiency of the flow of patients for your operative lists? How would this be facilitated?

Questions for Surgical Ward Managers and Nurses

- What surgical speciality is your ward? Do you cater for other surgical specialities? Always? Sometimes? Never?
- Do you have meetings with the surgeons and stakeholders for the service to discuss the planned elective activity? How often?
- How does the patient preparation work – admission process, consent, investigations, patient preparation
- Are you aware of the running order of the list? Does the ward have a copy?
- Are you made aware of any changes in the order of the list by Theatres? Always? Sometimes? Never?

- Do you have any issues with releasing staff to escort the patients to Theatres?
- Do emergency surgeries impact on your elective patients leading to cancellations?
- Are last minute cancellations a regular issue?
- Delays – are they because of mainly ward/ administration issues or Theatre issues?
- How often are do these delays impact on the planned surgical activity
- Recommendations for improvements?
- Would extra resource be useful in contributing to the safe efficient management of the ward – i.e. Link Practitioner?

4.7.3 Link Practitioner

An explanatory note concerning the introduction of a link practitioner as mentioned in the stakeholder questionnaire. A link practitioner would serve to bridge the gap between the surgical wards and operating theatre 'silos' to ensure that surgical patients are prepped and transported for surgery in a timely manner. The practitioner's work would promote a seamless service and reduce late starts and delays in the planned workload. The potential of this extra resource will be looked at in Chapter 5 – Results and will form one of the proposals for a clinical intervention with audit.

4.7.4 Transcription of Interviews

All interviewees were asked if they are willing for the interview to be recorded and transcribed. It is explained to them that the information they provide will be used anonymously and a consent form was signed to that effect.

The recordings were made using a digital dicta-phone. This allowed the researcher to capture the information with a high level of authenticity.

They have all received a copy of the transcription to review for accuracy and corrections before it is included in the research.

4.7.5 Documentation

Documentation plays a vital role in any data collection involved with case study methodology. Documentation is used to support and strengthen evidence from other sources.

Yin (2003) offers several main reasons for using corroboration and augmentation from other sources.

1. Confirming the correct spelling and titles of stakeholders and organisations
2. Keeping specific details that can support the verbal accounts of informants
3. Setting the context for interviews or discussions within the organisation being studied

Yin (2003) states that this category of evidence can take many forms such as reports, letters, organisational records, therefore documentation should be the object of specific data collection plans.

For the principal purpose of this research different documentation was collected through sources available to the researcher. This included clinical data spreadsheets, department of health reports and think tank reports (Kings Fund).

Data was managed by Nvivo software. Nvivo helps researchers to organise and analyse non-numerical and unstructured data. It has been described as a qualitative data analysis tool. It allows researchers to classify, sort and arrange information collected from a variety of sources which can be used by the analyst to test theories, identify trends and cross examine information in a multitude of ways. A body of evidence can be built by researchers to support their projects by interpreting the qualitative data.

4.7.6 Participant Selection

The researcher involved a broad range of stakeholder participants for the data collection. After discussion with the researcher's supervisor team it was felt that involving a wide spectrum of operating theatre users would afford a deeper perspective of both the operational agility and challenges affecting the large number of operating suites located within the base hospital.

Theatre Management, Surgeons, Anaesthetists, theatre nurses, operating department practitioners, theatre orderlies, ward managers and staff were all approached with invitations to participate.

The involvement of a large commercial organisation drafted into the Theatre department at the request of the hospital senior management in 2016 to review operational processes and offer working solutions to start times and delays has undoubtedly impacted on the researcher's requests to stakeholders for formal interviews and the structured observation. This is due to saturation for the requests for participants.

This unforeseen development at the very centre of the research period has been acknowledged in yearly progress reports to the researcher's supervisor team.

The data presented in this project will reflect the challenges of recruiting participants. Above all the data will consolidate the research position and justify the main research question.

4.7.7 Question Types

A topic guide was written by the researcher to offer to the interview participants. This was undertaken to give a clear picture of the intention of the research and explain the interviewees role in providing the anonymised data.

March and Shapira (1987) recommend that questions be clear and to the point. They also suggest that using clear and unambiguous language helps provide a definitive answer.

The interviews were a mixture of open and closed questions. This was designed to extract specific information about patient flow from the wards and within the operating theatres and for their recommendations to improve patient throughput.

4.7.8 Coding

The process of coding the interview transcripts and structured observations offers the researcher a useful tool to categorise rather than quantify the data. The coding process deconstructs the data into summary codes through asking questions and making comparisons. Similar responses became concepts which were grouped to form categories and themes where their properties and dimensions could be examined.

Strauss and Corbin (1990) state that coding is about conceptualising the data. This is followed by reconstructing data to understand details, re-organising data to find the interrelationships and comparing the data with themes and concepts.

The case study analysis uses the summary codes to identify commonalities in the stakeholder perspective.

4.7.9 Structured Observation

At the end of 2017 permission was sought from Theatres senior management to undertake several structured observation exercises with the Operating Theatre orderlies responsible for collecting and transporting the patients to and from the Operating Theatre Suites from the surgical wards.

This request to observe the activity first hand has offered the researcher an opportunity to review the underpinning processes involved. This work will also contribute to the construction of a process map using a role activity diagram detailing all the stages involved in the patient flow (Chapter 3). The information collected from this exercise will also be used in determining which area to focus on for the recommendation for clinical intervention trial.

The observations took place over a number of occasions involving different Theatre orderlies. They were all briefed as to the purpose of the observations and that all the information and data collected would be included in the data set in an anonymised manner. When the orderlies were asked to collect patients from the surgical wards the researcher accompanied them at a discreet distance. This enabled the researcher to observe the processes in an unobtrusive manner and to maintain a level of natural observation.

The reason for using different orderlies was to gather a broad perspective of the challenges they face when tasked to collect patients from the surgical wards. Their opinions on how the service is run and their suggestions for improvements were sought too.

As the QEHB is a large hospital with a large footprint there are occasions when patients waiting for collection for surgery may not be ideally placed geographically to the Operating Theatre suite. This is due to general patient capacity management and the housing of overnight emergency patient admissions by the hospital site night management teams.

This may mean that patients are remote to where they need to be for their surgical procedure and this factor builds in extra transportation time for both the orderly and the patient.

All the observed activity was recorded in real time and transcribed retrospectively. The transcripts were offered to the orderlies who participated in the observations for accuracy and corrections.

It was a very valuable exercise. It allowed the researcher the opportunity to see first hand all the processes involved in the preparation and collection of the surgical patients. The observations also

highlighted the reasons for delays. These delays were coded for commonalities. It became clear that there were regular issues that hampered the timely transfer of patients to the Operating Theatre reception.

These results will be presented in Chapter 5 – the Results chapter of this research project.

4.8 Conclusion

This chapter confirmed the methodological stance taken by this research to address the research question presented in chapter one. The research framework has been clearly defined seen through Figure 4.1

The framework serves as the platform for the research philosophy based on the philosophical assumptions of the Research Onion (Figure 6) and the selection of case study as the research position.

The main methods chosen to gather the data were then identified, a qualitative method underpinned by quantitative data (clinical activity data capture).

The main method of data collection was the stakeholder interviews and the structured observation exercise. This was supported by analysis of the clinical activity data capture.

The research strategy and methodology have been discussed and examples of the data capture tools used to gather the data given; the stakeholder interview questions and the structured observations.

Data analysis through coding has been presented and explained. Clinical intervention trials have been offered through recommendation of the link practitioner and Theatre turnaround teams.

In the following chapter the results will be presented in more specific terms along with a formal case study review including a cross case study identifying both common and generic theme findings.

CHAPTER 5 RESULTS

5.1 Introduction

This chapter of this research project presents the formal findings of the study based upon the information gathered through the methodology applied. The methodological approach as described in Chapter 4 directed the strategy applied to the data design and collection. The clinical data review forms the quantitative component of the data set. The coding of the data gathered through interview and observation, as described in the previous chapter, is formally presented in this chapter as the primary data contribution of the project, and the qualitative data findings are described.

The results chapter will state the findings of the research without bias or interpretation.

A case overview describes the case and the associated results presented in this chapter will reaffirm the research problem that underpins the purpose of the study. There will be a summary of the key findings arranged in sequence. A systematic description of the results highlighting observations that are most relevant to the topic under investigation will be presented in the text.

The act of articulating the results gathered from the methodology has allowed the researcher to understand the research problem from within by deconstructing all the elements and allowing the research problem to be viewed from diverse perspectives.

5.2 Case Overview

The case has been designed and conducted in a large NHS teaching hospital. This case is built around the research question:-

How can efficiency be improved in an NHS Operating Theatre environment ?

This question was constructed after a data gathering exercise on clinical activity in Theatres at QEHB and a literature review revealed both underutilisation of scheduled surgery and the depth of published work on addressing this particular topic as observed through the operational experience of the researcher. The literature review identified gaps in the research which offers opportunities to researchers for new thinking.

Context

The National Health Service (NHS) was founded in 1948 and led by Aneurin Bevan. It is a system of public healthcare providers in the United Kingdom which includes NHS England, NHS Scotland, NHS

Wales and Health and Social Care in Northern Ireland. The NHS was established as one of the major social reforms following the Second World War. Its founding principles are that health services are comprehensive, universal and free at the point of delivery from the cradle to the grave. The only exceptions are dental treatment and optical care. NHS England also charges for medicine prescriptions, currently £9.35 per item (April 2021) albeit with a range of exemptions available.

Each of the UK's health service providers operates independently and is politically accountable to their relevant governments.

The NHS currently employs 1.7 million staff and its annual budget is 139.3 billion. It is the largest employer in Europe and the fifth largest in the world. It delivers healthcare through a public sector business model that is admired by it's peers across the world.

The setting for this research is University Hospitals Birmingham NHS Foundation Trust. It is one of the largest teaching hospital trusts in England serving a regional, national and international population. The Trust comprises Queen Elizabeth Hospital Birmingham, Birmingham Heartlands Hospital, Good Hope Hospital and Solihull Hospital and Birmingham Chest Clinic. The combined hospitals of the Trust see and treat 2.2 million patients per annum. The Trust employs in excess of 20,000 staff.

The Trust is a regional centre for cancer, trauma, renal dialysis, burns and plastics, HIV and AIDS, as well as respiratory conditions like cystic fibrosis. They also have expertise in premature baby care, bone marrow transplants and thoracic surgery and have the largest solid organ transplantation programme in Europe.

The Trust also provides a series of highly specialist cardiac, liver and neurosurgery services to patients from across the UK.

The Trust is world-renowned for its trauma care and has developed pioneering surgical techniques in the management of ballistic and blast injuries, including bespoke surgical solutions for previously unseen injuries. As a result of its clinical expertise in treating trauma patients and military casualties, the Queen Elizabeth Hospital Birmingham has been designated both a Level 1 Trauma Centre and host of the UK's only £20m National Institute for Health Research (NIHR) Surgical Reconstruction and Microbiology Research Centre (SRMRC).

The case study has been conducted at Queen Elizabeth Hospital Birmingham. There are 23 Operating Theatres in the main theatre suite and 7 day case Operating Theatres in Ambulatory Care. In total the hospital has 42 rooms to provide its surgical services in.

5.3 Operating Theatre Reporting Structure

The reporting structure within the Operating Theatres Directorate begins with the Director of Operations. Ultimately the Director reports to the Chief Operating Officer and the CEO of the Trust.

The Director of Operations leads the senior management team responsible for the surgical service provision in the Trust. The Associate Director of Nursing (ADN) and the Divisional Group Manager report to the Director of Operations. They oversee the clinical and administrative management of the surgical services. The ADN has four Matrons that manage the Senior Team Leaders in the Operating Theatres. The Matrons are each responsible for a cluster of surgical specialities. The Senior Team Leaders are responsible for the nurses and healthcare practitioners on the shop floor who work with the clinicians and deliver the anaesthetic and surgical services to the patients. The clinicians who work in this environment are overseen by Clinical Service Leads for Theatres, Anaesthetics and Surgery. This is a shared responsibility between the clinicians with the average length of tenure set at two years.

5.4 Operating Theatre Environment

The elective surgery lists are prioritised in a number of ways. Cancer patients always take priority.

There are choose and book options available to patients where they can select the hospital and Consultant surgeon they wish to be admitted under. The decision to select a particular institution and clinician is made by patients through access to the performance reviews of the hospital and surgeon available online.

The out-patient clinics held within the hospital also furnish the operating lists. The patients who attend the out-patient clinics are referred by their general practitioners.

Provisional elective lists are composed by the choose and book team and also by the medical secretaries who work with the Consultant surgeons. These are scrutinised by the senior staff in the Operating Theatres for both suitability of case selection and as to whether the proposed work is achievable before they are locked down 48 hours before the day of surgery and published.

Regular weekly meetings held by all the senior team leaders from all the specialities in the Operating Theatres monitor these provisional lists to ensure that they are fit for purpose and the required skill mix within the nursing and theatre practitioner cohort is available and that all the specialist equipment and instrumentation required to deliver the surgery is available. In some cases specialist equipment required for a particular surgery that is not routinely held within the Theatres will need to be ordered in. If the specialist equipment that is ordered contains instrumentation this needs to be checked off by the theatre team and sent to the sterile services department for processing and sterilisation prior to the planned day of surgery.

The main suite of operating theatres at QEHB is located on the second floor of the hospital. It comprises twenty three operating rooms with adjacent anaesthetic rooms. There are two Recovery Rooms each comprising twelve bays to accept the patients once their surgery is complete. It has a significantly large footprint.

There is a reception area comprising four bays where patients are received by the theatre staff and checked in for their procedure. Four bays are inadequate for twenty three theatres at peak times (first patients on the morning and afternoon lists). During these peak times the Recovery Rooms are utilised to accept patients for admission and check in for their procedure. The Recovery Rooms may be distant to the Theatre where the surgery will take place. This is due to the larger footprint of the Theatre suite.

There are seven Ambulatory Theatres on the ground floor of the hospital. These Theatres host the majority of the day surgery performed in the Trust. These Theatres are much more compact than the main Theatre suite. The smaller footprint of the Ambulatory Theatres facilitates fewer issues with available space for accepting and checking patients in for their procedure as the Ambulatory day case ward is adjacent to the Theatres. The patients are usually transported from the ward directly to the anaesthetic room and the checks take place there as there is no formal patient reception in the Ambulatory Theatre suite.

Before each operating session there is a team brief between the surgeons, anaesthetist and theatre staff to discuss the planned work for the session. Any issues that need to be shared regarding the patients and the planned work are discussed at this point. Any prior equipment requests are also confirmed at this point. The surgeons will outline their plan for the proposed surgical techniques which will include patient positioning, surgical approach and the need for any specialist equipment and implants. The Anaesthetist will also map out their proposals for their anaesthetic techniques on

a patient by patient basis. The Theatre team leader will also confirm that their team has the appropriate skill mix to deliver the surgery required and that all the equipment required is available.

If there are any issues with surgery or anaesthesia this is the time for the teams to highlight this to their colleagues. It gives the teams an opportunity to address the issues for a solution prior to the commencement of the operating session rather than prior to an individual's surgery.

Prior to each individual surgery the clinicians and theatre practitioners have a ‘stop’ moment to undertake the WHO surgical safety checklist. This international initiative is undertaken to confirm the identity of the patient, the planned procedure and side of surgery (if required) and to highlight important information that may impact on the surgery i.e. co-morbidities, allergies to medication, blood transfusion requests etc

These checklists have been adapted from the airline industry (NHS England 2019). They were introduced to stem the tide of ‘never events’ occurring in the NHS. These ‘never events’ in surgery include wrong side and site surgery, wrong implants and medication errors. The checklist has been endorsed by the WHO and is championed by people who have had direct experience of healthcare failings with their families.

Using the checklist appropriately focuses the surgical teams on the planned procedures and identifies issues that will need special consideration for each individual patient.

At the end of each surgical case there is a ‘time out’ moment where the surgeon confirms the surgery conducted and any special instructions for the recovery practitioner who will be responsible for the care of the patient immediately after the surgery is complete and when the patient is transferred to the Theatre Recovery Room.

Once the operating session is complete there may be an opportunity for a team debrief for the whole team. However this debrief is concessionary and does not always happen. De-briefs are an excellent tool to monitor a team’s performance and to identify any areas of concern whilst also offering the chance to plan for future improvements if required.

The Group Manager of the Operating Theatres is responsible for a team of administrators. One of the administrators tasks is to monitor individual Operating Theatres performances. The overall performance of the Operating Theatres is reported to the senior hospital management as part of their operational strategy programmes.

The operational data is displayed outside each Operating Theatre and highlights start times, turnaround times, finish times along with any patient cancellations. This information is gathered from the Galaxy real time data collection system used by all the Operating Theatre staff across the Trust. It is useful information to monitor an individual team's performance and to highlight progress made through change management and the introduction of new processes should any be required. The information can serve to boost the morale of the teams too during what can be perceived to be a challenging operational workload.

The success of any operating theatre complex relies on good team working from all the stakeholders involved (Royal College of Surgeons 2014). Without this relationship the surgeon would be unable to carry out his work effectively and the patients would receive poor service. The Theatre orderly collecting the patient from the surgical ward plays an equally important part in facilitating the surgical services of the Operating Theatre. If they fail to collect the patient in a timely manner then the waiting surgeon in the operating room is idle and helpless to influence events that are happening on the surgical wards which in the setting of QEHB and its large footprint could be some distance away.

When looking at the patient flows through the Operating Theatre it was evident that encouraging the stakeholders to work more in unison rather than in isolated units would serve to improve communication and patient transportation times.

5.5 Research Context

The context of the research concentrates on the flow of patient throughput to the Operating Theatres from the surgical wards with emphasis on the operational issues that impact on the patient transfers and the scheduled surgery. The preliminary data reviewed for this project consisted of 18 months of clinical activity evidence collected from the Operating Theatres at QEHB. This quantitative data revealed regular underutilisation of the planned operating sessions. The impetus for this research was to firstly understand the reasons why this underutilisation was occurring and secondly to present recommendations for clinical trials and audit to address the problem.

It was decided to build upon the initial data gathering and quantitative review from the clinical data base by engaging in a case study with field work undertaken in the clinical setting to produce qualitative data. This involved conducting structured observations of the patient transportation to the Operating Theatres to observe first hand and understand the processes involved. From these

processes a role activity diagram and a process map were conceived. The map has been used to reference further processes in the collection of the patients for surgery from the wards.

What was witnessed during the observation of the processes required further validation from the interviewees selected from the stakeholder groups responsible for the surgical service provision. In seeking their views on the service and their recommendations for improvement the interviewees have served to triangulate the data presentation for the case study and its associated assumptions.

This has provided key findings regarding the issues that affect timely patient flow. These key findings have been discovered through a coding process undertaken by the researcher to reveal common elements. The results will be presented to support the key findings.

To complement these results the process map describing the elements involved in the delivery of an operating session has been prepared. A role activity diagram that describes the roles that the healthcare practitioners play in the processes has been developed alongside the process map which also highlights the responsibilities that the practitioners must fulfil during the processes and also their interaction between one process and another. The process map and role activity diagram are presented in Chapter 3.

5.6 Quantitative Data

The initial impetus for this research was guided by the collection of preliminary quantitative data from the Operating Theatres at QEHB. 18 months of data was collected from the clinical activity data capture system used by the Operating Theatre staff. Three intermediate surgical procedures scheduled for an average one hours duration featuring low variety and high volume surgery were selected for analysis.

Low variety high volume surgery leads to predictable needs for instrumentation, setup, and surgical approach. High volume surgery refers to the amount of patients who can receive this type of surgery during a full day of operating.

It was decided that this type of surgery was the most suitable to review in terms of recommending a clinical intervention to trial for improved patient turnaround. Complex surgeries lasting an indeterminate length of time were deemed unsuitable to research due to their unpredictable surgical intervention times based on the individual anatomical findings of the patient and the bespoke surgical approach adopted by the surgeon once the procedure has begun.

A number of graphs were modelled and produced by statistician colleagues from QUB that reflected the actual clinical activity as against the scheduled clinical activity of the selected period of study in the Operating Theatres at QEHB during the 2014-2015 period. The collaboration produced the initial data both to support the research question and to focus on further research strategies. This underpinning preliminary quantitative data guided the construct of the case study that forms the main qualitative data submission for this research project.

The modelling work served to reaffirm that there were issues experienced by the surgical services during the time period studied. It explains the flow of patients through the operating theatre environment. Importantly it also shows the challenges in meeting the predicted times for each phase of the patient journey to be completed.

The Galaxy data collection system used in the Operating Theatres at QEHB allows real time data capture of the patient phases and timings associated with receiving surgery.

Typically this data collection will begin with the time the patient is sent for by the Theatre team. The next timing will be the arrival of the patient in the Operating Theatre suite reception. Once the patient is checked in by the Theatre practitioner the patient is moved to the Anaesthetic Room. The arrival of the patient in the Anaesthetic Room will be recorded on the Galaxy system. The duration of the induction of anaesthesia and length of time the patient is in the Anaesthetic Room will also be recorded. The time of the patient arriving in the operating room will also be documented as well as the surgery start time once the patient has been positioned and the WHO surgical safety checklist has been completed by the team.

Completion of the surgery and preparation for the patient to transfer to the Recovery Room will also be recorded along with the time the next patient is requested by the team. Usually the next patient on the list is sent for prior to the end of the preceding patient's operation to ensure that they are in the Theatre reception ready for check in as soon as the Theatre team is free to do so. The patient's time in the Recovery Room is also timed and documented including when the ward is contacted to collect the patient along with the time the patient is discharged from the Recovery Room.

If there are delays on the wards in the transportation of the patient or there are unforeseen issues for the Theatre team with their current patient this will result in a temporary delay to the flow of the operating list and may impact on the patients scheduled for the rest of the operating list.

The patient flows associated with operating lists can be described as being in a constant state of flux. There are many operational influencers associated with perioperative patient flow. These influencers are reported on in the processes noted in the structured observation field work. Fine margins may impact on timely patient transportation and affect the efficiency of the individual Theatre teams.

The same process for calling for and receiving the next patient is repeated for all patients on the operating list. As a real time facility the use of the Galaxy system is reliant on the integrity of the practitioners in each Theatre to ensure that the timings of the various stages of the patient journey are accurate and represent the true timings of the clinical delivery of the surgical services.

5.7 Quantitative Results

The quantitative data was analysed and plotted in a number of graphs (Figures 7 - 12)

The actual clinical activity was reviewed against the scheduled activity.

The main themes of interest drawn from the 18 months of clinical data were:-

1. Late Starts
2. Delayed turnaround times between patients on both the morning and afternoon operating lists
3. Unplanned, unfunded overruns

The corresponding data arising from these themes which contributed to the underutilisation of the planned activity were plotted by the statisticians at QUB.

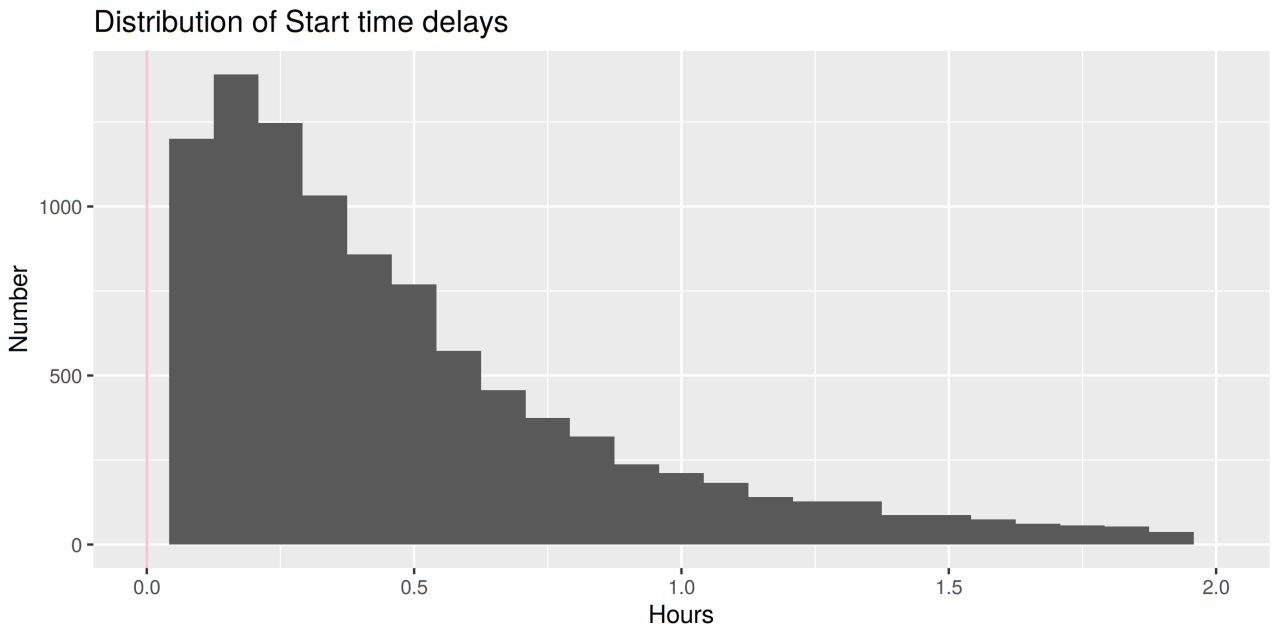

Figure 12: Distribution of Operating Session Late Start Times

Many sessions started out late, with a 15 minute delay being the norm. Very late starts did occur, but they were not the main issue.

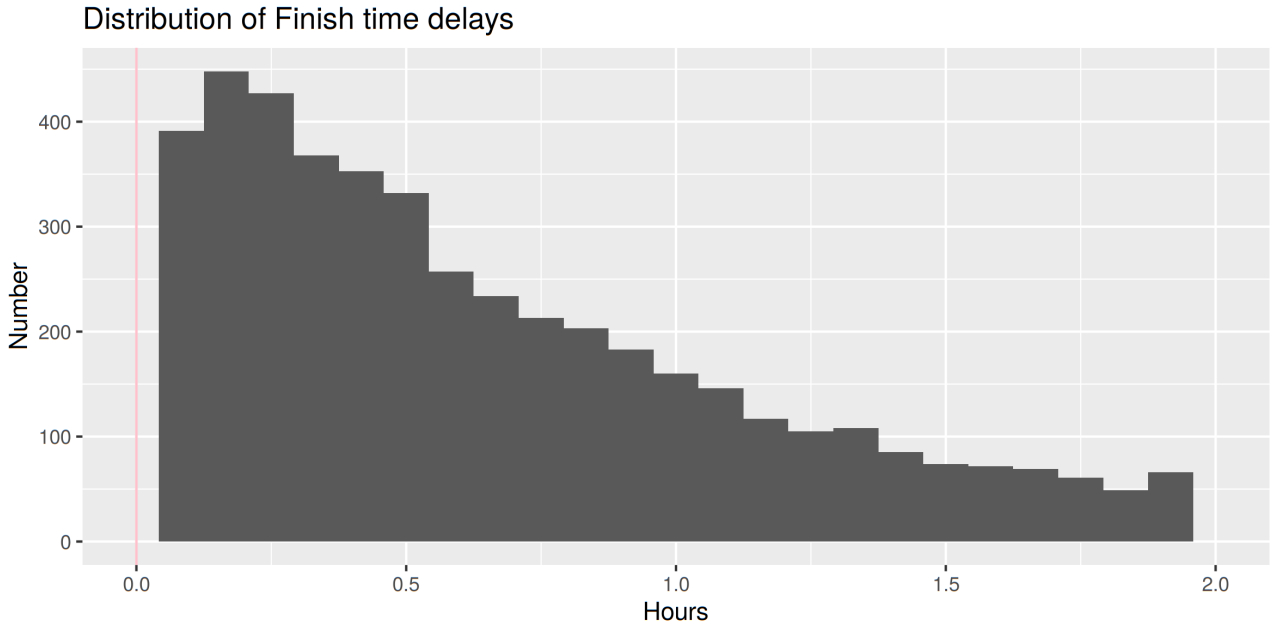

Figure 14: Distribution of Operating Session Unplanned Overruns

Again, sessions commonly overran. While more sessions end on time than started on time, delays of up to 30 or 40 minutes were common, and such delays can incur significant overtime costs, and may cause significant disruption to staff. There is also a long tail of session delays (not shown) running out to six hours.

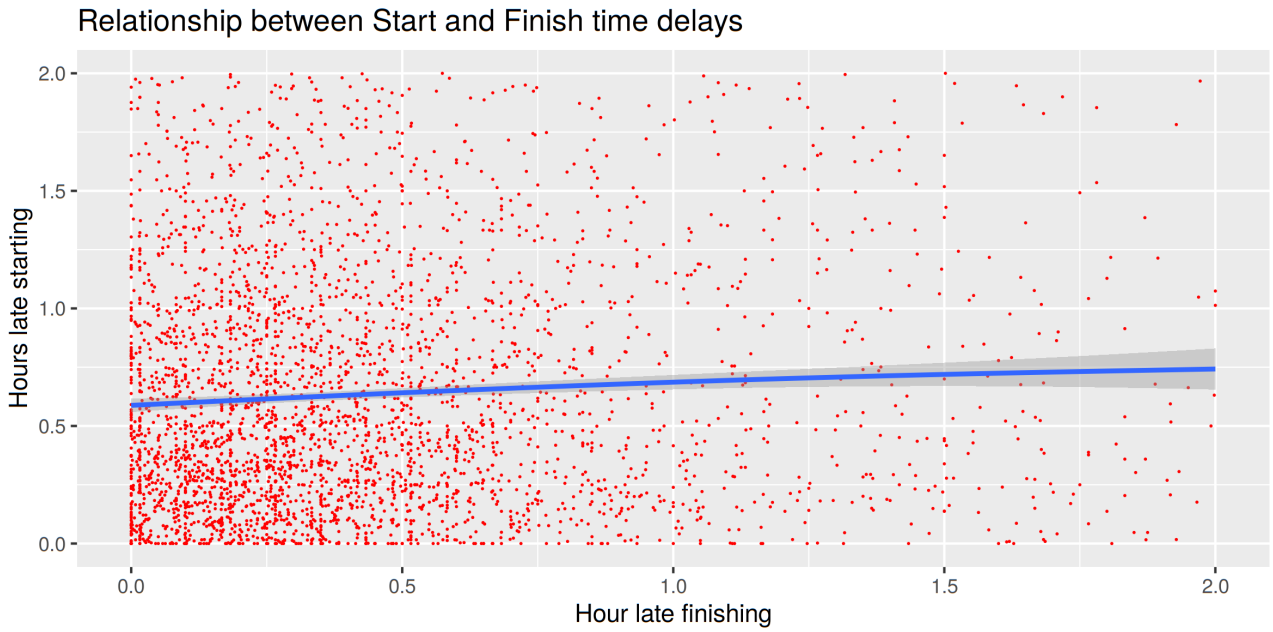

Figure 16: Relationship Between Operating Session Late Starts and Late Finishes

There is little indication of a strong link between late starts,and late finishes. A regression analysis gives the estimate that, on average, for every hour the session starts late, the session will finish late by 7.1 minutes (95% confidence interval 6.0 minutes to 8.8 minutes).

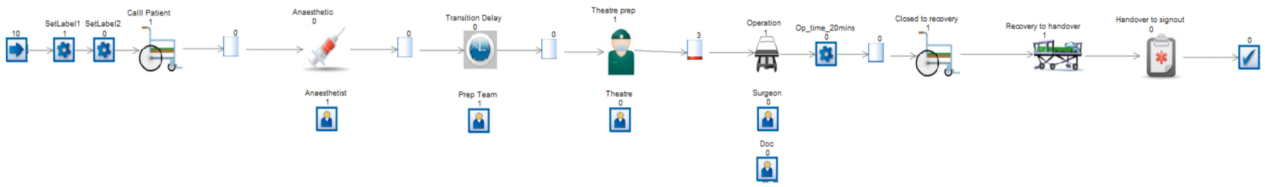

Figure 18: SIMUL8 Model of Surgical Patient Journey

Graphical representation of the patient journey for surgical procedures

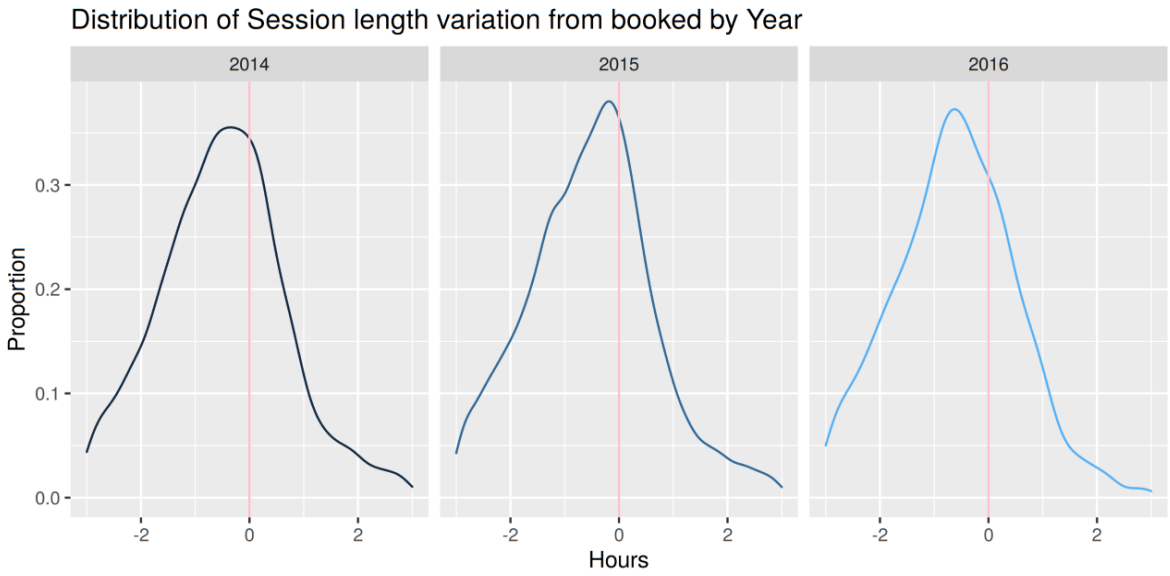

Figure 20: Distribution of Session Length Variation

This graph represents the both the underutilisation and over utilisation of the planned surgical sessions

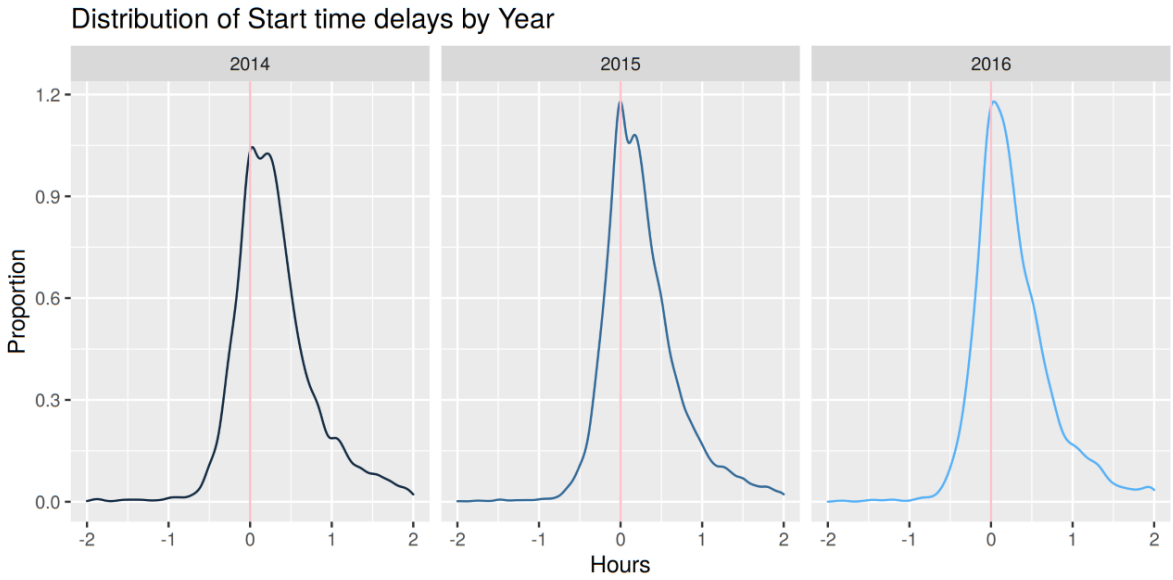

Figure 22: Delays in Session Start Times

Distribution of start time delays that can impact on session length and session completion to planned times

The evidence provided by the data gathering and collaboration with our statistician colleagues at QUB supported the preliminary conclusions drawn from the clinical activity capture facility used by

the Theatre teams at QEHB. It also shaped the initial stages and first active steps in the inquiry posed by the research question. The literature review confirmed that these phenomena are experienced at an international level and there is internationally published research addressing underutilisation issues in providing surgery in hospitals. For example the studies at the Academic Medical Centre Amsterdam and in Rome included in the literature review bear witness to this phenomena and are representative of the extent of the issues experienced by a broad range of international healthcare institutions that are reported upon in the literature review.

Undertaking the literature review identified a gap in the research approach. Most reviewed studies during the literature review focused on single clinical areas for their improvement programmes. This allowed this research project to undertake a unique overarching review of the service from the point of patient admission to transfer to the operating theatre which is presented in this research.

The quantitative data demonstrated in Figures 7-12 highlights the underutilisation of the scheduled activity from a small selection of the total operating sessions during an eighteen month period at QEHB. The impact of this underutilisation was deemed worthy of investigation through inquiry by the researcher. A case study was chosen as an approach to understand the operational procedures involved in delivering surgical services in healthcare institutions. Case studies involve research through an up close, in depth and detailed examination of a subject of study. Case study also acknowledges the related contextual conditions of the research subject and is bounded. In using a case study approach to the research the data generated reports on the complex operational enterprise that a large healthcare institution must undertake to provide its services.

The initial quantitative data is used as a platform to complement the qualitative data that forms the main body of the research results. Included in this results chapter is a resume of the findings of the case study. This presentation of the results will be followed by a chapter discussing the results and their relationship with the literature review. A compare and contrast review will be presented focusing on how the results confer with the literature review and how they are different. The differences will be discussed in the final chapter which will present the conclusion and findings of the research. This will include recommendations for future clinical trials and further research opportunities

5.8 Qualitative Data

To underpin and expand upon the quantitative data results a process mapping exercise and a field work initiative involving structured observation exercises was undertaken. This involved the researcher accompanying the Operating Theatre orderlies whilst they collected the patients from the surgical wards for transportation to the Operating Theatre suite reception.

These observations revealed the processes involved in collecting the patients and were defined using a role activity diagram. This diagram supported the formation of the process map. The mapping exercise endorsed the processes undertaken by the stakeholders in facilitating the patient preparation and transportation to the Operating Theatre.

The rationale behind these observations was to observe the processes involved in the collection and transportation of patients for the Operating Theatre. For each of the processes we used a structure, a timeline and they were referenced to the role activity diagram.

A number of observations were conducted with different orderlies. The purpose of this was to gain a broad perspective from the orderlies with regard to the challenges they face in collecting and transporting the patients from one clinical area to another. It also gave the researcher a unique opportunity to witness first hand the operational processes and challenges involved in the transportation of surgical patients. From these observations the researcher has, in conjunction with the data from the stakeholder interviews, created recommendations for clinical intervention trials. It is anticipated that should any trials be delivered by future research teams it will be audited for impact and efficacy in promoting improved efficient and timely patient transfer from the surgical wards to the Operating Theatre suite.

The qualitative data is presented here as a case study and provides the main supporting evidence for the research question. The data was collected using a standard field work approach.

Generally surgical services provided by Operating Theatre suites involve a number of stakeholders whose combined contributions culminate in providing surgery to patients. These stakeholders include surgeons, anaesthetists, theatre nurses, practitioners, support workers and orderlies, surgical ward nurses and healthcare assistants, radiographers and sterile services staff.

To triangulate the data collated through the mapping exercise it was decided to undertake a number of stakeholder interviews that addressed the main issues contributing to under utilisation of the planned activity. These issues were revealed in the quantitative data analysis. By requesting the views and opinions of the stakeholders who work for the surgical services the research has gained an invaluable opportunity to validate the assumptions raised.

All the data included in this research, both quantitative and qualitative, is presented in an anonymised format. All participants in the interviews and observations have consented to this format and have had access to the transcripts for corrections and accuracy prior to the data being included in the project.

5.9 Qualitative Results

The qualitative data results presented here form the main body of evidence to support the research question. The process observations have also been coded for common themes which impact on the patient transportation from the surgical wards to the Operating Theatre suite reception.

The stakeholder interviews have also been coded for themes. The interviewees add a triangulated validation of the data sourced from the surgical service provision by those involved in delivering the service.

The interviews and observations were conducted over an eighteen month period during 2018/2019.

5.10 Structured Observations with Theatre Orderlies : Venue: Main Theatres 2nd Floor QEHB

5.10.1 Introduction

This field work was arranged and carried out by the researcher. It was proposed that by undertaking this work the researcher could at first hand observe the patient transfer process. At the same time the operational processes involved in preparing patients for surgery could be noted. Most importantly the issues that affect prompt preparation and transfer of the patients for surgery could also be observed at close quarters by the researcher. It also gave the researcher the access to gain a perspective from several different Theatre orderlies as to why the issues occur and their suggestions for positive solutions.

The researcher sought permission from the senior management teams from both Theatres and the Surgical Wards to accompany Theatre orderlies collecting and transporting patients from the ward areas to the Theatre suite. The purpose of the observation exercise was to gain an understanding of the processes involved in the transportation of patients for surgery and the challenges faced by those involved – both the orderlies and the ward staff. For the purpose of this research it is critical to gain the perspective of those involved in the service delivery. By undertaking this exercise with a number of orderlies the project will gain a unique insight into the challenges faced by those involved and will offer recommendations from this particular group for improving the service provision.

5.10.2 Background

There are a number of orderlies assigned to Theatre reception on a daily basis. They work as a team and are managed by a senior theatre practitioner. Their jobs are assigned to them by this senior practitioner.

Although there are 23 operating theatres within Level 2 Theatres there are only four dedicated bays in Theatre reception for checking in patients. This results in congestion at peak times i.e. at the beginning of the morning lists and likewise at the beginning of the afternoon sessions. The Recovery Room is used on these occasions as an overspill area to check the patients in. However this option does not afford the privacy of the Theatre reception. It is also remote from a large number of the Theatres as it is not in a central position in the Theatre design. This is a common complication of Theatre suites when session start times are similar.

The transcripts of the structured observations the researcher undertook with the Theatre Orderlies are presented in **Appendix B**.

The timings of the Orderlies movements, drawn from the structured observation transcripts, have been used to construct the following plot.

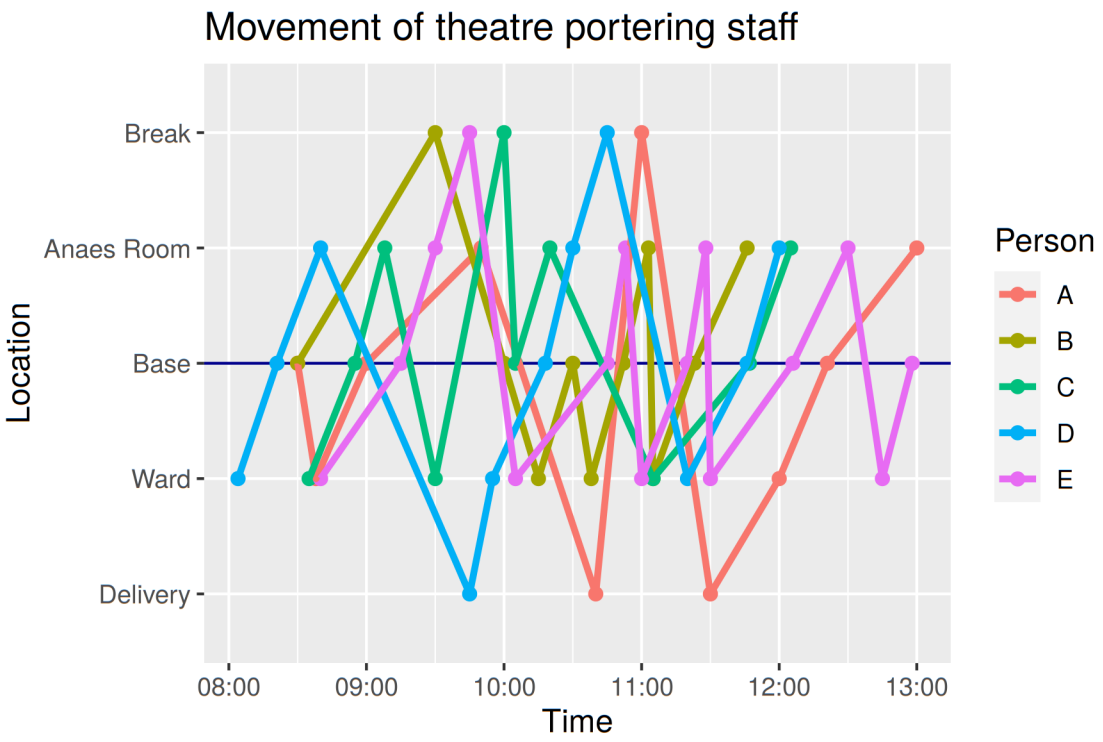

Figure 24: Movement of Theatre Portering Staff

5.10.3 Coding the Structured Observations

The preliminary coding of the structured observations began with the identification of common themes from within the transcripts by the researcher.

These common themes were then discussed with the orderlies that participated in the observations for further background. One important aspect in considering the final list of coding themes was the repetition of issues experienced by the orderlies in their daily work. This information was sought by the researcher to support the development of the coding list.

Once the preliminary coding list was drafted and the common themes verified by the orderlies, a final list of coding themes was produced.

The main themes to arise from coding the structured observations were

Theme 1 – Large footprint of the hospital

Theme 2 – Communication

Theme 3 – Incomplete patient preparation

Theme 4 – Availability of staff (Theatres and Wards)

Theme 5 – Administrative Omissions (Consent Forms – Admission onto PICS)

Theme 6 – Completion of Theatre checklist

Theme 7 – Availability of lifts between the hospital floors

Theme 8 – Unexpected changes to the order of the operating list

Theme 9 – Equipment availability and unanticipated malfunction

Theme 10 – Availability of interpreter (Observation 5)

Table 1 : Structured Observation Coding Themes

Theme	Person One	Person Two	Person Three	Person Four	Person Five
Large Footprint of Hospital	X	X	X	X	**X**
Communication	X		X	X	**X**
Incomplete Patient Preparation	X	X	X	X	**X**
Availability of Staff	X			X	**X**
Administrative Omissions	X	X		X	**X**
Completion of Theatre Checklist	X	X		X	**X**
Availability of Patients Lifts		X	X	X	**X**
Changes to Order of the Operating List					**X**
Equipment Availability	X		X		**X**
Availability of Interpreter					**X**

5.11 Stakeholder Interviews

To build on the evidence collected from the data gathering and the observations of the processes involved in flow of patients from the wards to the operating theatres it was decided to conduct a number of interviews with the stakeholders who work in the surgical service.

The interviewees included surgeons from different surgical specialities, anaesthetists, theatre nurses and practitioners and ward managers and nursing staff. The rationale behind this approach was to gather different perspectives of the performance of the surgical services in relation to the data already collated from the quantitative work and the initial qualitative patient process flow exercise.

All the data presented from the interviews is in an anonymised format. All participants were given a topic guide prior to the interview and asked to sign a formal consent form. All the interviews were transcribed and offered to the participants for accuracy and correction prior to their inclusion in the data set.

Once the interviews were completed all the transcripts were coded for commonalities of the themes discussed during the interview process with particular reference to the themes noted from the data gathering and the subsequent process flow mapping.

5.11.1 Themes Identified in the Stakeholder Interviews

Theme 1 - Is There Enough Operating Room Capacity? Is there enough surgery time available for the surgeons and their patients on their waiting lists? This is dependent on surgical speciality and the surgeon cohort of each individual healthcare institution. In November 2019 winter pressures were beginning to take effect in the NHS. The BBC reported that in November 2019 there were 4.42 million people waiting for treatment in NHS England. Only 84.8% are waiting under 18 weeks for treatment which is below the 92% target set in 2012 by the Government. (Triggle 2019).

Surgeon

'Trauma surgery is very seasonal. For Trauma Units to deliver we would need more capacity. Need more capacity to deliver the National Target of emergency patients waiting 48-72 hours for surgery. Elective surgery waiting lists will creep up as a result of incoming emergency patients. More outpatient capacity required to meet the demand. The more patients we have in the system the bigger the waiting list'

Surgeon

'No. We did an expansion plan three years ago. We were promised an extra all day list in Main Theatres that never materialised. As a compromise we have been offered a Saturday morning operating slot which is problematic in its own right. We do hybrid initiative work on this Saturday morning list. We need this formalised into a proper working schedule. We could still do with more slots to keep on top of the workload that we have.'

Theme 2 - Do you have enough OutPatient Clinic slots to Furnish your Operating Lists? Is there enough capacity in the OutPatient Clinics to plan and manage the available operating theatre

sessions? Outpatient Clinics run by healthcare institutions provide the access to surgical services for patients referred by their General Practitioners.

Surgeon

'No. Ideally we would need to appoint another two or three Consultant Surgeons, however we do not have enough outpatient clinics or operating theatre slots to accommodate them. We do balance but this is only through initiative (extra ad hoc operating lists) activity. To try and deliver the entire service with the job plan would be unachievable'

Surgeon

'There are enough outpatient clinics to furnish the operating lists. However where there should be fifteen patients per clinic we regularly see twenty two to twenty five patients per clinic'

Theme 3 - Do you experience patient cancellation on the day of surgery due to lack of available post operative beds? Due to capacity management issues and overnight emergency patient admissions are your patients ever cancelled due to lack of space on the surgical wards and Intensive Care Unit? This is a common problem in the current capacity management of healthcare institutions. In recent years it has become more difficult to 'ring fence' beds overnight to guarantee admission for surgical patients the next morning due to the demand for beds overnight.

Surgeon

'Regularly due to the complexity of the surgical cases, a lack of available Intensive Care beds and a lack of surgical ward beds especially during the capacity pressures experienced during the winter months'

Surgeon

'Sometimes but not very often as I judge the list to ensure that we have enough capacity as I know what the bed availability/pressures are. I alter my lists to anticipate the bed pressures'

Ward Staff

'Sometimes, the time of year can play a part in this'

Theme 4 – Do your Operating Lists experience late starts? Regularly? Sometimes? Rarely? Each session of surgery has a start, duration and end time. Do surgeons experience late starts on their scheduled operating lists? For what reasons? Are late starts avoidable?

Surgeon

'Late starts in Main Theatres are usually due to administrative issues and occasionally not identifying bed availability at an early stage. Day Surgery Theatres have variable reasons for late starts, there are a lot of specialty surgeons using this facility – with different patient groups there are different patient priorities in patient preparation. Which Theatre suite the patients are operated on has an impact on start times too due to the large footprint of the hospital'

Surgeon

'Occasionally experience late starts, there are multifactorial different reasons for this – the timing of sending for the patient, the surgical case mix, patients attending late for various reasons i.e. parking and delays on the ward'

Senior Theatre Team Leader

'Yes to the late starts. I am heavily focused on late starts at the moment. I pull the data from the computer operating system used in Theatres and display it for all users to see. One of the common issues is late arrival of personnel which has a knock-on effect to the prompt start and finish of the scheduled work load'

Theme 5 – Do your Operating Lists experience Delayed Turnaround Times between Patients. Is there unnecessary time lost between finishing a surgical procedure and starting the next case? Why does this occur? What can be done to minimise the delays?

Senior Theatre Team Leader

'Turnaround times between patients has been an issue but these times have massively improved as I have introduced a maximum fifteen minute waiting time. If it's any longer I escalate to the Coordinator to address or identify one of the team in the Theatre to fetch the next patient'

Surgeon

'Yes – the National Health Service in general is like a machine, if one of the cogs stops working or there is disruption the machine comes to a halt – this is what seems to happen. Again the large footprint of the hospital may affect the turnaround times due to the distances the patients have to be transported from the surgical ward to the Operating Theatre'

Theme 6 – Do your Operating Lists Finish on Time? Regularly? Sometimes? Rarely? Do the planned surgery sessions finish at the allotted time? If not, why not? What are the main issues with finishing on time?

Surgeon

'Usually we manage to complete our elective (non emergency) lists – this is because we have tailored our elective work to what is achievable'

Senior Theatre Team Leader

'Late finishes were steadily out of control but because of the introduction of weekly scheduling meetings and input from the surgeons we are now gradually pulling that back'

Theme 7 – Do your Operating Lists experience Unplanned, Unfunded Overruns? Do any of the scheduled operating lists run past their allotted finishing time leading to cost pressures on the Surgical Directorate budgets? Are these overruns avoidable?

Surgeon

'Rarely have an unplanned overrun as the last case tends to get cancelled. Prefer to waste 1.5 hours of operating time rather than the surgery overrunning by 5 to 10 minutes. System is designed to fail. Surgeons tend to get the blame but I believe it is non medical staff that cause the inefficiency. Patients do not receive a good service from this management position'

Surgeon

'Occasionally. My day case patients are housed in a short stay surgical ward that is located in a building that is a long distance from the Day Surgery Theatres – in fact it has a different postcode. There is a lot of wasted time going backwards and forwards between the areas to prepare the patients and to operate on them – this does lead to last minute cancellations. This is a slow inefficient crazy situation'

Theme 8 – Delay Factors - Patient Admissions Process These are the processes that the admitting ward staff and clinicians have to undertake to prepare the patients for surgery. It is important that these tasks are carried out in a timely manner. They include, patient consent, patient marking by the surgeon (where applicable), anaesthetic assessment by the anaesthetist, admission onto PICS for clerking and recording preoperative baseline observations. These processes form the first section of the process map. If there are any delays in these processes this will impact on the patient

flow further along the map resulting in a net delay. It may also impact on the completion of the rest of the scheduled operating list.

Do the processes involved in admitting and preparing patients for surgery in the hospital contribute to delays?

Surgeon

'In the old days we would admit the patient the day before surgery which would be fine. However due to demands for hospital beds the process now means the patient arrives on the day of surgery – they then have to go through a consenting process to make sure that everything is correct and in place using electronic systems. This is an immensely pressured time just before the operating list is due to start at 8am. We can encounter a variety of problems especially when third parties are involved. You may have difficulty in accessing a free computer to undertake the admissions process and looking at the patient's notes, there may be issues with the systems used to admit the patient, you may need a translator. Patients also want to ask questions regarding the planned surgery. There may be difficulty in finding a private room available to consent the patient and carry out the pre-assessment checks. Together with all the walking involved from the surgical ward to the operating theatre suite all these little things are time consuming when time is of the essence. Cannot work with the job plan – would mean the need to start 30 minutes earlier to complete the admission process – this is not a great way to live your life'

Theatre Practitioner

'Different issues – patient not prepared – no one available to collect the patient from the ward – patient not even in the hospital and late arriving on the ward. Sheer logistics of collecting patients from different areas of the hospital due to large footprint'

Anaesthetist

'Late starts occur because all patients are admitted to one area. This means that inpatients and day surgery patients are admitted to the same area creating a demand for space/rooms. This is a relatively small area with limited staffing to admit the patients. This can cause late starts.'

Theme 9 – Delay Factors – Communication. Do communication issues between the stakeholders contribute to delays in the service? Regularly? What can be done to improve communication? Are the communication channels set right? Would a reporting structure improve the ability to communicate in a clear, concise manner?

Ward Manager

'It's a communication issue between the surgeons and the Theatre staff and then them letting us know. The reason the patient is in the anaesthetic room is because the surgeon has sent for them. We do not send patients to Theatres from the ward area willy nilly. We send them down once the orderly arrives and the surgeons have changed their mind between leaving the ward and getting there; it's not very good for patient's to be at that point and then either be cancelled or sent back to wait again'

Senior Theatre Team Leader

'More collaboration, communication and an improved team approach with our clinicians. I think that is the key. Gone are the days when the surgeon expects to undertake x amount of work the next day with the anaesthetist and Theatre team are just going to turn up. I think it's a proven fact that if you involve everybody in the planning of the clinical activity it makes a huge difference to the efficiency and delivery of the expected clinical activity'

Theme 10 – Do Theatre Staff have any Influence over Delays and Issues on the Wards. If there are problems with preparing patients for surgery on the wards can Theatre staff influence and expedite the patient transfer time? What resources do the Theatre staff employ to monitor the patient transportation times from the wards to the theatre reception? Can this be further addressed?

Ward Manager

'We have a computer system which is great. That was supposed to be expanded on so it can be viewed in Theatres. It would mean the Doctors would be able to do their bit and tick it, the nurse would be able to tick it and also the Anaesthetist. This would show the patient as green on the system and Theatres could see that the patient was ready to be sent for. The patient would get changed and the Theatre orderly would arrive to collect the patient. The current situation is that Theatres phone to say they are sending. The nursing staff then check everything and may find they are not on PICS (Electronic Patient Record), not being consented or the Anaesthetist has not seen the patient.

When the system does go live we are looking forward to spending lots less time on the phone because everyone will be able to see who's done their bit and who has not'

Ward Nurse

'Maybe we could have staff from the ward spending time in theatres, recovery and reception and the other way around'

Senior Theatre Practitioner

'Yes, Theatre staff should be more proactive by contacting the wards, making sure that the surgical kit that the surgeon has asked for the previous day is available. Ensuring there is a good skill mix in Theatres to deliver the planned surgery. Sending for patients early enough. If there is no Theatre orderly available to collect the patient from the ward then the Theatre staff could oblige if numbers permitted'

5.12 Coding the Themes from the Stakeholder Interviews

To undertake the preliminary coding of the stakeholder interviews the common responses from the interviewees from the set questions were identified and listed by the researcher.

The interview questions were set to address the impact and influence of the contributing multifactorial proceedings associated with conducting operating sessions in a large healthcare organisation. All the participants in the interviews were sent a transcript to review for accuracy. Adjustments were made if the respondent sent instructions to do so.

The final coding list represents the common themes identified throughout the interviews conducted for the research. The final selection of themes are:-

Theme 1. Is there enough operating theatre capacity?
Theme 2. Do you have enough out-patient clinics to furnish your operating lists?
Theme 3. Do you experience cancellation due to a lack of post-operative beds?
Theme 4. Do your operating lists experience late starts?
Theme 5. Do your operating lists experience delayed turnarounds between patients?
Theme 6. Do your operating lists finish on time?
Theme 7. Do your operating lists experience unplanned unfunded overruns?
Theme 8. Delay factors – patient admission process
Theme 9. Communication
Theme 10. Does the theatre team have any influence over delays and issues on the wards?

Table 2: Stakeholder Interview Coding Themes 1-5

Interviewee	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
1	X	X	X	X	X
2	X	X		X	X
3	X	X	X	X	X
4	X		X	X	X
5			X		X
6				X	X
7	X		X		X
8	X	X	X	X	X
9				X	X
10					
11	X	X		X	X
12	X		X	X	X
13			X	X	X
14					
15				X	X
16				X	X
17				X	X
18			X	X	X

Table 3: Stakeholder Interview Coding Themes 6-10

Interviewee	Theme 6	Theme 7	Theme 8	Theme 9	Theme 10
1	X	X	X	X	X
2		X	X	X	X
3		X	X	X	X
4			X	X	X
5		X	X	X	X
6		X	X	X	X
7				X	X
8	X	X	X	X	X
9		X	X	X	X
10				X	
11	X	X		X	X
12	X		X	X	
13			X	X	
14				X	
15		X	X	X	X
16		X	X	X	X
17		X	X	X	X
18	X	X	X	X	X

5.13 Case Study Review

The quantitative data graphs clearly demonstrate the issues the surgical services incur with keeping to time with the scheduled workload over the eighteen month review period. This preliminary quantitative data review was pivotal in the composition of the research question and subsequent field work that generated the data to address the research topic. This work was carried out in Queens University and the researcher consulted with the research group there to ensure that the data accurately reflected the situation in the hospital.

The themes identified for the case study from the qualitative field work comprising both the stakeholder interviews and the structured observations represent the views of the interviewees and of the observed patient flow by the researcher over an eighteen month period.

These qualitative themes have been plotted in Tables 2 & 3. The themes from the interviews represent an important perspective from the service users in relation to their contractual commitment to provide surgical services to the patient cohort. The observations are a unique snapshot of the operational processes of a large healthcare institution.

Case study was chosen as the research methodology as it provided an opportunity to examine the processes and challenges that healthcare institutions face in delivering their day to day business. The in-depth analysis derived from the data collected from the field work will showcase the surgical services provision and also identify common stresses apparent in the operational delivery of the service. These stresses are, for the decision to select a case study approach, initially identified in the literature review and borne out in the bounded study.

The field work undertaken to complete the case study has delivered the presentation of the data which presents a microcosm of the surgical services of a large healthcare institution over an eighteen month period. This ‘as is’ view of the operational processes will be accompanied by an ‘as can be’ recommendation for future research intervention and opportunity to promote service improvement.

The ‘as is’ representation of the patient throughput in the operating theatres is reflected in both the quantitative data plotted by the statistician at QUB and the qualitative data accrued through the field work. In case study it is important to represent the present operational overview of the

organisation. Interventions guided by the observed operational performance of the organisation can be introduced. These interventions must be reviewed under close scrutiny for efficacy and undergo rigorous audit. An audit will help confirm whether an intervention is both influencing and improving the service or causing further unpredicted issues.

Audit and research have much in common; they share a rigorous approach to methodology in terms of design, procedure, analysis and interpretation of data. At times, the distinction between research and audit can be blurred. However there are a number of major differences.

> Clinical audit: is a way of finding out whether you are doing what you should be doing by asking if you are following guidelines and applying best practice.
>
> Research: evaluates practice or compares alternative practices, with the purpose of contributing to a body of knowledge by asking what you should be doing.

It is clear from the data collected for the research that there have been issues over the selected time period with late starts, delayed turnaround times between patients and unplanned unfunded overruns for the operating theatres at QEHB. The views of the stakeholders interviewed confirm that these issues are both known to the operating theatre groups and the senior hospital management. In 2016 the hospital brought in an external consultancy to review the operating theatre performance with a view to suggesting improvement strategies to address the under utilisation of the scheduled work. The consultancy made some initial changes with perceived improvements. This included automatic sending for the first patient on the morning operating list at a designated time to expedite a prompt start to the operating session. The researcher asked to review their final report from the consultancy that they prepared for the senior hospital management showcasing the improvements they made within the service. However this has not been forthcoming and the researcher was unable to access their report to enlarge on their recommendations and to contrast their work with our research in this thesis.

However the case study undertaken for our research project confirms that there is much more work to be done to improve patient throughput in the operating theatre setting.

This research project's recommendations for improving the service will focus on better pre-assessment and preoperative patient preparation on the surgical ward areas and also an improved turnaround time in the operating theatre suite for the patients.

A link practitioner based on the surgical wards who is conversant with both the workings of the surgical wards and the operating theatres can be responsible for both confirming that the patient pre-assessment is complete and is at hand for the clinicians who need to review and use it and also the preparation of the patient for the journey to the operating theatre suite in good time.

Dedicated turnaround teams based in the operating theatres will provide support to the anaesthetic and surgical practitioners in assisting with improved turnarounds between patients on the list. Their responsibilities will be to clear away and process equipment used for the first patient on the list whilst also cleaning the area and preparing the furniture and surgical instrumentation for the next patient. This removes this responsibility from the anaesthetic and surgical practitioners who can focus on their documentation and their own clinical preparation for the next patient.

Where the onus for these tasks remains for the anaesthetic and surgical practitioners, the planned turnaround times can be extended leading to delays and patient cancellations. Where turnaround teams work together with the anaesthetic and surgical practitioners there is published research that suggests turnaround teams improve performance times.

Turnaround teams are being periodically introduced in operating theatres as they are perceived to contribute to improvements in patient throughput. The NHS Institute for Innovation and Improvement has determined that a £7 million saving can be achieved per trust by improving theatre efficiency. Dedicated turnaround teams may contribute to the overall efficiency strategies available to NHS Trusts.

This research project is advocating that turnaround teams become a regular part of the surgical provision stakeholder group working within the operating theatre environment. If properly funded by healthcare institutions this group of practitioners will contribute to a more effective and efficient surgical service.

As the focus of this project is targeting improving high volume low variety surgery patient throughput their presence and impact will be vital to ensure prompt patient turnaround.

These recommendations will be explored and presented for future research in Chapter 6 the Discussions chapter which follows on from the Results chapter.

5.14 Cross Case Study

In this single case study the cross case analysis will focus on the themes emerging from the stakeholder interviews and structured observations.

Cross case analysis is a research method that can mobilize knowledge from individual case studies or themes. Mobilization of the case knowledge occurs when researchers accumulate case knowledge, compare and contrast cases or themes and in doing so produce new knowledge.

Cross case analysis facilitates the comparison of commonalities and differences in the events, activities and processes that are the units of analyses in case studies.

Cross case analysis also enables researchers to delineate the combination of factors that may have contributed to the case and further articulate the concepts, hypotheses or theories discovered or constructed from the original case.

5.15 Cross Case Generic Theme Findings

5.15.1 Stakeholder Interviews

Throughout all the stakeholder interviews common themes were raised about the efficiency of the surgical services which were revealed through the coding process. Coding text is an acknowledged research tool that allows researchers to index and categorise text in order to establish a framework of thematic ideas about it.

Coding enables researchers to organise their data so the relationships between the codes can be examined and analysed in a structured way. Coding is not just an exercise in labelling; it links the data back to the research idea and also back to the other data.

The generic findings in the interviews were identified as:

1. Late Starts
2. Delayed Turnarounds between Patients
3. Late Finishes
4. Unplanned Unfunded Overruns
5. Patient Admission Process

6. Communication

7. Influence of Operating Theatre Staff on External Operational Issues

There was a general consensus amongst the interviewees that these generic issues were influencing the service on a regular basis. There were also recommendations from these service users for improvement strategies based on their operational experience of the service.

Late starts of the operating sessions are inherent in Operating Theatres. This is borne out by the literature review and both the quantitative and qualitative data. Late starts in surgery are experienced across many healthcare institutions worldwide.

There are many different influences that contribute to late starts. Common influences have been identified through the coding. These include poor communication between the stakeholders responsible for the service. This exacerbates the argument for cohesive unified working as against current silo working scenarios. Poor communication can contribute to inadequate patient preparation via the admission process prior to their surgery.

Late starts can result in late finishes or patient cancellation further down the operating list. The underutilisation of the operating session can be further compounded by delayed turnarounds between patients and can ultimately lead to unplanned unfunded overruns.

All these generic themes are interlinked and explain the variability and inconsistency that influences efficient surgical patient throughput.

The implications of these themes will be further discussed in Chapter 6 with discussion and recommendations for further research opportunities.

5.15.2 Structured Observation

The structured observations were documented in real time by the researcher. These observations have shown in detail the operational challenges faced by healthcare institutions in preparing and delivering their surgical services. The coding of the observations has emphasised the ‘silo’ working environment that populates healthcare institutions and reinforced the drive to establish cohesive working from stakeholders to streamline the perioperative patient pathway.

The generic findings of the structured observation coding are:

1. Large Footprint of Healthcare Institution

2. Communication

3. Patient Preparation

4. Incomplete Administrative Issues

5. Theatre Checklist

6. Availability of Lifts

Undoubtedly the large footprint of the healthcare institution plays a part in influencing prompt start times for the surgical sessions. Due to the previous day's in-patient intake and the overnight emergency patient admissions, surgical patients who are due for surgery may not be housed in the most optimal areas for their designated operating theatre on the morning of their admission. This can lead to extended patient transportation times with the possibility of delayed arrival into the Theatres admission reception. If the unavailability of lifts between floors is factored into the patient transportation time then there is a possibility for further delays. There are no dedicated lifts assigned to the Operating Theatres which was noted in the structured observation transcripts. Peak times for the beginning of both the morning and afternoon operating lists also coincides with the ward rounds conducted by the medical teams in the morning and the patients' visitors arriving over the lunchtime period in the afternoon. This results in heavy usage of all the lifts available. The unavailability of access to the lifts further compounds the housing of patients in areas remote to their venue for their surgery.

Communication issues were a leading factor of unanticipated delays in surgical patient transportation during the structured observations. The Theatre orderlies who participated in the observations confirmed that this issue regularly impacted on timely patient transportation.

Incomplete patient preparation and incomplete administrative issues were also observed and noted. The incomplete Operating Theatre care plan that is initially started by the ward staff prior to the patient leaving the ward area for Theatres was also identified by the Theatre orderlies as a contributing factor in transportation delay.

5.16 Cross Case Findings Common Across All Themes

The findings common across all themes are:

1. Communication

2. Patient Preparation

3. Incomplete Administrative Issues

4. Large footprint of the Healthcare Institution

5. Staffing Issues (Wards and Operating Theatres)

6. Availability of Lifts between hospital floors

Common findings across all the themes were evident upon the analysis of the coding. Patient preparation for surgery is reliant on a number of different teams in different locations all working together to facilitate prompt transportation of the patients to the Operating Theatre to receive their surgical treatments.

Incomplete patient preparation results in time wasted as ward staff and clinicians play catch-up. Poor communication will further add to the timing issues and impact on the planned schedule.

Availability of staff can also impact on the process. Ward staff may not be readily available to escort the patients due to their other commitments on the ward. Theatre staff may not be readily available to check the patient in for their surgical procedure if there are delays in preparing the Theatre or with equipment.

Availability of lifts between floors at peak times is also a contributing factor to patient transportation times.

The net effect of these operational issues can mean that patients scheduled lower down on the operating list may be cancelled at short notice due to a lack of session time or that the list may run over to accommodate all the scheduled patients. This is negotiable with the surgeon and the team he is working with and in many respects relies on good will. However, work-life balance is an extremely important consideration that healthcare institutions should take for the well being of their employees. It is in everyone's interest to start on time and aim to finish on time in a consistent manner. When lists unexpectedly overrun there are also additional costs to consider which impact on finite hospital budgets.

The impact of all these common themes either singularly or in combination have been identified through the research as contributing factors to delays and under utilisation of the scheduled surgery.

Discussion of the findings of the case study and its implications will be presented in full in Chapter 6. There will be both a comparison and a contrast of the literature review with the project results along with a resume of the project's findings. There will be a presentation of the clinical recommendations to support change.

Following on from the discussion and findings chapter, Chapter 7 is the final chapter and will present the contribution and novelty of this research alongside the clinical intervention recommendations formulated from the results of the data synthesis. The clinical intervention recommendations will be offered to future research teams for further implementation and trial. The limitations of the research and the direction for future research are also presented. The chapter concludes with the central conclusion of the research project.

Table 4 : SUMMARY OF RESULTS AND CONCLUSIONS

Quantitative Approach	Surgical Case Mix Reviewed – 3 Intermediate Surgical Procedures – Average Duration 1 Hour – Low Variety High Volume Surgical Provision Provided the Impetus for the Research
Quantitative Conclusions	Initial Supporting Conclusions Late Starts Delayed Turnaround Times between Patients Unplanned Unfunded Overruns Underutilisation of Planned Elective Surgical Sessions evident Series of Graphs produced by colleagues at Queen's University Belfast support the evidence from the Theatres clinical activity data capture Aligned with the comparable evidence revealed in the Literature Review
Qualitative Approach	Case Study – Bounded Contextual Observation and Review of the Complex Organisational Operation required by a Large Teaching Hospital to Deliver their Surgical Services To Build upon the Quantitative Findings To Underpin and Broaden the Research Hypothesis Stakeholder Interviews and Structured Observations
Qualitative Conclusions	Main Supporting Conclusions Structured Observations Clear Evidence of Recurrent Issues in the Clinical Setting creating Bottlenecks and Unanticipated Delays Witnessed and Documented during the Structured Observations Underutilisation of the Planned Activity (Cancellation of Patients further down the Operating List) or Overruns from either the Morning Session into the Afternoon Session or into the Evenings after the Scheduled Finish Time is Surpassed Coded for Commonalities Recurrent Themes Identified – Communication, Large Footprint of the Hospital, Incomplete Patient Preparation, Availability of Staff, Equipment and Patient Lifts, Administrative Omissions Stakeholder Interviews Broad Range of Stakeholders involved in Delivering Surgical Services provided Perspective – Coded for Commonalities Recurrent Themes Identified – Lack of Capacity to Tackle Waiting Lists, Incomplete Patient Admission Processes, Late Starts, Delayed Turnaround Times, Overruns, Communication, Reduced Influence from the Surgical Team on Events Causing Delay Remote to the Operating Theatre

CHAPTER 6 PROJECT DISCUSSION and FINDINGS

6.1 INTRODUCTION

This study investigated why operating theatres incur under-utilisation during their scheduled elective surgery sessions in a large teaching hospital in the UK. It explored why delays occur during these sessions. The literature review presented in Chapter 2 showed that there was little research regarding all the stakeholders responsible for delivering the surgical service working in a cohesive manner.

The content of the research question arose from the extensive literature review around the international surgical service operational performance with particular focus on projects designed to improve efficiency and surgical patient throughput. It was evident whilst conducting the literature review that there were many successful published projects to evaluate. However most projects reviewed focused on one particular area of the surgical patient journey for their improvement strategies.

There are many stakeholders involved in the preparation and transportation of surgical patients to the operating theatre. Therefore it was decided that engaging in an over-arching review of the whole patient journey would identify areas along the pathway that were causing regular issues with patient transfer times and delays. This gap in the research revealed in the literature review formed the basis of the research question and the methodological approach in the promotion of the stakeholders working with more cohesion rather than in isolated units (silo working).

Chapter 5 presents the results of the field work undertaken to address the research question posed in this project. The results arise from the case study conducted at QEHB and have been processed and coded. The raw data in the results forms the body of work in Chapter 5 with limited analysis and review of the findings.

This Discussion chapter will enlarge on the data analysis and the findings of the project. Theme 1 will review the research objectives. Theme 2 of this chapter will present a comparison of the findings with the literature review. Theme 3 will provide contrast of the findings with the literature review by emphasising the new data generated from the field work at QEHB.

Theme 4 presents a resumé of the project findings with a discussion focused on the unique and original research and the opportunities available to research teams for future investigation.

Theme 5 presents recommendations for clinical trial intervention and audit.

The data analysis conducted from the field work supports the limitations of 'silo' working and gives rise to recommendations for new ways of working for the stakeholders involved. These recommendations are offered to promote better communication and administrative performance. Expediting the patient preparation process may contribute to more effective patient transportation from the ward areas to the operating theatres. It may also support better utilisation of the operating sessions.

By encouraging closer working from the stakeholders it is expected that some of the recurring delays and bottlenecks identified in the field work will be reduced by the collaboration.

Any intervention introduced into clinical practice will need to be subject to rigorous audit and review to monitor progress and identify any unforeseen issues.

The underlying aim of the research question and its associated data set has been to propose clinical interventions aimed at drawing the surgical services provision together whilst challenging whether the service can work with more cohesion and whether this will contribute to improved clinical efficiency.

The scale of the issues faced by the stakeholders in delivering their surgical service has been acknowledged by the field work. The following themes in this chapter will confirm commonalities with the literature review and also present contrasting new evidence to support change.

In lining back the key areas with the literature it is worth revisiting the key areas discussed in Chapter 2 in the context of the results prior to the final discussion on the thematic review. There were four key areas discussed : these were

> ***1.Productivity*** - The review of the quantitative data that served to motivate the main qualitative data collection and analysis was seen as confirmation of the issue surrounding the productivity of the planned elective surgical sessions at QEHB. The under utilisation of this planned activity directly relates to the importance that both private and public sector organisations place on their performance indicators to measure productivity. This is clearly reported in the complex nature of modern business through the published literature and the synthesis of the data for this research project confirms the validity of the themes discussed in Theme 1 of the Literature Review. Productivity is widely recognised as a critical determinant of cost efficiency. Identifying the under utilisation of planned surgical activity

would serve to promote review of the determining factors affecting the service. Senior management would be expected to formulate a plan to address the issues and improve the planned utilisation. The analysis and review of the qualitative data sourced from the surgical services has delivered a set of clinical recommendations to trial and audit. These recommendations are designed to promote a more cohesive service and improve utilisation. These recommendations will be presented to the Senior Management and together with funding sourced from the National Institute for Health Research there will be opportunity to test the hypothesis. Whether in the private or public sector arena the delivery of improvement initiatives are important to maintain the vitality of the enterprise concerned. This directive has been a primary focus of the literature review and expanded upon during the data collection and data synthesis.

2.Change Management - Complex public organisations are expected to provide an assured service through best management of the public funding they operate with and in the services they provide to their clients. The literature review on change management highlighted the challenges of introducing change management in the public sector. Greenwood and Hinings argue that an organisation's institutional context can limit the possibilities for change especially when an organisation is embedded in a wider system that has tightly coupled relationships (Greenwood and Hinings 1996). The effect of the tightly coupled relationships is felt both in the private and public sector. Within the healthcare sector the literature review has provided commentary on a multitude of initiatives and projects introduced over the last few years that have had a varying amount of uptake and success. The literature review also revealed the importance of identifying that robust audit with any such initiatives is vital to sustaining any change management program. It is clear from the clinical recommendations of this project that without robust audit in place the process may suffer from a 'fail to plan is a plan to fail' outcome. As change management is becoming increasingly challenging in every field of modern commerce change project managers must be aware of both the benefits and pitfalls of introducing new ways of working. This is reflected upon in the literature review and becomes a primary focus for the researcher when forming a solution to the underutilisation issue and in the subsequent trial and audit of the recommendations which are seen to move the various clinical teams responsible for delivering the surgical services away from their established silo working methods towards working together in a more cohesive system led service.

3.Systems for Change - There are a multitude of published papers on initiatives to introduce systems for change in the operating theatre environment. A selection of these projects have been reviewed and commented upon within the literature review. The purpose of reporting on past projects serves to highlight both the successes and challenges achieved by research teams when tasked with delivering change and service improvement. Undertaking this review allowed the researcher to understand the depth of the published work and identify a gap in the research to exploit and build a thesis upon. This is an established gateway taken by aspiring academics undertaking doctoral research. Using this published evidence the researcher was able to make an informed choice with regard to the project proposal and research question and in the strategy used to collect and analyse the supporting data. The clinical recommendations arising from the data analysis consolidate the systems for change strategy underpinning this thesis

4.LEAN - The published papers on the origins of LEAN substantiate the gains that private sector manufacturers made upon engagement of its principles. By focusing on process and product flow, manufacturers were able to produce their goods more quickly and offer variety in product choice. The public sector has engaged in LEAN too and has benefited from innovation and improved operational processes. The Apollo space program was influential in developing leading edge technology during its missions. LEAN has been influential too in the service industry and healthcare focusing on targets and performance indicators. The principals of LEAN are well documented and form the main focus of Theme 4 in the literature review. Several LEAN projects within the healthcare setting are presented in the literature review to confirm both their validity and success in their delivery. These projects served to motivate the researcher by providing the direction for the research strategy. Without acknowledgment and understanding of these projects in the literature review the research undertaken would not have fully established its strategy and development. The results from the data collection and their analysis are further enhanced by acknowledgment of similar past projects. The clinical recommendations of the thesis are directly influenced by the success that these past projects have delivered .

6.2 Theme 1 Research Objectives

The initial research work focused on patient timings for three intermediate elective surgery procedures as captured by the electronic data capture system used in the operating theatres. The procedures were Laparoscopic Cholecystectomy, Hernia Repair and Arthroscopy of Joints (Knee, Shoulder, Ankle). This initial data gathering was analysed and the under-utilisation was represented in graphical form. The research question was formulated around this quantitative data set.

The objectives were:

1. To conduct a comprehensive literature review appraising international projects seeking to improve perioperative efficiency
2. To review under utilisation of elective surgery sessions gathered in the data capture
3. To develop a conceptual model to represent how complex things work the way they do and the way of thinking taken in the study of this problem.
4. To observe surgical patient flow to determine why and where there are delays
5. To construct a process map and a role activity diagram to assess where interventions may impact on efficient surgical patient transportation times
6. To interview the stakeholders responsible for delivering the surgical services for their perspective and to triangulate the data set.
7. To code the structured observations and interviews to identify the critical bottlenecks and inertias in the patient transportation that cause delay and under utilisation
8. To identify the impact of these delays upon scheduled elective surgery sessions
9. To offer recommendations to promote cohesive working amongst the stakeholders to expedite patient transportation from the wards to the operating theatres.

The limitations of this research will also be presented alongside recommendations for future study around this topic.

6.3 Theme 2 Comparison with the Literature Review and Project Results

There have been very positive inroads made in the planning and delivery of surgical services by the service users in recent years.

Improved capture of clinical activity and audit through systems introduced into operating theatres have allowed management teams to identify recurring problems and address them. Forward planning has also been introduced to ensure that the operating team skill mix is appropriate for the planned procedure and that the equipment required is to hand. These regular meetings are designed to advise all those involved in the planned surgery and to minimise any disruption on the day of surgery. Pre admission for the patients is also more effective with healthcare institutions offering screening facilities to their patients at home via a PC which negates an extra visit to the hospital.

The introduction of the WHO Surgical Safety Checklist in 2008 for the operating team has also contributed to safe surgery (World Health Organisation 2019). The checklist is designed to focus all the team on the planned surgery and to identify any issues or concerns prior to the commencement of the surgical procedure. During this checklist the correct procedure and site of the operation is confirmed. Any concerns for the patient are also confirmed (allergies, comorbidities). The checklist is designed to reduce the occurrence of 'never events' as classified by the NHS. These adverse events include wrong site surgery, incorrect implants and medication administration errors. Audit of the checklist use shows significant reduction in both morbidity and mortality and is now used by the majority of surgical providers around the world (NHS England 2019).

The literature review undertaken for this project confirmed that improving operating theatre efficiency projects are prevalent across the worldwide health community. Past published projects have taken a broad approach in addressing operational issues experienced at the coal face by healthcare practitioners.

The scrutiny of these published papers bears testimony that clinical intervention and change management does have a positive effect on service delivery and that robust audit serves to check and confirm the service improvements.

The study undertaken by van Veen-Berkx at the Academic Medical Centre in Amsterdam looking at the effectiveness of cross functional team utilisation served as a pivotal paper to support our research question. The study was undertaken at eight healthcare institutions over eight years and was published in 2015. Their paper supports the benefits of utilising multi-disciplinary team working by establishing a cross functional team working for the planning and delivery of surgical services. This natural progression away from 'silo' working serves as an exemplar in projects designed to improve clinical performance within the operating theatre environment (Van Veen-Berkx 2015).

To further review their success the researcher made contact with their research team and was fortunate to be invited to the Academic Medical Centre in Amsterdam to observe their clinical practice.

The researcher visited their facility in 2015 and was invited to join one of their operating teams for the day to witness their operational processes. There was also opportunity to present the project to a group of healthcare practitioners at their regular morning meeting prior to the start of their clinical work.

The project was well received and there was mutual consent from the group regarding the recurring issues experienced by their teams as well as in the UK.

The researcher then joined the team in the operating theatre thereafter and reviewed their clinical practice. It was evident that the team was well supported by the senior theatre management and that the cross functional team working was proving to have a very positive effect on their patient throughput.

The researcher then met with Elizabeth Van Veen-Berkx, lead researcher for their paper, to discuss research opportunities and how our research question and the field work data collected could influence new ways of working. The discussions were very positive. The advice and support received from this senior academic was invaluable in shaping our research methodology and timetable. The visit to Amsterdam provided clear evidence that operational issues with surgical services are experienced at an international level. The data collected in the field work and presented in Chapter 5 acknowledges the similarities faced by many different healthcare institutions across the world.

A sister paper from Van Veen-Berkx looking at successful interventions to reduce first case tardiness published in 2014 also echoes the issues perceived through the field work within this project. First case tardiness refers to late starts for the first patient on the operating list.

The paper reviewed 190,295 elective inpatient surgical cases that qualified as the first case of an operating room day. This data was collected between 2005 to 2011 from eight medical centres across the Netherlands. The data collected by the research team demonstrated that 43% of all first operations on the operating list started at least 5 minutes late. This accounted for 452,612 minutes (7,094 hours or 887 8-hour operating list days) being lost annually.

Their suggestions for improvement included introducing a national benchmarking programme across the Netherlands to review and improve strategy and clinical performance. They state that

efficient use of operating room capacity is vital as the rooms are considered as a high cost environment but a limited hospital resource (van Veen-Berkx 2014).

The data collated from QEHB from 30 theatres over a nine month period from April to December 2014 revealed similar issues with late starts and under utilisation of operating lists. In the main theatre suite housing 23 theatres 114,886 minutes (1,915 hours) were lost. In ambulatory theatres, where there are 7 theatres, 31,031 minutes (517 hours) were lost. It is estimated that 51% of unplanned overruns would have been avoided if a prompt start to the operating list had been achieved (QEHB Systems Department).

A literature review from Belgium in 2014 by Van Reit and Demeulemeester focused on the benefits that teams responsible for providing surgical services could gain by planning surgical activity. Through identifying the principal sources of variabilities that impact on clinical productivity in surgical care they were able to highlight the challenges faced by healthcare institutions. These challenges ranged from late arrivals of patients, medical staff and medical notes and test results, variability in anaesthetic times, surgical duration and turnaround times between cases.

These challenges were noted and recorded in the part of the field work presented in Chapter 5 of our study.

The Belgian study also presented a commentary on the large differential in the setting of their reviewed papers which would likely impact significantly on comparing like for like inter-institution comparison (Van Reit and Demeulemeester 2014).

Betancur looked at fast track surgery in Latin America. By focusing on low complexity cases their project managed to reduce anaesthesia induction times by 50% and surgical skin to skin time by 28%. Prior to the study 50% of all cases started on average 23 minutes late. Even though the study is isolated to a single healthcare institution, their approach to change management and their audit of operational performance serves to prove that it is possible to improve clinical practice. Review of such projects serve to guide and inspire further research. Their selection of low complexity cases for improvement measures was noted in the composition of the research question for this project. High volume, low variety surgery is a commonly chosen sector of surgical practice for review and improvement initiatives (Betancur 2015).

Another single centre study was delivered by a multidisciplinary team based at Bambino Gesu Children's Hospital, Rome, Italy. Barbagallo and his research team looked at the optimization and planning of theatre activity. They stated in their paper that providing surgical services and its

associated resources contributed up to 40% of total costs in a modern healthcare facility. Therefore, the optimization of surgical services should be a universal objective. Their research served to reaffirm and strengthen the research question composed for our study. The advantages associated with optimising the surgical service also became evident as our field work and data synthesis unfolded (Barbagallo et al. 2015).

Since the onset of the current global recession in 2008 there has never been a more pertinent time to improve operating room efficiency for healthcare institutions working within tight budgetary constraints.

6.4 Theme 3 Contrast with the Literature Review and Project Results

Where there have been similarities with the published research presented in the literature review this project has been guided by the opportunity to explore a unique approach in the examination of perioperative patient flow. This gap was identified in the initial literature review which informed the expression of the research question. By investigating the whole patient flow process, both through direct observation and by gathering the perspective of the service users, this project presents an overarching review of the challenges the service endures.

The clinical recommendations offered in this project seek to encourage better engagement within the stakeholders and to expedite improved operating session utilisation by reducing patient transportation delays.

In promoting an inclusive, cohesive conceptualization of the service in preference to current silo working this project takes an innovative approach to the body of published research.

The majority of the published literature reviewed presented projects that delivered advancements in operating theatre efficiency. However most projects isolated their research to a particular clinical area or segment of the patient flow cycle in delivering their data and results. Whilst many researchers demonstrated initial improvements, they also stressed that key to the continued success of their work was the robust audit and review of the new ways of working that they introduced. Amendment of the new working arrangements if identified through project audit also served to embed their project's sustainability. This is paramount in ensuring the operational change remains steadfast.

This project has built upon the published research presented in the literature review. The contrast begins with the methodological approach. A case study was proposed to review the whole perioperative patient journey as it was felt by the researcher that the recurrent issues experienced in the transportation of the patients from the wards to the operating theatre largely stem from the stakeholders working in isolation of each other. Simple constraints experienced through this silo working such as communication, patient preparation, availability of staff and equipment combine to affect straightforward patient transfers. The case study allowed the observation of these constraints and the formation of proposals and recommendations to improve the processes.

By engaging with a broad range of practitioners within the stakeholder group responsible for the surgical services this research presents an eclectic overview of the operational agility of a large healthcare institution. This perspective is important in the sense that as the various sub sections of the practitioners become aware of the responsibilities and actions of their peers they will come to understand the benefit of working more closely as a cohesive unit.

In relation to the content of the literature review the individuality of this project research approach and its subsequent findings is offered for consideration for inclusion in the body of published work covering this research topic.

As many published papers look at improving their individual services there is also a focus on managerial teams to instigate audit and change. However this project moves away from this approach by engaging with several groups of practitioners that combine to deliver the service. A view of the service, from the orderlies that collect the patients from the wards to the practitioners who prepare the operating rooms and assist with the anaesthesia and surgery to the anaesthetists and surgeons who perform the clinical procedures, has been sought and reported in the data set.

As surgical service provision looks to keep pace with an ever increasing demand it is vital that all the agencies involved in delivering the service move towards a more inclusive working strategy. These individual agencies, frequently known as stakeholders, all play an important role in facilitating the many thousands of operations that take place in the NHS per annum. However with an increasing elderly population in the UK there are unprecedented demands on the NHS to deliver healthcare in a timely efficient manner. Modern medicine is allowing the UK population to live longer with successful treatment regimes for comorbidities. Cancer survival rates are improving too. These medical advances are however been counteracted by the pressures of the sheer numbers of patients using a healthcare system funded with a finite budget.

In September 2019 the NHS reported that 4.42 million patients were on the waiting lists. Only 85.8% of those patients were seen in under 18 weeks which is the national benchmark for delivering treatment. The national target for referral to treatment is 92% - these September figures of 84.8% represent the worst performance since the target was introduced in 2012 (Triggle 2019).

With the global economy still making a tentative recovery from the recession of 2008 and with the uncertainty of a finalised deal for Brexit for the UK (December 2019) there has never been a more appropriate time for the NHS to take stock of its service and performance. As a large institution the NHS must avoid a 'firefighting' approach to its day to day operation. Clear guidance and performance strategies from its senior tier of management must be cascaded through the ranks.

Winter 2019/20 will see the biggest challenges for the NHS to cope with winter pressures and inpatient bed capacity management. The winter periods of 2017/18 and 2018/19 have previously witnessed unprecedented demands for beds and treatments. It is anticipated that winter 2019/20 will be similar. Certainly leading medics and think tanks are warning the health secretary to prepare for the consequences of a busy 2019/20 winter period and the strain it puts on NHS resources. The COVID-19 pandemic has changed many of these issues, but the underlying problems remain.

Surgical services can contribute to overall healthcare institutions performances by expediting their surgery programmes to ensure beds become available at the earliest opportunity. This will ensure that 'bed blocking' does not impact on the surgical patient cohort. 'Bed blocking' usually refers to medical patients who are medically fit for discharge from hospital but are unable to leave due to home or social service issues. With these patients there is no option but to allow them to stay in the hospital in a safe and supported environment until provision is in place to allow them safely back into the community. If this does not happen the patients are released from hospital without full support and are likely to be readmitted within days if their health fails again in a category known as 'failed discharge patients'. Efficient provision of surgery and discharge will contribute to freeing up vital bed space.

If 'bed blocking' is reduced this will allow more medical patient admissions. Traditionally there is a spike of medical patient admissions in the winter months as the damp cold weather experienced in the UK brings more respiratory and chest related illnesses into the hospitals. With an ever increasing elderly population the numbers of this category of patients to be treated will inevitably rise during the winter period.

6.5 Theme 4 Summary of Research Project Findings

The research presented in this project was initiated from the clinical data gathering exercise undertaken at the outset of this study. The under-utilisation noted from the data gathering and analysis shaped the research question at the centre of this work.

The project remit was for the researcher to observe and identify the issues responsible for causing delays to the scheduled clinical work which ultimately led to the under-utilisation of the operating session and on occasion the cancellation of elective surgery for patients.

Identification of these issues under direct observation led the researcher to construct a process map detailing the relationship between the stakeholders responsible for delivering the surgical service. This in turn produced a role activity diagram which further explains the responsibilities the stakeholders have in delivering the tasks and processes involved in the preparation and transportation of patients from the wards to the operating theatre.

Alongside the process map and role activity diagram a conceptual model was designed to outline both the barriers and facilitators to perioperative patient flow. The conceptual model is the central focal point of this research; the point of convergence for all the data. Conceptual modelling delivers the objectives, inputs, outputs, content, assumptions and appropriate simplifications required for the stakeholders to better understand their situation (Allen 2019).

The process map and role activity diagram allowed the researcher to pinpoint areas that were showing repeated concern. Recommendations for a clinical trial based on these areas of concern are also offered to future research teams for further investigation and audit.

It is clear from the data set that there are a number of the processes involved in preparing the patients for surgery that should be of concern to those stakeholders responsible for providing surgery to the patient cohort.

a. The large footprint of the hospital can affect patient transfer times due to the sheer size of the building. Planned admission areas for elective surgery patients may change overnight due to the volume of emergency admissions from the emergency department in the night filling up those spaces. This can mean that patients who are scheduled for a specialist procedure in a particular theatre may be at the other end

of the hospital. This means extra time taken for surgeons to walk to the ward to consent and mark the patient. The anaesthetist will have the same issue when visiting the patient for their anaesthetic assessment. The theatre orderly will increase his footfall when travelling to and returning from the ward with the patient to the operating theatre reception.

b. Lack of patient preparation is also a big influencer on delays as drawn out in the observation. There are a number of set procedures to undertake before a patient is deemed ready to depart from the surgical ward for their surgery. Patient identification labelling, consent and marking, anaesthetic pre-assessment, pre-op medication, entry onto the PICS system on the hospital's Clinical Portal and an available area for the patient to change into their hospital gown are all part of the patient preparation process. Failure to undertake any of these tasks prior to the arrival on the ward of the theatre orderly to transfer the patient to the operating theatre will lead to the inevitable delay and threaten the full utilisation of the scheduled work.

c. Lack of staff. This is a persistent issue amongst healthcare institutions. If there are staffing issues on the wards there may not be the right amount of staff available at a given time to check the patient off for surgery or offer patient escort duties. This will ultimately lead to delays. Likewise in the operating theatres if there is not the skill mix available amongst the theatre team then there is a possibility for delay whilst the correct skill mix is sourced.

d. Communication. Will always be an issue where multiple stakeholders are involved. Any issues from either the ward side or the operating theatre side need to be communicated in a timely manner to the appropriate personnel. This is particularly important if there are remedial actions to undertake by third parties to ensure the issues are resolved. Too often communication breaks down and is not relayed to the right recipients which can further contribute to delays in the scheduled work and under utilisation of the operating room session.

e. Administrative Issues. If there are delays in sending for the patients to the pre-assessment clinics or their admission onto the Clinical Portal this will produce a knock on effect for their allotted day and time for surgery. Missed letters or emails for

patients requiring surgery is very frustrating for patients and their families. Letters may be misdirected in the post and emails may inadvertently end up in junk email rather than inboxes. If this leads to cancellation then the patients have to endure more stress whilst another date for surgery is fixed and all the arrangements to attend for surgery are re-organised. Failure to admit the patient to the Clinical Portal on the day of their admission for surgery may prevent access to the PICS system which will delay clinicians in accessing and using the patient's medical records.

f. Patient lifts. The lifts in QEHB are not dedicated for patients. This means everyone using the lifts must wait their turn. This is frustrating at peak times where the movement of hospital staff and visitors tie up access to the lifts. Other institutions have a secure lift facility which allows sole access to patients being escorted from the wards to the theatres. This allows unhindered transfers of patients between the two clinical areas. It is something that all large healthcare institutions should consider when mapping their patient processing times. The availability of patient lifts do contribute to improved transfer times. A simple time exercise in patient timings both with the dedicated lift access and without it will bear testimony to this.

g. Changes to the order of the operating list. This can occur due to a number of reasons. Patient clinical need priority, availability of senior surgeons, late arriving patients, incomplete patient preparation, equipment problems, staffing problems etc. The key to overriding any time lost due to unexpected changes in the order of the list is good timely communication between all the stakeholders involved in the patients' surgical plans. If communication breaks down there is a strong probability that operating session time will be lost and will impact on patients further down the operating list.

h. Equipment Issues. In the field of surgery there are more and more sophisticated anaesthetic and surgical hardware being used to deliver clinical procedures. For some specialities in recent years there has been the introduction of robotics and artificial intelligence (AI) to deliver surgical techniques. Urology is an example of a surgical speciality that has seen increased use of laser, robots and AI in recent years. Anaesthetic machines that maintain a patient's anaesthesia whilst they undergo surgery are highly sophisticated driven by software applications. This equipment is highly specialised and therefore highly sensitive. If there are issues with any of this

equipment it may lead to delays in the scheduled work or even cancellation of the patients.

i. Unavailable Support Staff – Surgery is reliant on supporting practitioners which assist in the surgical provision. Radiographers for imaging services, Sterile Service personnel who clean and reprocess sterile surgical instruments. Interpreters who facilitate patient consent and relay information concerning patient's medical histories. If any of these supporting practitioners are delayed or unavailable then this will impact on the planned procedures and may lead to delay or cancellation of the patients on the operating list.

The review and the analysis of the clinical data along with the stakeholder interviews and structured observations have provided a strong platform for the new thinking and clinical solutions offered in this thesis

The thesis proposes a shift from traditional silo working in healthcare to promotion of a cohesive service amongst all the stakeholders involved in delivering surgical services

This cohesion will be driven by the establishment of a link practitioner to unify the service by ensuring that patients awaiting collection from ward areas for surgery are ready at their allotted time for collection. This would entail the practitioner engaging in all the processes required to ready the patient for collection - including completion of consent forms, investigations and clinical notes. In effect the link practitioner becomes the process manager for the patient preparation service and is the central player between all the stakeholders involved in the surgical provision.

Turnaround teams in the operating theatres to expedite improved patient turnaround times would compliment the work of the link practitioner in working towards better utilisation of the planned elective surgical activity.

Less inertia in the service through these initiatives may contribute to an improved service and better outcomes for the patients by avoiding unnecessary delays and cancellations.

6.6 Theme 5 – Clinical Recommendations To Support Change

This project offers two clinical recommendations to encourage the stakeholders involved in the surgical service provision to work more inclusively. The recommendations have been identified by

the researcher as having the potential for clinical trial and audit to impact on the service by promoting cohesive working.

1. **The introduction of a Link Practitioner working between the Surgical Wards and the Operating Theatres**

   This practitioner would be solely responsible to act as the surgical patient advocate by ensuring they are ready for their surgery when requested by the operating theatres. This would entail the practitioner ensuring that all the appropriate preparation for the patient is in place before the scheduled sending time for the operating theatre. If there are any omissions it would be the responsibility of the practitioner to facilitate the completion of the patient preparation using their insider knowledge of how the patient preparations processes work. This would mean liaising with all the agencies involved in the stakeholder group. It would be a very responsible role for a senior healthcare practitioner experienced in both surgical ward and operating theatre environments for any impact to be achieved.

2. **The introduction of Operating Theatre Turnaround Teams**

   These teams are used to assist with the clean up and preparation of the operating theatres between patients. This will involve tidying away the used surgical instruments, cleaning the furniture and floors and setting up the next lot of surgical instrumentation for the following procedure. This frees up the nurses and practitioners to focus on their administrative commitments and anaesthesia requirements between patients.

   There are a number of healthcare institutions in the UK who already utilise these teams. This project recommends that turnaround teams should become a regular feature in the operating theatre environment to assist the surgical services across all UK healthcare institutions to improve on operating theatre utilisation.

These recommendations are offered for further scrutiny via clinical trial and audit for future research teams.

Due to the limitations of the field work which could be conducted for this research (mainly owing to time constraints imposed by the introduction of an external agency to review the operating theatre

processes) there has been no opportunity to introduce the clinical recommendations for trial. This was an unforeseen development for the research programme.

However it leaves open the opportunity for future research teams to trial and audit the recommendations. There will also be an opportunity to further expand upon the scope of the recommendations from innovative researchers.

These two recommendations will require extra initial resources to establish. However it is anticipated that this extra resource will be offset by the improvement in the utilisation of the scheduled elective surgery sessions. More throughput of surgical patients will generate more income for the healthcare institutions. Robust audit of the clinical trials will monitor the progress and report back on any efficiencies achieved.

Following on from this discussion and findings chapter, the final chapter of the thesis presents the conclusions of the project. Chapter 7 will present the contribution and novelty of this research alongside the clinical intervention recommendations formulated from the results of the data synthesis. The clinical intervention recommendations will be offered to future research teams for further implementation and trial. The limitations of the research and the direction for future research are also presented. Chapter 7 closes with the central conclusions of the research project.

Table 5 : SUMMARY OF RECOMMENDATIONS

Link Practitioner	The introduction of a Link Practitioner working to unite the surgical wards and the operating theatres. This practitioner would be solely responsible for acting as the surgical patient advocate by ensuring they are ready for their surgery when requested by the operating theatres. This would entail the practitioner ensuring that all the appropriate preparation for the patient is in place before the scheduled sending time for the operating theatre. If there are any omissions it would be the responsibility of the practitioner to facilitate the completion of the patient preparation using their insider knowledge of how the patient preparations processes work. This would mean liaising with all the agencies involved in the stakeholder group. This recommendation is best suited in placing a Link Practitioner both on the surgical wards and in the operating theatre reception for the duration of the surgical sessions to promote improved cohesion of the service. These practitioners would take responsibility for ensuring patients are prepared, transported and checked in for their procedure in the operating theatre in a timely manner. This alleviates the pressure away from both the ward and operating theatre staff to focus on their clinical responsibilities. This Link Practitioner role would be ideally suited to responsible senior healthcare practitioners experienced in both the surgical ward and operating theatre environments for any impact to be achieved.
Introduction of Operating Theatre Turnaround Teams	The introduction of turnaround teams will assist with the clean up and preparation of the operating theatres between patients. This will involve tidying away the used surgical instruments, cleaning the furniture and floors and setting up the next lot of surgical instrumentation and furniture for the following procedure. This frees up the nurses and practitioners theatre team to focus on their administrative commitments and the safe emergence and induction of anaesthesia for the patients. There are a number of healthcare institutions in the UK who already utilise these teams. This project recommends that turnaround teams become a regular feature in the operating theatre environment to assist the surgical services across all UK healthcare institutions to improve on operating theatre utilisation.
Recommendation for Introduction of Clinical Interventions with Audit	The recommendations associated with this research are suitable for a clinical intervention with audit It is the intention to offer these recommendations to interested researchers at Masters Level for an intervention trial in the clinical arena. Audit by the researchers will test the interventions for impact and project the suitability of the interventions for the long term

CHAPTER 7: CONCLUSION

7.1 Introduction

The primary purpose of this research was to understand why there is under-utilisation in scheduled elective operating theatre lists and to contribute to an in-depth investigation into why this occurs.

The study was built on a case study at a large teaching healthcare institution in the UK. This involved field work using a mixed methods approach incorporating both quantitative and qualitative data. This triangulation was designed to promote a broad perspective of the surgical service provision.

The structure of the thesis is as follows:

Chapter 1 justified the background of the study and provided an overview of the research question, the research approach and the key findings. It also has an outline of the thesis.

Chapter 2 is the literature review that inspired this research. It reviews private, public and health sector productivity and also reviews change management programmes from a people, process and technology perspective. It then reviews published projects on systems for introducing change and LEAN initiatives in industry and healthcare. Gaps in the literature were identified by critical review to determine the appropriate theories to adopt for this research.

Chapter 3 presented the conceptual model for this research and the data processing tools in designing and examining the case study.

Chapter 4 presented the chosen research methodology. This presentation included the research question, the research framework, the research philosophy and research strategy. It also includes a detailed research methodological approach and a review of the analysis.

Chapter 5 provided the results of the triangulated data set.

Chapter 6 discussed the findings of the triangulated data set which offered both quantitative and qualitative data together with the literature review revealing the similarities and differences between the literature and the results to highlight the contributions of this research.

This closing chapter will now summarise this process, highlighting the main contributions of this research followed by its recommendations, limitations together with direction for future research.

7.2 The Contribution and Novelty of this Research

This section presents the empirical and theoretical contribution of this research. It was identified in the literature review that past published projects addressing perioperative efficiency mainly looked at one particular clinical area, or one process, in devising programmes to facilitate change and an improved surgical service.

These projects looking at isolated areas of the surgical service were reviewed in Chapter 2 in order to explain how this study fills a gap by doing an over-arching review of the perioperative patient throughput, and by recommending clinical interventions that will add to our understanding of how to manage and improve upon under-utilisation of scheduled elective surgery operating lists.

To fill the gaps in the literature a case study was designed to review the perioperative patient throughput. The main purpose of this was to analyse the perioperative patient journey through an analysis of routine quantitative data, and an investigation into the causal factors associated with bottlenecks and delays by direct observation. A triangulation of the data set was completed with a number of stakeholder interviews from the various specialties that deliver the service, to form a broad perspective of the state of the operational performance and its challenges. Critical factors, impacts and barriers influencing efficient perioperative patient throughput were also investigated.

The case study and review of the data has made it possible to offer clinical intervention recommendations to improve perioperative patient throughput. The following points represent the main contributions outlined in this research.

Contribution One: Theoretical and Empirical Contribution:

The theoretical contribution to this research is informed by the empirical data analysis and the knowledge gained by means of the direct observation of the preparation and processes required to prepare and transport patients from the surgical admission wards to the operating theatres. The theoretical input advocates a clinical intervention programme to address the pressures on the surgical service. This programme has been formulated to recommend trial 'cohesive' working by introducing a link practitioner and operating theatre turnaround teams to expedite patient preparation and throughput. This extra resource is needed to impact on under utilisation of scheduled operating sessions. Thus, this study has significantly contributed to this particular field of

research as well as providing essential recommendations for clinical trials with adoption if successful.

Contribution Two: Conceptual Model and Process Map

A conceptual model and a process map designed specifically to support this research project are presented with particular focus on how these research tools allow the stakeholders involved in providing surgical services to understand the wider concept of the patient flow process and aid the recommendations offered for an improved cohesive service.

Contribution Three: Understanding the critical factors associated with perioperative patient throughput delays through direct structured observation:

The observation of the processes involved in preparing and transporting patients from the ward areas to the operating theatres granted the researcher the opportunity to directly witness and record the critical factors involved. Understanding why issues with these factors affect utilisation of the scheduled operating sessions was key to formulating the clinical intervention response.

Contribution Four: Assessment of the impacts and barriers influencing clinical efficiency:

Assessment of the impacts and barriers influencing clinical efficiency in the operating theatre environment followed the completion of the triangulated data set – the quantitative and qualitative data assumptions were validated by the stakeholder interviews.

Contribution Five: Analysis of the clinical activity data capture from the Operating Theatres:

The initial clinical activity data gathering exercise reviewed 18 months of activity around intermediate elective surgical procedures. The under-utilisation of the scheduled work was noticeable. This initial analysis shaped the formation of the research question. It also informed the research methodology, conceptual model and the decision to choose case study for the qualitative data contribution.

Contribution Six: Contribution to the scarce supply of studies around silo versus cohesive working by surgical service stakeholders:

The literature review undertaken for this research identified only a small body of published papers testing the merit of ‘silo’ versus ‘cohesion’ working in healthcare. This thesis makes an interesting contribution to this body of work by taking an overarching review of the perioperative patient

throughput process and by championing 'cohesive' working in the pursuit of a seamless operational service.

7.3 Clinical Recommendations

Recommendation One: Introduction of Link Practitioners

The structured observations undertaken for this project highlighted several common issues faced by the Theatre orderlies in collecting the patients from the surgical wards for transportation to Theatres. At this particular point in the patient collection process the Theatre orderly is the 'gatekeeper' of the service. The start of the operating list is dependent on the orderly being able to collect the first patient on the list in a timely manner. The operating team are waiting in the Operating Theatre. They will have little influence on the orderly who has been tasked to collect the first patient. They are reliant on the orderly facilitating the transfer and arrival of the first patient on the operating list. If there are any issues that need resolving with patient administration or preparation this will most likely lead to a delayed transfer from the ward to the operating theatre.

A link practitioner employed to act as a surgical patient facilitator would be responsible for ensuring that all the patients housed in the ward area are ready in good time for their place on the operating list. This would entail ensuring the patient is consented, marked, and pre-assessed for their anaesthesia. It would also mean that the patients are 'live' on the Clinical Portal so the clinicians and nursing staff can access the patient's medical records. All the fine details of the patient's admission for surgery would be entrusted to the link practitioner. It would be their sole focus of responsibility. The practitioner would act as a focal point for the stakeholders involved in the patient's treatment plan. The introduction of the link practitioner would move the surgical service towards a more cohesive working platform.

This recommendation is offered for clinical trial and audit

Recommendation Two: Introduction of Operating Theatre Turnaround Teams

Operating Theatre Turnaround Teams are directed to support the Operating Theatre nurses and practitioners in the clean down and preparation of the Operating Theatre room in between patients. This extra support is designed to reduce patient turnaround times and improve session utilisation. The nursing and practitioners can focus on their administrative duties and preparation for the next patient whilst the cleaning, restocking of surgical instrumentation and soft packs and theatre

furniture set up is handled by the turnaround team. The amount of teams required is dependent on the number of rooms within individual Operating Theatre complexes. Teams would rotate through the complex as required by individual theatre teams.

This extra resource has had a limited roll-out across the UK.

This recommendation is offered for clinical trial and audit for adoption by more Operating Theatres in the UK.

7.4 Limitations of the Research

There has been limited academic research regarding the proposal of healthcare teams working in an inclusive way. System led healthcare provision is not widespread. Traditional silo working is embedded in the healthcare sector.

Therefore from the methodological and theoretical perspectives there were limitations to the research undertaken here.

The research proposal gave rise to a research question asking whether operating theatres could improve on their efficiency by working in a more cohesive way.

The initial intention of the research was to conduct a clinical intervention trial based on the analysis of the data. The interventions would look to target the pinch points and bottlenecks in the patient throughput identified in the process map and the structured observation process exercise.

However the field work for this project was put on hold in 2016 as QEHB employed an external agency to review their operating theatres operational performances. The senior management of the surgical services asked for our field work to be postponed so as not to create a conflict of interest with the commercial company.

The researcher was unable to commence their field work until the beginning of 2018. There was a reluctance from some stakeholders to engage in interviews for this study due to previous involvement with the commercial company. It is with regret that this study has been unable to test any of its recommendations due to time and resource constraints. Instead recommendations for future clinical trials are offered in this study.

The limitations within this body of work include

- Time – The researcher was unable to conduct the proposed clinical trial and audit due to time constraints
- Access – The researcher was unable to access the clinical area to conduct the clinical trial due to a directive from the Senior Management Team at QEHB
- External Influences – In 2016 QEHB invited an external agency into the Operating Theatres to review operational performance and suggest recommendations for improvement – this invitation hampered the clinical trail aspiration of the researcher due to conflict of interest
- Stakeholder Participation – The work conducted by the external agency included a number of focus groups to discuss the issues and propose resolutions. This meant that when the researcher was able to commence the field work there was a natural reluctance for stakeholders to revisit the same issues by agreeing to be interviewed again after such a short period of time.
- Report Request – The researcher requested a copy of the final report from the external agency to review their findings and recommendations. Unfortunately neither the Trust or the external agency were able to provide the report. If the report had become available the researcher would have been able to conduct a data and recommendation comparison. As the report was not forthcoming this is a missed opportunity. The comparison would have further strengthened the context of the study and provided a further data set to consolidate the project findings.
- Covid 19 – The global pandemic experienced from March 2020 further compounded any attempt to conduct clinical trials as elective surgery was stopped en mass as healthcare practitioners were diverted away from the operating theatres to work with colleagues on intensive care units and emergency departments during the peak of the crisis. This understandably has led to record patient waiting list numbers for treatment which will impact on global healthcare providers for the foreseeable future.

Future research teams may use the clinical recommendations for clinical trail and audit. There will be an opportunity for further innovation by future health researchers around this research topic[2].

[2] To move this research on to the clinical trial and audit phase of the recommendations contained within the project the intention is to apply for funding from the National Institute for Health Research department 'Health Services and Delivery Research' in the UK. If the application is successful then the researcher can approach QEHB to ask permission to conduct the trial and audit. The funding secured will allow the researcher to approach academics at the University of Birmingham (UoB) to establish a clinical trials unit together with statisticians to

7.5 Directions for Future Research

This research has established a starting point for understanding the limitations of silo working and the potential for improved clinical efficiency in the Operating Theatre environment through the introduction of cohesive working amongst stakeholders.

The overarching review of the perioperative patient throughput from admission on the surgical wards to arrival in the operating theatre reception in this research gives this study a unique viewpoint and validity.

The overall findings, as well as the limitations of this study, provides guidance for further research in the surgical service setting.

This guidance includes

- The impact of extra resources to improve the efficiency of the perioperative patient throughput (link practitioner)
- Influence reduced patient turnaround times in the operating theatre by employing turnaround teams to expedite preparation of the operating theatre for the next scheduled patient.
- Clinical trials to assess the impact of these interventions via robust audit
- Sustainability of new ways of working to achieve maximum service impact
- International collaboration between researchers to conduct further study and develop new knowledge in the theory of constraints
- Future research could use a systematic review to provide a complete summary of the current evidence relevant to the research question
- Use an either purely quantitative or qualitative research approach to the research

facilitate and record the trial and audit with the operating theatres. The University of Birmingham has a long established research relationship with QEHB with an international reputation for its joint work. Their scientific campus is adjacent to the hospital site.

Dr Tony Whitehouse, the hospital based clinical supervisor for the project, will oversee the application for funding and the introduction to academics at UoB to sponsor the trial and audit. The researcher is confident that the roll out of the clinical trial and audit would be best suited to a Masters student at UoB.

topic. Clinical data mining and analysis on a larger scale would produce a quantitative perspective

- Use a mixed methods approach to triangulate the research data

Applying a qualitative grounded theory approach to future research would develop the theories after the data had been collected.

There are two potential sections of interest within the thesis that are suitable for submission to relevant scientific journals for publication.

Publishing work that contributes to the overall thesis is a traditional method of showcasing the results of the thesis to the scientific community by demonstrating the validity and possibilities of the research.

1. The Literature Review

A literature review is defined as both a summary and an explanation of the published knowledge of a chosen limited topic (Royal Literary Fund 2019).

The Royal Literary Fund state there are four main objectives of a literature review:-

1. It surveys the literature in a chosen area of study
2. It synthesises the information in that literature into a summary
3. It critically analyses the information gathered by identifying gaps in current knowledge by showing limitations of theories and by formulating areas for further research
4. It presents the literature in an organised way

The literature review presented within the thesis covers the following themes

1. Productivity
2. Change Management – People, Process, Technology
3. Systems for Introducing Change in Surgery
4. LEAN in Industry and Healthcare

These four main areas of interest were explored in the published literature to review the current work around the theme of improving operating theatre patient throughput and efficiency. This helped the researcher understand the depth of work already conducted by researchers in the field and also provided an opportunity for the researcher to ask questions of the under-explored areas with the scope for further research.

The commentary about the published work provided in the literature review served to justify the composition of the emerging research question to be examined through the project and importantly the gaps in the published body of work for the researcher to exploit to form an original position for further new research.

2. Case Study

The research is presented through a case study using qualitative data, initially motivated by quantitative clinical data that served to highlight the issues with operating theatre session underutilisation.

Case study is empirical inquiry that investigates a contemporary phenomenon within its real life context – the boundaries between phenomenon and context are not clearly evident. The researcher understood that in using a case study as a research methodology it would generate an in-depth, multi-faceted understanding of a complex issue in its real life context. Given the complex nature of delivering surgical services in a modern healthcare institution this philosophical positioning was deemed as appropriate.

The case study incorporated stakeholder interviews with a broad range of healthcare practitioners who contributed to the surgical services. Theses interviews were conducted to seek the perspective of the practitioners responsible for the delivery of the service and to gather their recommendations for improvement.

Alongside the interviews the researcher undertook a number of structured observations with the operating theatre orderlies. This involved the researcher accompanying the orderlies as they went about their daily business of collecting and transporting the patients from the ward areas to the operating theatre. The recording of these observations allowed the researcher to witness first hand the processes involved in the preparation and transportation of the patients for surgery and critically the reasons and timings behind the unanticipated delays and inertias observed. Confirmation of these recurring issues allowed

the researcher to formulate recommendations to address the problem through clinical trial and audit.

All the data from the case study was presented in an anonymised format.

7.3 Conclusion

Notwithstanding the limitations included in this chapter, this research contributes in a unique way to understanding operating theatre under-utilisation and the recommendation for clinical trial and audit. A mixed methods methodology was used for this study to provide the evidence to support the data set. This was achieved through the gathering and exploration of the clinical data, process mapping utilising a role activity diagram, structured observation of the processes involved in the preparation and transportation of patients from the wards for surgery and through interviews with the stakeholders responsible for the service to validate and triangulate their assumptions and perspectives.

This study explores the challenges and issues around better utilisation of scheduled elective surgery lists to provide a more comprehensive understanding of the impact that delays and bottlenecks have on the efficiency of the service.

Finally this study has offered recommendations for clinical interventions for trial and audit. These interventions can be reviewed and developed further in future research. Healthcare institutions with responsibility for delivering surgical services can consequently benefit from the insights offered in this study.

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Appendix A: Ethics

Ollscoil Chathair Bhaile Átha Cliath
Dublin City University

DCU

22nd May 2015

Prof. Anthony Staines
School of Nursing and Human Sciences

REC Reference: **DCUREC/2015/141**

Proposal Title: **Improving Perioperative Efficiency and Patient Safety**

Applicant(s): **Prof. Anthony Staines; Mr Ged Doyle;**

Dear Anthony,

This research proposal qualifies under our Notification Procedure, as a low risk social research project. Therefore, the DCU Research Ethics Committee approves this project.

Materials used to recruit participants should state that ethical approval for this project has been obtained from the Dublin City University Research Ethics Committee.

Should substantial modifications to the research protocol be required at a later stage, a further submission should be made to the REC.

Yours sincerely,

Dónal O'Mathúna

Dr Dónal O'Mathúna
Chairperson
DCU Research Ethics Committee

DCU
Research & Innovation

Taighde & Nuálaíocht Tacaíocht
Ollscoil Chathair Bhaile Átha Cliath,
Baile Átha Cliath, Éire

Research & Innovation Support
Dublin City University,
Dublin 9, Ireland

Ethical clearance for this project has been secured from my workplace Queen Elizabeth Hospital Birmingham United Kingdom where the project is registered as a clinical audit. The registration number is CARM-12239

Clearance has also been granted from the ethics team at Dublin City University (Appendix A).

As the data contained within the project is all anonymised I have not had to take the formal ethical approval route.

Appendix B: Structured Observation Transcripts

Process 1 – Person 1

Introduction

Theatre orderlies have staggered start times from 07.30 to cover the uplift in patient movement from 08.30 onwards and to support the evening shift if there are any unforeseen overruns. The orderly I am observing starts his duties at 08.30am. This is the traditional time that individual Theatres send for their first patient of the day. The purpose of the structured observation is to shadow the Theatre orderly as he undergoes his designated duties. This shadowing will capture a series of tasks undertaken by the orderly, observed in a natural setting and documented independently.

Observation 1

08.30 - We are dispatched to a Ward on the fourth floor which is two levels above the Theatre suites. On arrival there are issues with the patient's preparation. These are identified by the orderly. The Theatre pre-operation checklist has not been completed by the ward staff. Also as the patient has a syringe pump attached with prescribed medication administration active.

Comment

As the patient is attached to a syringe pump and is receiving prescribed medication a trained nurse must accompany the patient from the ward to the theatre suite. In this instance it is unsuitable for a healthcare support worker to undertake this task in case of any issues with the delivery of the medication via the syringe pump. The checklist is ideally completed prior to the arrival of the orderly to collect the patient. Once a trained nurse is free to undertake the escort duties the patient will be able to leave the ward area.

08.50 – Leave ward for Theatre.

09.00 - The patient arrives at the Theatre reception at 9am. The journey has taken 30 minutes. Designated Theatre informed by telephone.

Comment

According to the orderly this is twice as long as it would normally take. The delay has already impacted on the operating session. By 9am the patient should have received their anaesthetic (if non-complex) and be in the Theatre ready for surgery to begin.

09.20 - There is no sign of the Theatre team to check the patient in.

Comment

It appears that there is an issue with equipment in the Theatre which is preventing the start of the operating session.

09.40 - Theatre staff arrive to check the patient in.

09.50 - The patient is moved to the Anaesthetic room.

Comment

The total time taken from dispatch to delivery of the patient to the Anaesthetic room is 1 hour and 20 minutes. The time allocated on the clinical data capture system used in Theatres for this part of the patient's procedure is 15 minutes. The orderly confirmed that although this length of delay is unusual it is not uncommon for a combination of issues both on the wards and in the Theatre suite to combine to force delay on the planned Theatre activity.

Observation 2

10.00 - The orderly asked to fetch a bed from Critical Care for a Theatre. This took 10 minutes.

10.35 - The orderly asked to take specimens to the basement. This took 15 minutes.

Comment

In the meantime at 10.30 I observed another orderly dispatched to a ward on the sixth floor to collect a patient for Theatres. The patient arrived in Theatre reception at 10.55am some 25 minutes later

11.00 - The orderly I was observing was allowed to take his morning break. We reconvened at 11.30.

Observation 3

11.30 - The orderly was asked to fetch units of blood for the Theatre blood fridge. This task took 15 minutes.

Observation 4

12.00 – Orderly dispatched to one of the day surgical units to collect a patient.

Comment

This unit is in the old part of the hospital connected via a link bridge which at conservative estimates is a quarter of a mile long. Our outward journey took 6 minutes.

12.06 - On arrival to the ward the ward sister was completing the Theatre pre-op checklist and looking for an escort for the patient.

12.15 - Left ward with the patient.

12.21 - Arrived at the Theatre reception. Escort returned to the ward (normal practice) and the designated Theatre was informed by telephone. Patient kept company by the orderly.

12.41 - No sign of Theatre staff.

12.57 - Theatre staff arrived to check the patient in.

13.00 – Patient is moved to Anaesthetic Room.

Comment

By this point the patient had been in Theatre reception for 36 minutes. The total time from dispatch to arrival of check in staff was 57 minutes. Total transfer time one hour. No definitive reason given to the patient as to the delay in the Theatre staff arriving in the Theatre reception to commence the check in process.

Opposite this patient in the Theatre reception is another patient who has waited for one hour for Theatre staff to arrive and commence the Theatre check in process. This does not consider the time taken to collect patients from the ward area. This is a parallel observation of the patient flow through the Theatre reception area.

13.30 - Observation ended

Post Observation Discussion between Orderly and Observer

In conversation with the orderly there appears to be a commonality of issues affecting effective practices :

Communication

Lack of patient preparation

Ward nurse availability

Relatives wishing to see patients prior to surgery

Consent Form and Clinical Investigation issues

Escorts from certain clinical areas (day case) allowed to return to their workplace as soon as they have delivered patient to the theatre reception – no point of contact for check in staff in Theatres should any unforeseen issues arise

Process 2 – Person 2

Introduction

The Theatre orderly will be shadowed and observed as he engages in the collection and transportation of patients from the wards to the Theatre reception. Other ad hoc duties will be noted too. This exercise will capture a series of tasks undertaken by the orderly, observed in a natural setting and documented independently.

Observation 1

08.30 - Observation starts

No patient collection requested between 08.30 – 09.30 due to delayed operating session starts.

Comment

There delays are inherent for all the Theatres working this morning. This is due to a recent directive from the senior nursing management at QEHB stipulating that student nurses are not allowed to escort surgical patients to Theatres. I believe this is a local Trust policy and not a national directive.

Due to this directive only Staff Nurses and Healthcare Support Workers are able to escort the patients to Theatres. This is leading to delays on average of 10-15 minutes according to the orderly I am observing today. Although student nurses are not part of the nursing numbers they contribute in a very effective manner to the day to day functioning of the clinical areas of hospitals. Stopping their availability to escort surgical patients to Theatres passes the onus onto the nursing staff to complete this duty. Due to fluctuating daily staffing levels in clinical areas this may lead to delays in timely transfers to Theatre due to competing clinical commitments undertaken by the ward staff.

09.30 – Break taken by orderly. Resumes duties at 10.00.

Observation 2

10.15 – Collected bed from Intensive Care and returned ward bed. Time taken is 15 minutes.

Observation 3

10.30 – The orderly is asked to fetch a patient from the Surgical Short Stay Unit.

Comment

The Surgical Short Stay Unit is located in the old section of the hospital site and involves a walk across a link bridge which is approximately a quarter of a mile in length.

10.38 - Arrive on the ward. Located the patient and sought a free member of the nursing staff to organise the patient's notes and check sheet. Patient is checked off for Theatre by Ward Sister who is the only free member of the team.

10.42 - We leave the Ward for Theatres and make good progress along the link bridge.

10.52 – Arrive Theatre Reception.

10.53 – Designated Theatre contacted by phone to say a patient has arrived.

10.57 - Theatre staff arrive to check patient in.

Comment

It is a straightforward check in with no issues to delay the process.

11.01 – Patient checked in.

11.03 – Patient arrives in Anaesthetic room.

Comment

Total time from patient request to arrival in Theatre Anaesthetic Room is 33 minutes – good response time.

Observation 4

11.05 – Orderly requested to fetch patient from ward for Theatre – the ward is on the fourth floor of the new hospital – two floors above the Theatre suite.

11.08 - Arrive on the ward.

Comment

The computer display which indicates the location of each patient on the Ward is not in operation. We need to ask where the patient is. The wards in the main building are horseshoe shaped in design, They have three nurses stations, one at each end and one in the middle. Each of the three areas has their own set of nurses who only manage the patients in their area. It may be that a nurse from nurse station 1 will not know the location or history of a patient housed in the nurse station 3 area.

11.10 - Patient located after asking Ward staff.

Comment

It takes the Ward Sister five minutes to locate an appropriate member of staff to check off the patient to Theatres.

11.16 - Healthcare Support Worker located and designated for escort duties.

11.17 - Leave ward for Theatres – wait 3 minutes for the lift to arrive on the fourth floor.

11.23 - Arrive Theatre Reception.

11.24 – Designated Theatre informed that the patient is in reception.

11.36 - Theatre staff arrive to check in patient.

11.46 - Patient arrives in Anaesthetic room.

Comment

Total time from patient request to arrival in Anaesthetic Room is 41 minutes – highlights variability in patient request response time and transfer processes

12.00 - Observation ends.

Post Observation Discussion between Orderly and Observer

In the review of the observation the orderly highlighted the following issues that impact on timely transfer of the patients from the ward areas to the Operating Theatre suite reception. Theatre checklist is not undertaken on wards until orderly arrives – used to be completed in advance of this – adds time to process but idea is to reduce clinical documentation errors. Lifts – would a

dedicated lift for Theatre patients (during peak surgery times only) improve transfer times? There are indications that other similar sized healthcare institutions promote this facility. A review of institutions that have or have not dedicated surgical patients lifts may be of interest in assessing patient transfer times.

Process 3 – Person 3

Introduction

The observation starts at 08.30am. This structured observation exercise will continue to shadow and record the activities engaged in by the Theatre orderly over the course of a morning operating session. This shadowing will capture a series of tasks undertaken by the orderly, observed in a natural setting and documented independently.

Observation 1

08.35 -First patient requested from the 4th floor.

Comment

This sending time is 20 minutes behind schedule – problem sourcing instrumentation for the operating list.

08.40 – Arrive on ward.

08.42-Issues locating escort nurse due to staffing issues – Ward Sister to source escort.

08.44 - Consent form and Care plan checked and complete.

Comment

The patient requires an allergy armband which is not in place. This red arm patient band alerts all healthcare practitioners to the fact the patient has an allergy which can be verified and confirmed on PICS which is the Trust's electronic digitalised patient record system.

08.46 – Red arm band printed and attached to patient's wrist.

08.48 – Escort nurse identified.

08.49 – Leave ward for Theatre.

08.55 - Arrive at the Theatre reception.

Comment

Lifts are slow this morning due to heavy volume of staff, patients and visitors – No dedicated Lifts for surgical patient transport.

08.56 – Designated Theatre informed by telephone that the patient is in Theatre reception.

09.00 – Theatre staff arrive at reception to check patient in for surgery.

09.05 – Patient is checked in.

09.08 - Patient arrives in Anaesthetic room for the induction of anaesthesia to commence.

Comment

Total time taken to complete patient collection is 30 minutes – however due to equipment problems and incomplete patient preparation the patient arrived in the anaesthetic room 23 minutes later than scheduled. This could impact on the rest of the planned surgery for the morning list. This may lead to an unforeseen overrun and impact on the afternoon operative session starting on time.

Observation 2

09.30 – Asked to collect a patient from the 6th floor.

09.40 – Arrive on ward.

09.42 – Patient needs to change into hospital gown – only recently arrived on the ward.

09.45 – Signed consent form and completed Theatre care plan checked by orderly.

Comment

It is discovered by the escort nurse that the patient has not been marked for surgery – fortunately the surgical registrar responsible for the patient's planned procedure is still on the ward clerking other patients for later in the morning. He is asked to confirm the consent form with the patient and marks the area and side on the patient for the intended procedure.

09.55 – Leave ward.

10.05 – Arrive in Theatre reception – again waiting for Lift to arrive at the 6th floor due to heavy traffic.

10.07 – Designated Theatre informed by telephone that the patient is in Theatre reception.

10.08 - Patient is transferred from ward bed to Theatre trolley.

10.13 – Theatre staff arrive to check patient in.

10.20 - Patient arrives in the Anaesthetic room for the induction of anaesthesia to commence.

10.25 – orderly transfers ward bed from Theatre reception to be parked outside designated Theatre – patient will be transferred directly from operating table to the ward bed at the end of the procedure.

Comment

Total time taken to complete patient collection is 50 minutes – this could have been significantly reduced if the patient had been fully ready for collection on our arrival on the ward at 09.40. If the surgical registrar had not been present on the ward there would have been further delay upon locating a member of the surgical team to visit the patient to mark the site of the operation.

N.B. - marking the patient for surgery is a mandatory requirement of the WHO Surgical Safety Checklist – it is particularly important when identifying the correct side or limb for surgery. It is intended to rule out wrong side/site surgery which is one of the 'Never Events' that healthcare institutions need to avoid as part of their duty of care to their patient cohort.

10.30 – orderly goes for morning break – returns at 10.55.

Observation 3

11.05 – Asked to collect patient from the short stay surgery unit in the old part of the hospital.

11.12 – Arrive on the ward.

11.15 – Location of patient on ward for surgery confirmed - ward sister approached for notes and consent form and care plans – checked by orderly – care plan not complete – ward sister to action.

11.20 – Patient is approached – wants to speak to surgical team before leaving the ward area to confirm treatment plan as consent form was signed at an out patients some weeks previously.

11.25 – Ward sister contacts the surgical team.

11.32 – Surgical registrar arrives on ward to speak with patient – treatment plan agreed by both parties.

11.40 – Patient leaves ward on ward bed,

11.47 – Arrive in Theatre reception – long journey time due to distance from ward in the old hospital to the new hospital.

11.48 –Designated Theatre informed by telephone that the patient is in Theatre reception.

11.49 – Patient transferred onto theatre trolley.

11.53 – Theatre staff arrive to check patient in.

12.00 - Patient checked in.

12.05 - Patient arrives in the anaesthetic room for the induction of anaesthesia to commence.

12.10 – Orderly moves ward bed from Theatre reception to designated Theatre.

Comment

Total time taken to complete patient collection is 60 minutes - this highlights the delays that can be caused by the distance the ward area is from the Theatre. The surgical registrar had to travel

from the Theatre to the ward to speak with the patient prior to the patient leaving the ward once they were satisfied with the treatment plan.

Signing consent forms in advance of the day of surgery may lead to delays if the surgical team does not get a chance to visit the ward during a busy morning of surgery. Again this time could have been reduced by timely completion of the required documentation on the ward and early identification that the patient wished to speak with the surgical team regarding the treatment plan prior to leaving the ward.

12.30 - Observation ends.

Post Observation Discussion between Orderly and Observer

Points of note discussed with the orderly post observation were lack of patient preparation, the large footprint of the hospital and improving communication.

Process 4 – Person 4

Introduction

Observation started at 08.00. This shadowing will capture a series of tasks undertaken by the orderly, observed in a natural setting and documented independently.

Observation 1

08.04 - First patient requested from the 4th floor.

08.06 - Arrive on ward.

Comment

Issues locating consent form in the notes and the patient is feeling nauseous due to nerves (young patient for major surgery). Patient is spoken to by Ward Sister who is able to reassure the patient that they are in good hands and will be looked after by the Theatre team.

08.17 - Leave ward for Theatre.

08.21 – Arrive in Theatre reception.

08.22 – Designated Theatre informed by telephone that a patient is in Theatre reception.

08.24 - Patient transferred onto theatre trolley from ward bed.

08.32 - Theatre staff arrive at reception to check the patient in for surgery.

Comment

By 08.35 all four Theatre reception bays are full leading to newly arriving patients being directed to the Recovery Room to be checked in – quite a common feature during the first patient collection of the day according to the orderly I am accompanying today.

Recovery Room is remote from twelve of the Theatres and can lead to delays in the timely arrival of patients in the anaesthetic room after they have been checked in

08.40 - Arrive in the Anaesthetic room for the induction of anaesthesia to commence.

Comment

Total time taken to complete patient collection is 36 minutes – this could have been reduced by 15 minutes if the patient on the ward had been fully ready to leave once we arrived and the Theatre staff had been waiting in Theatre reception to greet the patient on arrival.

08.42 - Ward bed is moved from Theatre reception to outside designated Theatre – it may need to be exchanged for an intensive care bed later depending on the outcome of the planned surgery and plan for recovery.

08.44 - Orderly arrives back at the Theatre reception.

Observation 2

08.57 - Orderly sets off for the Pharmacy department for routine collection of items for Theatres.

09.20 - Orderly returns with Pharmacy items.

09.40 - Orderly accompanies colleague to the Intensive Care Unit to collect a bed for the Theatre.

09.45 - Returns with bed and heads towards designated Theatre.

Observation 3

09.55 - Asked to collect a patient from the 6th floor for Theatre.

10.00 - Arrive on the ward.

The patient needs to change into a hospital gown.

10.05 The signed consent form and completed Theatre care plan checked by orderly.

Comment

At 10.07 it is discovered by escort nurse that the patient has no elasticated stockings on – these are worn by surgical patients to reduce the chance of developing a deep vein thrombosis during and after surgery.

The elasticated stockings are located and patient puts them on.

10.12 - Leave ward (patient walking).

Comment

The escort nurse discovers that the intravenous cannula care plan is missing from the notes while we are walking in the corridor towards the lift

We have to return to the ward whilst we are waiting for the lift to arrive – the plan is completed in the lift as we travel to the Theatre suite situated on the 2nd floor.

10.18 - Arrive at the Theatre reception. Designated Theatre informed by telephone that patient is in Theatre reception – patient gets onto Theatre trolley.

10.20 - Theatre staff arrive to check patient in at 10.20.

10.25 - The patient check in is completed and the patient leaves Theatre reception for designated Theatre.

10.30 - Patient arrives in the Anaesthetic room for the induction of anaesthesia to commence.

Comment

Total time taken to complete patient collection is 35 minutes – again this could have been significantly reduced if the patient had been fully ready for collection on our arrival on the ward at 10.00.

10.45 - Orderly takes morning break and returns at 11.10.

Observation 3

11.20 - Asked to collect patient from the day surgery unit in the old part of the hospital.

11.27 - Arrive on the ward. The location of the patient for surgery was confirmed. The ward sister approached for notes and consent form and care plans.

Comment

At 11.30 it is discovered that the consent form is not with notes – a search is conducted and the form is found at the nurses station by the ward clerk (? Left by the surgeon once the patient had signed it).

The patient is approached – does not have an identity bracelet in place – a sheet of patient stickers has to be printed off to generate the laser printed patient identity bracelet which is then placed onto the patient's arm by the ward sister once the details have been mutually verified. All patients in hospital must wear these identity bracelets to confirm their details – name, date of birth and hospital number.

11.35 - Leave the ward with the patient on a ward bed.

11.46 - Arrive at the Theatre reception.

Comment

Long journey time due to heavy traffic (staff, visitors, other beds) on the link bridge from the old hospital to the new hospital (length of link bridge is approximately quarter of a mile).

11.47 – Designated Theatre informed by telephone that the patient is in Theatre reception.

11.48 - Patient transferred onto theatre trolley.

11.50 - Theatre staff arrive to check patient in.

11.55 - Patient checked in and leaves Theatre reception.

12.00 - Patient arrives in the Anaesthetic room for the induction of anaesthesia to commence.

12.05 – Orderly moves ward bed from Theatre reception to designated Theatre.

Comment

Total time taken to complete patient collection is 40 minutes. Again this time could have been reduced by timely preparation of the patient on the ward.

12.15 - Observation ends.

Post Observation Discussion between Orderly and Observer

The orderly's main concern about the patient flow from the various collection points to Theatres throughout the hospital is communication between all the stakeholders involved in providing the service. This coupled with the issues with incomplete patient preparation leads to unnecessary delays in the transportation times.

Process 5 – Person 5

Introduction

The orderly I am observing starts his duties at 08.30am. The purpose of the structured observation is to shadow the Theatre orderly as he undergoes his designated duties. This shadowing will capture a series of tasks undertaken by the orderly, observed in a natural setting and documented independently.

Comment

There are staffing issues with the Theatre orderlies – they are one person down due to sickness. The Theatre reception coordinator is calling staff due in later in the day to see if anyone can start earlier than normal to support the morning team.

Observation 1

08.40 - The orderly is asked to collect the first patient on the list from the Admissions Lounge. The Admissions Lounge is on the same floor as the Theatre suite.

08.45 - Arrive at the Admissions Lounge.

Comment

Patient is not ready to leave the ward for Theatres. The patient needs an interpreter to complete the consenting process and to accompany them to the Theatre suite. There is some confusion as to whether there has been an interpreter booked to assist the patient with communication and consent. The ward clerk is trying to contact the Interpreting Service used by the Trust for an update.

08.50 - Orderly calls Theatre reception to update the designated Theatre of the situation.

08.55 - Theatre reception call the Admissions Lounge to advise that the designated Theatre would like to change the order of the list due to the issues with the first patient. Can the second patient on the list be prepared and sent to the Theatre.

Comment

Between 08.55 and 09.10 the second patient prepared and escorted to the Theatre reception to be checked in for surgery.

09.15 - Second Patient on the list arrives at the Theatre reception.

09.20 – Theatre staff arrive at the Theatre reception to check patient in.

09.25 - Patient transferred from Theatre reception.

09.25 - Patient arrives in Anaesthetic room.

Comment

Total transfer time is 50 minutes – already the morning list is running 30 minutes behind schedule and may affect the rest of the planned surgery on the operating list.

09.30 – The orderly undertakes a 15 minute break and general duties on return. Afternoon orderly arrives early to support the morning team.

09.32 - The Admissions Lounge calls the Theatre reception to inform the designated Theatre that the interpreter has now arrived and the first patient on the list will now be able to come next.

Observation 2

10.05 - Orderly asked to collect patients from the Surgical Short Stay Unit.

Comment

This involves a long walk for the orderly from the new to the old part of the hospital via a link bridge that is a quarter of a mile long. The hospital has a large footprint which impacts on patient transfer times.

10.15 - Arrive on the unit.

Comment

Ward Sister asked where the patient is and their paperwork. Patient identified and all the patient's notes and consent are present. Escort is required and requested. Ward Sister informs us that one of her Healthcare Support Workers is currently in Pharmacy so we will have to wait for them to return before she will allow another member of her team to leave ward due to staffing levels.

10.20 - Orderly calls Theatre reception to inform them of the delay.

10.30 - The Healthcare Support Worker returns from Pharmacy. Informs us it is very busy there today.

Healthcare Support Worker places collected pharmacy items in a secure area and is then free for escort duties.

10.35 - Leave ward with patient for Theatre reception.

10.45 - Arrive at Theatre reception – escort returns to ward (normal practice).

10.48 - Theatre staff arrive to check patient in.

10.53 - Patient arrives in Anaesthetic room.

Comment

Total transfer time is 48 minutes due to staffing issues on the ward.

Observation 3

11.00 - Orderly asked to collect patient from the 4th Floor.

11.05 - Arrive on ward.

11.10 - Patient ready, all documentation available and checked, escort available.

11.15 - Leave ward for Theatre reception.

11.20 - Arrive in Theatre reception Theatre staff waiting to check patient in.

11.28 - Patient arrives in Anaesthetic room.

Comment

Total transfer time is 28 minutes and uneventful.

Observation 4

11.30 - Orderly asked to collect patient from the 7th Floor.

Comment

Heavy traffic with the lifts due to the large volume of patients and visitors using them – wait 6 minutes for the free lift to arrive.

11.40 – Arrive on ward.

Comment

Patient identified – noted to be receiving low volume oxygen via nasal specs – no request made by ward for the orderly to bring a portable oxygen cylinder to escort with the patient (usually the Theatre reception coordinator will ring the ward prior to the orderly setting out for the patient to see if portable oxygen is required – on this occasion this was not done due to staffing constraints in the Theatre reception).

11.45 - The orderly tries to locate a portable oxygen unit on the ward – unsuccessful – leaves for adjacent wards to see if he can borrow one for the transfer.

Comment

In the meantime the ward staff prepare the documentation and consent in preparation for the transfer.

11.53 - Orderly returns with a portable oxygen cylinder borrowed from an adjacent ward.

11.55 - Escort collects all relevant documentation and we leave the ward with the patient.

Comment

Again the lifts are busy due to the time of day – have to wait for a completely empty lift to accommodate the patient's bed and the three staff members.

12.01 - Lift becomes available.

12.06 – Arrive in Theatre reception – escort returns to ward and kindly offers to return portable oxygen cylinder to adjacent ward on the 7th Floor.

12.20 – Theatre staff arrive to check the patient in.

Comment

No reason offered for delay in arriving at reception.

12.25 - Patient checked in.

12.30 – Patient arrives in Anaesthetic room.

Comment

Total Transfer time is 60 minutes – will definitely impact on whether the afternoon scheduled patients are operated on.

12.35 - Orderly is asked to return a patient from Theatre reception to the 6th Floor.

Comment

Patient had arrived for surgery to be informed by the surgeon that there has been a malfunction in an important piece of equipment required to facilitate the surgery for the patient and unfortunately they have been unable to source a replacement. The patient is understandably upset about their cancellation and the surgeon has reassured the patient that they will be given another date for surgery within 28 days (as per national cancellation policy). The surgeon also promises that there will be the requisite equipment ready and working for their next visit.

12.40 - Theatre reception contacted the ward to explain the issues and the plan to rebook the patient for surgery within 28 days.

12.45 - The patient leaves the Theatre reception for the 6th Floor.

12.58 - Orderly returns to Theatre reception - again there has been a long wait for the lifts.

13.00 – Observation ends.

Post Observation Discussion between Orderly and Observer

Main concerns:

Large Footprint of Hospital – leads to long transfer times.

Communication – can be improved – the lack of oxygen cylinder available for the patient is a good example of how communication breakdown affects efficient practice.

Staffing Levels in Theatres and Wards – always a regular issue (nationwide).

Availability of Interpreter – again an administrative error.

Unexpected changes in the order of the operating list – avoidable.

Request for Appropriate Equipment for Patient Transfer (Oxygen Cylinder) – as above.

Unanticipated Theatre Equipment Malfunctions – unanticipated and can lead to last minute cancellations and patient distress.

Appendix C: Paper 1

INFORMS ANNUAL GENERAL MEETING GEORGE R. BROWN CONVENTION CENTRE HOUSTON TEXAS USA OCTOBER 2017 PRESENTATION ABSTRACT

Session TP04 - Tuesday Poster Session

6 - IPREP : Improving Perioperative Efficiency and Patient Throughput

October 24, 2017, 12:30 PM - 2:30 PM	Exhibit Hall

Authors

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Abstract

IMPROVING PERIOPERATIVE EFFICIENCY AND PATIENT THROUGHPUT

The challenge is to reduce delays and 'silo' working. The technique involves modelling preliminary patient movement data using SIMUL8 to identify bottlenecks. A clinical intervention trial will be selected from the modelling.The focus of the research is to establish a cohesive pathway for surgical patients where all the hospital departments work together to ensure improved throughput and efficiency.

Appendix D: Paper 2

THE OPERATIONAL RESEARCH SOCIETY OR60 ANNUAL CONFERENCE LANCASTER UNIVERSITY UNITED KINGDOM SEPTEMBER 2018 PRESENTATION ABSTRACT

13/09/2018 14.30 Room - Private 1 Code: OR60A3414

iPREP - Improving Perioperative Efficiency and Patient Throughput

Mr Gerard Doyle and Professor Anthony Staines (Dublin City University)

Eighteen months of perioperative clinical activity data reviewed from 30 theatre suites in a large UK teaching hospital in 2015. 2,823 operative sessions analysed. Late starts, delayed turnaround times and unplanned unfunded overruns identified.

Research Question – Why is this and what can be done to introduce an improvement?

Research proposal accepted and registered at Dublin City University, Ireland.

Literature Review confirms a wealth of international work addressing the same issues. The majority of published work concentrates on one particular area of the whole journey to focus on improvement strategy. My research proposes the development and sustainability of a cohesive service where stakeholders work in unison rather than individual units.

Collaboration with statisticians at Queen's University Belfast established in 2016. Modelling of the data undertaken using SIMUL8 software to identify recurring bottlenecks. This qualitative methodology will allow the research team to identify suitable points along the perioperative patient pathway to trial a clinical intervention. The trial will support the overall aim of using LEAN to establish a 'system' led surgical service in comparison to the 'silo' led service seen in healthcare institutions worldwide.

Sustainability of the intervention if there is a measured improvement is also key to the research.

In conjunction with this parallel project I am conducting qualitative research through field work at the base hospital. This entails anonymised stakeholder interviews supported by a questionnaire. This will allow my research to benefit from opinion and suggestions for improvement strategies from the perspective of a broad range of practitioners. Structured observation is also being conducted which allows me to shadow and observe the practitioners who collect the surgical patients for theatres. This allows opportunity to review issues that occur during this important phase of the perioperative patient journey.

Appendix E: iPREP Powerpoint Presentation 2015

iPREP
Improving PeriopeRative Efficiency and Patient safety

Ged Doyle
Queen Elizabeth Hospital Birmingham

iPREP Project Proposal

- Improve Perioperative Clinical Productivity
- Scrutinise Clinical Flow Process
- Recommendations to provide cohesive pathways by diminishing silo working

iPREP

- Maximise Theatre Utilisation through innovative team working
- Introduce a Link Practitioner to Coordinate Patient Flow
- Turnaround Teams used to reduce time between Surgical Cases

iPREP Background

- Last Quarter to September 2014 saw 15,729 procedures cancelled due to non clinical reasons (NHS England)
- 90,000 more patients waiting for surgery than a year ago (BBC News/Health 14/11/2014)
- Pressure on A&E admissions in England has led to a 62% rise in cancelled operations (BBC News/Health 14/01/2015)

iPREP Manifesto

- Process Mapping to identify Inertias
- Structured Observation of the Patient Journey
- Stakeholder Interviews – Healthcare Practitioner Engagement across all skill levels
- Interventional Trials with Stakeholder Engagement

iPREP Clinical Supervisor Team

- Professor Anthony Staines – Chair of Health Systems, School of Nursing, Psychotherapy and Community Health Dublin City University
- Dr Paul Davis – Program Director in Strategic Procurement, Supply Chain and International Management Dublin City University
- Professor Vinod Patel – Principal Clinical Teaching Fellow in Clinical Skills Warwick Medical School and Consultant in Acute Medicine and Endocrinology George Eliot NHS Trust
- Dr Tony Whitehouse – Consultant Anaesthetist, Research Lead for Theatres and Critical Care Queen Elizabeth Hospital Birmingham

QEHB Performance April – December 2014

› Late Starts – 3373 On Time – 900

› Main Theatres – 1,912 sessions

› Ambulatory Theatres – 911 sessions

iPREP

Minutes lost due to late starts

› Main Theatres – 114,886 = 1,915 Hours

› Ambulatory Theatres – 31,031 = 517 Hours

› 51% of Unplanned Overruns Avoidable if Prompt Start Achieved

iPREP - Recommendations

› Create a 'System' approach to Perioperative Practice to link in all stakeholders

› General need to promote systems in healthcare to link up specialities (Reith Lectures Gawande December 2014)

› Improve Perioperative Productivity utilising extra support teams for cohesive turnaround times and administrative duties

iPREP

› Introduction of Link Practitioners based on wards to facilitate smoother patient journeys

› Theatre Turnaround Teams to reduce time between surgeries

iPREP – The Challenge

› Monitor Clinical Flow Process

› Assess the Efficacy of Current Provision

› Explicit Improvement Methodology

› Construct a Transformational Strategy

iPREP

› Project will present an opportunity to implement a New Care Model

› Multidisciplinary Engagement in an Improvement Programme

› Tangible increase in productivity through commitment rather than compliance (Kings Fund 06/2014)

iPREP

- Extra Resource will be required to facilitate uplift in performance
- Aim for Cost Neutral transition toward increased clinical activity
- Lean Lubeck = Increased Enterprise and Revenues