Introducing a Fast Track for Patients Undergoing Arthroscopic Subacromial Decompression and/or Rotator Cuff Repair

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Declaration Form

I declare that this dissertation, which I submit to RCSI for examination in consideration of the award of a higher degree MSc Physician Associate Studies, is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

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Date:
Acknowledgements

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Firstly, I would like to thank Mr Hannan Mullet for providing me with the opportunity to produce a Quality Improvement Intervention and for continued and unwavering confidence and guidance.

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Abstract

The prolonged length of stay (LOS) after Arthroscopic Subacromial Decompression (ASD) and Rotator Cuff Repair (RCR) is having an adverse effect on the efficiency of the healthcare system. Improving the time patients remain in hospital after surgery will have a positive impact on the patient and on the healthcare providers. The aim of this Quality Improvement Plan (QIP) is to reduce the LOS after ASD or/and RCR designing a Fast Track to allow patients to access these procedures as Day Case. Using the DMAIC (Define, Measure, Analyse, Improve and Control) framework for Quality Improvement (QI), the journey of patients undergoing an ASD and/or RCR procedures was reviewed. QI tools such as a stakeholders analysis, fishbone diagram, process flow maps and data collection were applied to identify the ‘root cause’ of the problem and to recommend changes. The results indicated patients are staying in hospital for an average of 2.1 days, negatively impacting on waiting times for ASD and/or RCR procedures, which at the time of this plan was up to 24 months. It will be proposed for a pre-operative scoring system to be introduced to facilitate healthcare professionals in identifying those patients better suited to undergo ASD and/or RCR procedures using the Fast Track approach. This will ensured these procedures could be performed as Day Case permitting an early functional recovery, subsequently reducing the LOS after surgery without increasing complication rates.
# Table of Contents

Declaration Form 2  
Acknowledgements 3  
Abstract 4  
Table of Contents 5  
Table of Figures 8  

## Chapter 1.0 Introduction

1.1 Introduction 9  
1.2 Organisational context 9  
1.3 Rationale for Quality Improvement 10  
1.3. Considerations on ASD and RCR 11  
1.4 Aims and Objectives 13  
1.4.1 Aim of this QIP is to: 13  
1.4.2 Objectives of this QIP are to: 13  
1.5 Role of the student 14  
1.6 Summary 14  

## Chapter 2.0 - Literature Review

2.1 Introduction 16  
2.2 Search strategy 16  
2.3 Review of themes 18  
2.3.1 Increase incidence of ASD and RCR 18  
2.3.2 Predictors of outcome and complications for ASD and RCR 20  
2.4 Implications for the project 22  
2.5 Summary 23
### Chapter 3.0 Methodology

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Introduction</td>
<td>24</td>
</tr>
<tr>
<td>3.2</td>
<td>Approaches to Quality Improvement</td>
<td>24</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Lean Six Sigma</td>
<td>25</td>
</tr>
<tr>
<td>3.2.2</td>
<td>The Model for Improvement</td>
<td>26</td>
</tr>
<tr>
<td>3.2.3</td>
<td>DMAIC</td>
<td>27</td>
</tr>
<tr>
<td>3.3</td>
<td>Rational for model selected</td>
<td>28</td>
</tr>
<tr>
<td>3.4</td>
<td>DMAIC framework overview</td>
<td>29</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Define</td>
<td>29</td>
</tr>
<tr>
<td>3.4.1.1</td>
<td>Process flow map</td>
<td>30</td>
</tr>
<tr>
<td>3.4.1.2</td>
<td>Stakeholder analysis</td>
<td>33</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Measure</td>
<td>35</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Analyse</td>
<td>37</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Improve</td>
<td>39</td>
</tr>
<tr>
<td>3.4.4.1</td>
<td>The role of Fast Track</td>
<td>45</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Control</td>
<td>49</td>
</tr>
<tr>
<td>3.5</td>
<td>Summary</td>
<td>51</td>
</tr>
</tbody>
</table>

### Chapter 4.0 Evaluation

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction</td>
<td>53</td>
</tr>
<tr>
<td>4.2</td>
<td>Overview of QI and expected outcomes</td>
<td>53</td>
</tr>
<tr>
<td>4.3</td>
<td>Evaluation</td>
<td>55</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Aim of control phase of DMAIC framework</td>
<td>56</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Monitor and review</td>
<td>56</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Expected results</td>
<td>57</td>
</tr>
<tr>
<td>4.4</td>
<td>Dissemination plan</td>
<td>58</td>
</tr>
</tbody>
</table>
4.5 Summary

Chapter 5.0 Summary and Conclusion

5.1 Introduction

5.2 Impact of the project

5.2.1 Patients

5.2.2 Staff

5.2.3 Stakeholders and hospital practice

5.3 Strengths of the Project

5.4 Limitations

5.5 Recommendations

5.6 Learning and Quality Improvement

5.7 Summary and conclusion

Chapter 6.0 References

Appendices

Appendix A American Society of Anaesthesiologists Physical Status Score

Appendix B Data

Appendix C Proposed Pre-operative scoring sheet. Front Sheet

Appendix D Proposed Pre-operative scoring sheet. Back Sheet

Appendix E GANTT chart
Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Model for Improvement</td>
<td>28</td>
</tr>
<tr>
<td>Figure 2</td>
<td>DMAIC steps</td>
<td>28</td>
</tr>
<tr>
<td>Figure 3</td>
<td>DMAIC steps and tools</td>
<td>29</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Process flow map</td>
<td>31</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Stakeholder analysis</td>
<td>33</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Bar-graph for waiting times</td>
<td>35</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Day Case vs. Inpatient pie chart</td>
<td>36</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Bar-chart for Length of Stay</td>
<td>36</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Fishbone Diagram</td>
<td>37</td>
</tr>
<tr>
<td>Figure 10</td>
<td>ASD Criteria</td>
<td>40</td>
</tr>
<tr>
<td>Figure 11</td>
<td>RCR Criteria</td>
<td>40</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Contributory Medical Conditions</td>
<td>41</td>
</tr>
<tr>
<td>Figure 13</td>
<td>VAS score</td>
<td>41</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Constant Score</td>
<td>42</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Oxford Score</td>
<td>43-44</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Revised flow map</td>
<td>48</td>
</tr>
</tbody>
</table>
Chapter 1.0 Introduction

1.1 Introduction

This chapter begins by describing the context within which this QIP was planned. It continues with a brief description of Shoulder Impingement and Rotator Cuff Tear as pathological entities and their treatment based on most recent evidence. It follows with a rational for the QIP before stipulating the aim and objectives of that underpin it. This is followed by a brief overview of the role of healthcare professionals participating in this project. The final section offers a summary of each chapter going forward.

1.2 Organisational context

This QIP was planned in an Irish university hospital, the second largest in the Republic of Ireland. The philosophy of the hospital is to deliver high quality care to patients, provide excellent training to students and create a friendly, motivating and professional environment for staff \(^1\). It is situated in North Dublin and provides approximately 290,000 people with acute general services and 54 medical specialties. A 24-hour emergency service is available, as well as access to an assigned cancer centre and province wide treatment centre for Ear, Nose and Throat, and Gastroenterology. The centre for national referrals to Neurosurgery and Neurology, Renal Transplantation, and Cochlear Implantation are also located at this hospital. It employs over 3,000 staff and has 820 beds \(^2,3\). This QIP will function in the hospital’s orthopaedic department along with support from its Physiotherapy and Rehabilitation Centre, identified as setting the standards of outstanding person
centred care. There will be a range of highly skilled and dedicated staff involved, ranging from doctors, nurses, healthcare assistants, Physiotherapists and clerical workers, each of whom will play a viable role in the of care experienced by the patient.

1.3 Rationale for Quality Improvement

For any Healthcare system to operate effectively maintaining a person centred ethos is essential. For this to happen it is imperative for common healthcare practices to be continually monitored and evaluated to ensure sustained quality of care across the service and recommendations for improvement implemented in areas of patient care deemed in need of change \[4\]. To achieve this hospitals will regularly undertake QIP’s to ascertain changes that will improve patient experience and satisfaction. The following QIP identified a need to reduce the LOS for patients undergoing ASD and RCR procedures using the Fast Track approach, subsequently leading to a reduction in waiting times. Currently in Ireland there is up to an 18 month waiting time reported for orthopaedic procedures in general \[5\]. Specific data for ASD and RCR reveal patients are waiting on average of 9.7 months, with some waiting as long as 24 months. This is contrary to the key recommendations set out in the Slaintecare report that states by indorsing the Irish (Slainte) Health Act:

‘no patient should be waiting more than twelve weeks for an inpatient procedure, ten weeks for an outpatient appointment and ten days for a diagnostic test’ \[6\].

There is now a growing expectation that waiting times in all public hospital departments in Ireland, including planned Day Case and Inpatient procedures are reduced \[7\]. By addressing waiting times, the quality of care for patients begins prior
to their arrival in hospital. It is reported, that the extensive waiting lists currently in operation are having negative impact on patients’ health and wellbeing\textsuperscript{[8]}. In addition to a strong association between a delay in procedure and a poor outcome\textsuperscript{[9]} and the increase in demand for surgical procedures, the need to address waiting times is essential if we are to meet the growing demand for comprehensive patient care. Furthermore waiting times are reported to be having an adverse effect on the Irish Health System due to the relative cost being ensued\textsuperscript{[8]}. A QIP will assist in identifying factors contributing to lengthy stays and waiting times and provide a framework to allow these factors to be systematically addressed. A QIP will guide the planning and implementation of changes without compromising on the quality of patient care.

1.4 Considerations on ASD and RCR

Shoulder pain is a common presenting complaint in primary and secondary care clinics and is highly prevalent in the general population\textsuperscript{[10]}. Shoulder Impingement Syndrome (SIS) is likely the most common cause of shoulder pain in these settings\textsuperscript{[10]}. SIS was first described by Neer in 1972 and refers to a combination of shoulder symptoms, examination findings, and radiologic signs attributable to the compression of structures around the glenohumeral joint that occur with shoulder movement,\textsuperscript{[11]} which can cause persistent pain and dysfunction. The initial approach for SIS is similar to that for rotator cuff (RC) tendinopathy, with exercise-based programmes, physical therapy and localised injections of steroids as the mainstay\textsuperscript{[12]} and defined as conservative management. Generally, conservative management is deemed unsuccessful if the complaints persist after six months\textsuperscript{[12,13,14]}. Operative
management is the choice after conservative management has failed; with evidence-based practice suggesting that arthroscopic technique (ASD) offers better outcomes than the open surgical technique [14]. Another notable finding suggests that continued exercise therapy after procedure has proven benefits [15]. Only some aspects of SIS’s management are supported by randomized trials, and the overall quality of available evidence pertaining to its treatment is weak [14].

Rotator Cuff tear (RCT) and Rotator Cuff tendinopathy are common causes of pain and functional limitation of the shoulder with an estimated prevalence amongst the general population from 20.7 to 22.1%, however this percentage increases with age [16,17]. The treatment options of RCT depends upon several factors, such as shoulder dominance, duration of symptoms, type of tear (partial versus full thickness), as well as specific patient factors related to age, comorbidities, and levels of activity [17]. The nonoperative management consists primarily of a trial of physical therapy with three distinctive stages. The first stage aims to recover the range of motion, the second stage emphasises strength and the third focuses on functional recovery of the shoulder [18]. Localised steroids injections are reserved for patients with severe pain from RCT or tendinopathy and not routinely used in RCT [18]. It appears to be consensual that surgical intervention in RCT is considered only when conservative measures fail [19] unless acute traumatic RCT in which cases immediate surgical repair is recommended [20]. Nevertheless and similarly to the management of SIS some aspects of treatment remain controversial and controlled prospective trials maybe needed to clarify approach options available to date [21,22].
1.5 Aims and Objectives

The following section will present the objectives of this QIP following the SMART (Specific, Measurable, Achievable, Realistic and Time-bound) goal principles.

1.5.1 The aim of this QIP is to: Reduce the LOS by 50% after surgery by the increasing the number of patients undergoing Day Case surgery within six months from the implementation of the Fast Track.

1.5.2 The objectives of this QIP are to:

- Identify and meet the key stakeholders in order to recruit their support for the QIP by February 2018.
- Investigate the amount of time patients spend in hospital after ASD and RCR by May 2018.
- Explore the potential factors effecting increased LOS and their potential impact on waiting times for ASD and RCR by March 2018.
- Describe patient’s journey from initial referral by their General Practitioner (GP) or the Emergency Department (ED) to waiting lists if surgical indication was decided by May 2018.
- Design a QIP to reduce LOS for patients undergoing ASD or/and RCR in project hospital by August 2018.
1.6 Role of the student

As a second year Physician Associate student (PA) I was allocated a three week rotation in the orthopaedic department at the project hospital. During this time, I assisted the orthopaedic consultants in the outpatient department (OPD) and also during the ward rounds. Working as a student gave me an invaluable opportunity to observe daily clinical practices and identify areas that could benefit from improvements. One area identified as causing innumerable constraints to the function of the orthopaedic department was the LOS of patients undergoing ASD and RCR procedures. It appeared patients were remaining in hospital for longer than necessary according to the opinions of senior consultants and this was possibly leading to a reduction in the number of surgical procedures performed. This provided an opportunity to propose a QIP that would undertake a comprehensive evaluation of patient care and practice in the orthopaedic department and identify ways in which an improvement can be made. However, taking into consideration that I am not a regular staff member and as a student I belong to the lowest level in the medical hierarchy, I recognised to commence an evaluation and to implement any formal improvement required the authorisation and support of a consultant. My consultant supervisor recognised the merits of a proposed evaluation of the orthopaedic department, paying particular attention to LOS of patients undergoing ASD and RCR procedures.
1.7 Summary

This chapter offers an introduction to the QIP. It begins by describing the context within which this project was based, offering a rationale and continuing with aims and objectives. It concludes with a brief overview of the role of the student within this project. Chapter 2 provides an appraisal of prior literature influence on shoulder surgery in general and for ASD and RCR specifically within the framework of international and Irish healthcare. It explores the relationship between the increasing incidence of shoulder pathologies and its impact on LOS and existing waiting lists. This will be followed by a review of the outcomes and its possible complications, and its influence on deciding which patients requiring ASD and RCR would be suitable for Fast Track surgery. Chapter 3 presents an overview of the methodology and methods used in carrying out the project. Chapter 4 sets out the proposed method for evaluating the QIP. Chapter 5 is the discussion section of the QIP, aimed at reviewing the findings and link conclusions from the previous studies to inform future recommendations with the intention of promoting a successful project outcome.
Chapter 2.0 Literature Review

2.1 Introduction

This chapter provides a review of the literature collected for the purpose of this QIP. Section 2.2 identifies the type of search strategy employed to find relevant literature. In Section 2.3 the research is reviewed and a number of themes outlined. This continues with the introduction of each theme, beginning with the increasing incidence of ASD and RCR in developing countries, followed by the predictors of outcome and ending with a review of predictors for early and delayed complications. Section 2.4 continues by outlining the implications of the research on this project. The chapter concludes with a summary of the main points to emerge.

2.2 Search strategy

Google Scholar was initially used to research papers with the terms ‘predictors of outcome in arthroscopic subacromial decompression’. This produced a large selection of articles related to this topic, a small number of which were selected for contribution. This was followed by new search criteria “predictors of outcome in rotator cuff repairs’ again yielding a wide selection of results to be reviewed before selecting the final papers for the literature review. It is important to note that all papers found in both searches were 5 years retrospective with preference to Level 1 cohort design treatment trials, however other studies with lesser levels of evidence were also included.

Further searches were pursued based on phrases ‘early complications in arthroscopic subacromial decompression predictors’ ‘delayed complications in
arthroscopic subacromial decompression predictors’. The search continued with ‘early complications in rotator cuff repair’ and ‘delayed complications in rotator cuff tears’. These searches generated a large volume of results, which were eventually reduced based on the criteria of relevance and contribution to this project. Additional criteria set for this literature review included articles published no later than 2013. Again these papers were 5 years retrospective with preference to Level 1 cohort design prognosis studies, nonetheless other additional studies with lesser levels of evidence were also included.

Additional searches were supported by the RCSI library databases, namely Pubmed and Uptodate. This commenced with a MeSH search of the terms ‘outcome rotator subacromial decompression’ and ‘outcome arthroscopic cuff repair’. This included searches for any title, abstract, full text, clinical trials and reviews containing these phrases. The Bone and Joint Journal was used for a focused search to examine research on the aforementioned topics and on ‘international trends for ASD RCR’, ‘Increasing incidence of ASD RCR’ and ‘UK Ireland practices on ASD RCR’ due to the high numbers of epidemiological studies published and quality of same. The aim was to corroborate the data from other sources and select research papers imperative to this project and to further supplement the literature review. Information gathered through the Slaintecare report was also included. The RCSI e-publications was used to search for QIP’s published to date in order to review the practicalities and processes involved in the design of a QIP. The research available in these areas appeared to be overwhelmingly produced in developed countries, specifically from Europe, North America, Australia, Japan and South Korea. Some of the studies were randomised trials with high levels of evidence. Some other studies were of lesser
level of evidence but provided a long-term follow-up allowing for a comprehensive insight into shoulder pathology, which helped to support this literature review.

2.3. Review of themes

After a review of the pertinent literature two main themes were extrapolated. These included:

- Increasing incidence of ASD and RCR in developing countries.
- Predictors of outcome and complications for ASD and RCR.

Each of these themes will be given individual consideration to determine the influence each could have on the success of the QIP.

2.3.1 Increasing incidences of ASD and RCR

When investigating the pervasiveness of shoulder pathology in general, one common premise has emerged from the literature and that is an increase of SIS\textsuperscript{[23]} and RCT\textsuperscript{[24,25]} and subsequently an associated increase in its surgical management, namely ASD and RCR procedures\textsuperscript{[26,27]}. The predilection of shoulder lesions for active people of working age, especially over 40 is well established\textsuperscript{[28,29,30]}. Further research has found that in developed countries the population is reportedly living longer due to improved healthcare, allowing for easier access to diagnostics possibilities and advanced medical technology. The literature suggests that a significant percentage of our population is older and predicts around 20% of the population by 2030 will be sixty-five years of age or more\textsuperscript{[26]}. This is a significant shift in the demographics and reflective of the changes recorded in the profile of
patient accessing the health system and the increase in shoulder pathology, which is reported to be common in older people\textsuperscript{[25]}. The epidemiology studies suggest the dramatic surge in ASD and RCR is coincidental with the increase in computer work. A factor supporting this is the incidence of shoulder pathology found to be higher in urban areas compared to rural areas since 1996 in Denmark\textsuperscript{[25]}. These authors also stated that no research was found linking the increase in computer work to specific shoulder lesions and further investigations will be necessary to determine whether a link exists.

Research has revealed the number of patients in the UK receiving subacromial decompression has increased from 2523 between 2000-2001 to 21,355 in 2009-2010, totalling a significant 746.4\% rise in this procedure over ten years\textsuperscript{[27]}. In Denmark there has been a statistically significant increase in RCR’s, with research reporting a 465\% over an 18 year period\textsuperscript{[25]}. The data of both countries is in keeping with findings reported in the rest of Europe\textsuperscript{[31]}. The increase in shoulder pathology is becoming a significant burden to the healthcare systems in Europe\textsuperscript{[31]}. Other research reveals a similar increase in the USA, whereby in 1996 there are 30 recorded ASD procedures per 100,000 people in New York State, associated or not to RCR, a figure which increased to 109, per 100,000 by 2006. This calculates as a 254\% increase in ASD procedures in the last decade\textsuperscript{[28]}.

Currently the gold standard treatment for shoulder impingement is a combination of physiotherapy for a minimum of twelve weeks and two subacromial injections\textsuperscript{[12,32,33]}. It has been suggested that for conservative management treatment to be effective, patients require very specific exercises provided by a physiotherapist which may not be available for every patient\textsuperscript{[32]}. The literature agrees when conservative management has failed within six months of diagnosis, an ASD should be
performed. It has been proposed that while concerns for conservative management increase so do the demands for ASD’s. This suggests conservative management may not be as effective as initially thought and may be associated with the rise in ASD procedures $^{[12,34]}$. The literature also points to surgeons becoming more insistent that surgical intervention for shoulder impingement should take place early, in correlation with recent research findings $^{[12,27,32,34]}$.

### 2.3.2 Predictors of outcome and complications for ASD and RCR

Research indicates a growing need to identify those patients who would benefit most from ASD and or RCR surgery, especially after the conservative management phase of their treatment has failed. The use of scoring systems such as Constant Score $^{[35]}$, Oxford Scoring System $^{[36]}$ and Visual Analogue Scale (VAS) $^{[37]}$ are essential tools to surgeons in pre-empting the success rate amongst patients undergoing ASD and/or RCR’s. Constant Score helps to measure range of motion in the shoulder allowing for standardised scores to be applied. The Oxford Scoring system allows for the outcome of treatments to be measured from the patient’s perspectives and assessing the outcome of surgical intervention, while VAS provide a psychometric test to subjectively measure patient’s pain $^{[35,36,37,38]}$.

The literature reveals a 72-90% good or excellent outcome for ASD using Constant score, Oxford score and VAS $^{[39]}$. Factors cited in the literature for predicting a good outcome include persistent symptoms for more than six months, even after a course of targeted physiotherapy, a persistent positive Hawkins test result, pain after overhead activities and radiological changes of impingement on both acromial and humeral region in the subacromial space $^{[40]}$. Further research indicates approximately 77% of surgeons consider a good but temporary response to
subacromial steroid injections as a predictor of good outcome for subacromial decompression. Predictors of poor outcome are reported to be perioperative pain for more than six months prior to procedure and when working compensations is involved. The latter topic, while an important area to investigate, is not the focus of this review.

Research linked to the outcomes for RCR consistently support a good to excellent outcome in four out of five procedures, especially if performed early. The reported features associated with a poor outcome in the literature are a full thickness tear greater than two centimetres and significant fatty infiltration of the rotator cuff muscles. This is assessed using the Goutallier classification which measures the extent of fatty degeneration of the rotator cuff muscles. It uses an MRI scan to quantify the percentage of atrophy and fatty infiltration present in the compromised muscle and grades it. The grading reflects the severity of degeneration with higher grades of three and four indicating a 50% or greater indication of muscle atrophy and correlating with poorer return to normal function following RCR. Other studies have stated the integrity of the repair can also account for postoperative function, as performing a full repair of the RCR is associated with a good outcome and better post-operative function, in comparison to a partial repair which is linked to poorer outcomes.

Studies classify both ASD and RCR’s as safe procedures with complication rates less than 2%. A clear indication of these limited risks are evident when analysing the prevalence rate of each identifiable risk. These include:

- Return to theatre at 0.29%
• Surgical site infection as 0.16% for superficial and 0.01% for deep site infection
• Deep Vein Thrombosis at 0.09%
• Pulmonary Embolism at 0.06%

There are identifiable risk factors associated with complications and these include Smoking, Congestive Cardiac Failure, Chronic Obstructive Pulmonary Disease, BMI greater than 35, American Society of Anaesthesiologists Physical Status (ASA PS) Classification System score [49] (See Appendix A) greater than two, chronic steroid use and operating times greater than 90 minutes [45,46,47,48].

Implications for the project

As previously stated, the increased incidence of shoulder pathology in general and both SIS and RCT in particular can be attributed to a number of comprehensive factors. The impact of increasing rates in SIS and RCT is the untold pressures on an already precarious HSE, due to an increase in waiting times, amongst other reasons [27,31,32]. The literature demonstrates better outcomes for ASD and RCR when performed early, suggesting within six months for ASD [9,13] and as soon as the nonoperative management has been deemed ineffective for RCR [41,43] in order to guarantee the best possible outcome. A positive outcome is defined by limiting deleterious changes in the muscle, preventing stiffness, loss of function and absence of pain [39]. Research has also consistently proven that ASD and RCR are safe procedures both in the short and long term due to low rate for complications [45,46,47,48]. As stated in the literature, the aim of Fast Track is to safely operate on patients on a Day Case basis, whilst securing early discharge and a prompt
functional recovery through access to specialised care delivered by highly motivated professionals \cite{74,75}. The overall impact is an improvement in patient care and experience \cite{72,73}. It suggests to the writer of this QIP that the introduction of a Fast Track programme is an appropriate approach for patients undergoing ASD or/and RCR procedures and may simultaneously reduce LOS and waiting times.

2.5. Summary

This chapter outlined a comprehensive review of literature, introduced in section 2.2 with the literature search strategy, and from this two themes emerged. These themes were identified and explored in section 2.3, under review of themes, firstly increasing incidence of ASD and RCR and finally predictors of outcome and as well as predictors for early and delayed complications for ASD and RCR. The themes that arose from the literature offered an insight into the key areas in need of change and how improvements could be introduced in this QIP. The implications for the project were discussed in the section 2.4.
Chapter 3.0 Methodology

3.1 Introduction

The chapter provides an overview of the models that underpin QI and reviews the rationale for the inclusion of the DMAIC (Define, Measure, Analyse, Improve and Control) framework [50]. The processes involved in identifying the focus for QI based on data collected and using the DMAIC approach are also described. The outcome of the data collected is the proposed QIP to reduce the LOS by 50% after surgery by increasing the number of patients undergoing Day Case surgery within six months. This chapter concludes with a summary of the relevant findings.

3.2 Approaches to Quality Improvement

QI offers a systematic approach to reviewing procedures and implementing change, with the aim of improving organisational performance, provide better patient outcome and promote professional development amongst healthcare professionals [51]. It is important for QI in healthcare to recognise and preserve the needs of the patient, while keeping improvement as the primary focus [52]. QI offers a selection of approaches contingent on the type of organisational structure intended for improvement. There are methods that focus on improving flow while others may focus on modifying a procedure or a combination of both [53]. For a QIP to be successful it is important for the correct model to be selected [54]. There are numerous models to select from and three of these will be discussed as part of this QIP. The following models selected for discussion are, the Lean Six Sigma, Plan Do Study Act (PDSA) modified by the Institute of Healthcare Improvement (IHI)
becoming the Model for Improvement and the DMAIC framework for Improving Quality.

3.2.1 Lean Six Sigma

Lean Six Sigma is a combination of two pre-existing models that place customer value at the forefront of QI, with the goal of reducing waste and increasing value for the customer. Lean seeks to improve flow in the value stream and eliminate waste [55]. Using Lean in the healthcare setting has led to an improvement in how a patient moves through services, removing non value added processes to the patient’s journey. Other types of waste identified include overproduction, stock, and costs of quality [56]. Six Sigma investigates discrepancies and variation within a system using facts and data, including both qualitative and quantitative techniques to impel the improvement process. Use of Lean Six Sigma are implemented jointly to account for variations in specific areas in response to process flow. The identification of ‘root causes’ is what makes this approach user friendly [57]. The common goal of both approaches is to provide the user with the best possible quality, cost and outcome [56,57].
3.2.2 The Model for Improvement

The Model for Improvement as developed by the Associates in Process Improvement acts as a tool for accelerating improvements \[^{[57,58]}\]. The Model for Improvement incorporates two parts, as recommended by the IHI, the first involves three essential questions to determine what is the main aim, what suitable changes will led to improvements and what measures will be used to assess if change is an improvement \[^{[59]}\]. Completing these questions allows for the commencement of the second part which is the implementation of the Plan-Do-Study-Act model developed by Demings \[^{[59]}\]. This PDSA model proposes change in a real time setting and advocates for continuous improvement as progress is presented as a cyclical flow. The first step of the PDSA cycle is ‘plan’ which selects an area for change and creates a plan for this change. The second step ‘do’ indicates how plan could be implemented. The ‘Study’ step involves analysing performance and outcomes \[^{[60]}\]. The final step ‘Act’ applies previous knowledge to plan for new improvements, before returning to step 1 plan \[^{[60]}\]. See figure 1 for Model for Improvement diagram.
3.2.3 DMAIC

DMAIC is a structured framework that synthesizes the processes used in Lean Six Sigma model to provide a well organised system to review both process flow and variation within a specific area. There are five phases to the DMAIC framework. Figure 3 demonstrates the DMAIC process from a start to end as a one-way flow.
Each stage of DMAIC uses tools to enable process improvement and advance the QIP through to the next stage [57]. Defining an area for improvement and establishing the aims for QI is the first phase of the process [55]. A range of tools can be used such as a stakeholder analyses to identify staff essential for the success of the QIP or process flow maps to visually represent a patient’s journey compared to staff views of the process [52,57]. The next stage Measure allows those involved in the QIP to collate data related to the problem area and continue to the Analyse stage. The Analyse stage uses methods such as the 5 whys, fishbone diagrams and waste identification to help discover the source of the problem. Identifying the ‘root cause’ [51,57] will permit the improvement phase of the QI to commence and ideas for progress to be proposed. The control phase will determine if the improvements made are continuing and having a positive impact.

3.3 Rationale for the model selected

Waste was identified as a target by the healthcare providers and is a topic that was extensively studied [61,62]. The Lean Six Sigma model used primarily in the industrial sector uses a systematic approach to avoid waste, however within the context of direct patient care it is often easier to gain providers support to reduce waste rather than the way they deliver care [61,62]. The IHI incorporated no waste as one of the 5 goals of healthcare change and added to the list of desirable outcome which includes no needless death, no needless pain, no helplessness and no unwanted waiting [61]. The DMAIC framework, coupled with the Lean Six Sigma can provide measurable response variables susceptible to improvement [50, 63]. DMAIC offers a comprehensive and systematic approach that aims to breakdown the problem into
separate components, suitable for individual measurement and analysis as exemplified in figure 3\[50, 63\]. Furthermore, DMAIC is very intuitive and compelling and was applied successfully in the past with measurable and reproducible satisfactory results\[61,63\].

<table>
<thead>
<tr>
<th>Define</th>
<th>Measure</th>
<th>Analyse</th>
<th>Improve</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS after ASD and RCR.</td>
<td>Data on waiting times for surgery</td>
<td>Fishbone diagram</td>
<td>Pre-operative Scoring Sheet</td>
<td>Pre-operative scoring sheet in operation for six months</td>
</tr>
<tr>
<td>Process Flow Map</td>
<td>Data on Day Case vs. Inpatient after surgery</td>
<td></td>
<td>Revised Process Flow Map</td>
<td>Repeat data collection on waiting times, Day Case vs. Inpatient and LOS after surgery</td>
</tr>
<tr>
<td>Stakeholders Analysis</td>
<td>Data on LOS after surgery</td>
<td></td>
<td></td>
<td>Compare data</td>
</tr>
<tr>
<td>Gantt Chart</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 - DMAIC steps and tools.

3.4 DMAIC framework overview

3.4.1 Define

It is custom to begin the DMAIC at the define stage to identify an area for improvement. The focus of this QIP centers around an orthopaedic department at an Irish university hospital, with growing concerns amongst consultants that patients are staying too long after ASD and RCR procedures. In fact patients stayed a minimum of two days after either or both interventions. It is the opinion of the sponsor of this QIP that this prolonged LOS may also be impacting on waiting times. There is an
expectation that patients referred for surgery will be treated within twelve weeks, but unfortunately waiting times vary between 18 to 24 months which is deemed unacceptable by the Slaintecare report \(^8\). It is the expectation of the writer for LOS to reduce, allowing for more cases to be performed and potentially reduce waiting times over time. As part of the Define stage, a process flow map and a stakeholders analysis are applied to identify how changes could be made.

### 3.4.1.1 Process flow map

The first improvement tool used was a process flow map \(^{[64]}\). This tool facilitated the writer's understanding of a patient's journey from the point of referral and identified factors contributing to long stay in hospital after surgery. To gain a comprehensive overview of a patient's journey, they were followed from the initial referral stage, either from their GP or ED, with their journey documented to the point of receiving surgery. The patient’s journey was discussed with relevant staff and department heads to verify the existing process flow from referral to post procedure. The use of a process flow map helped to gain an understanding of the problems in need of improvement before attempting to make changes. Below in figure 4 is the process or the current patient's journey for ASD and RCR procedures.
Figure 4 - Process flow map*.  

*This process flow map represents the patient journey in operation at the project hospital. Patients can opt out of this process flow map to seek care in the private sector or return at any stage.
This process flow map represents the patient journey in operation at the project hospital. Patients can enter this process through two points of referral, from their GP or through an ED referral. When patients are referred from a GP they move to the assessment stage of the process, whereby they have access to an orthopedic assessment and are placed on a waiting list for an MRI scan. Once the MRI scan is completed patients are granted another orthopedic assessment. If the patient has a pre-existing MRI scan they are signposted directly to an orthopaedic assessment for possible surgical indication. The outcome of this assessment decides if a patient receives the recommended two courses of conservative management or is transferred to the waiting list. Patients from this waiting list are allocated a slot for surgery in either the project hospital or an alternative hospital. Those patients accessing surgery through the project hospital will receive treatment as an inpatient and remain in hospital post procedure for a minimum of two days. Patients can opt out of this process flow map to seek care in the private sector or return to this process flow at any stage.

Patients referred from the ED will receive an emergency MRI scan and place the next emergency appointment available. This will move patients coming from ED onto the assessment stage of the flow map within a shorter time frame. Once they have been assessed in the orthopedic assessment, they will progress to the pre-procedure stage of the flow map and allocated a slot on the emergency waiting list of one to two weeks. Surgical interventions are generally performed as Inpatient procedures, with patients remaining in hospital for a minimum of two days. As with patients from the GP referral, patients can opt out of this process flow to or from the private sector at any stage.
3.4.1.2 Stakeholder analysis

The completion of the process flow map lead to the decision to introduce a second structured tool, a stakeholder analysis. A stakeholder analysis allows for information on all interested participants to be systematically collated and assessed to determine which viewpoint should be considered when developing a plan for improvement [65].

This tool helps to identify the key stakeholders and gain an insight into different perspectives. It is important to maintain contact with stakeholders and keep them informed as the process progresses. There are four categories of stakeholder: high power with low interest, high power with high interest, low power with low interest and low power with high interest. The final stakeholder analysis can be seen below in figure 5.

![Stakeholder Analysis Diagram]

Figure 5 - Stakeholders analysis.

Low power and low interest are identified as porters, clerical assistants and healthcare assistants, as they are not directly connected to the project and perceive all the processes involved as unfamiliar to them. The patients attending hospital for
ASD and/or RCR are the most important stakeholders and the focus of this QIP, however, they have low power and are passive agents in this process. This QIP will attempt to focus on the Clinical Governance, Audit team and Hospital Directorate as they have the power and resources to facilitate change. In addition, the orthopaedic Nursing staff, Non-Consultant House Doctors, Recovery nurses, Enhanced Recovery Nurse and Physiotherapist’s expressed their interest in reducing LOS and to increase the wellbeing of patients. All of the participants mentioned in this category appear eager for change to happen, but their authority is very limited and for this reason they are in the low power, high interest category.

There are four key stakeholders identified as high powered forces driving forward this QIP. The Orthopedic Consultants, the Clinical Governance and Audit Department are eager for a QIP to reduce patient’s LOS in hospital, potentially leading to the reduction of waiting times for ASD and RCR. These stakeholder have the power to introduce change, which is why they have been grouped in the high interest, high power category for stakeholders. The final high powered stakeholder identified is the Hospital Directorate, as they also have the power to implement changes. However, with the level of pressure currently experienced by individuals in these positions, there appears to be a growing need to prioritize new initiatives and ideas. It is the opinion of the writer that when the time comes to decide on the next new initiative to endorse, this QIP may not be given priority and thus will be categorized as low interest.
3.4.2 Measure

The second stage in the DMAIC process is to collect data to help quantify the problem. This data was collected over the course of a year to obtain a representative sample and to gain a comprehensive insight into the problem identified. The data was collected from the participating hospital database, after authorisation from the participating consultant and sponsor. All the information from the database was collated from the individual medical files requested from the medical records. The following data was obtained: patient demographics, reference letter from current episode and treatments implemented to date of the operation. To confirm the date of the operation, procedures performed and duration of same, the operative protocol for procedures were checked. Finally, a thorough reading of the evaluation notes occurred to review reports of recorded complications, confirm date of discharge and follow up appointment. The data collected indicated 38 patients in total were waiting for RCR and ASD procedures. This included a wait of up to twelve months for a significant number of patients, with a further 4 patients waiting almost 24 months. See figure 6 below.

![Waiting Times](image)

**Figure 6 - Bar-graph of waiting times.**
It appeared clear from the data that most of the procedures carried out from January-December 2017 were Inpatient, with 27 out of 30 patients accounting for this trend, while the remaining 3 patients as Day Case. See figure 7 below.

![Day Case vs. Inpatient pie chart](image)

**Figure 7 - Day Case vs. Inpatient pie chart.**

Out of these 30 patients, a significant number remained in hospital for two days, with the average LOS calculated as 2.1 days. See below in Figure 8 for average LOS for patients receiving ASD/RCR performed from January 2017 to December 2017.

![Length of Stay bar chart](image)

**Figure 8 - Bar-chart for length of stay.**
3.4.3 Analyse

The third stage of the DMAIC involves analysing data to identify the cause of the problem. The second improvement tool selected at this stage was the Fishbone Diagram\[66\]. This tool helps to visually represent the source of the problem identified for improvement. Grouping each cause by people, process, environment and resources allows for a comprehensive analysis of factors that may be contributing to lengthy stays in hospital for ASD and RCR.

This is illustrated in figure 9.

![Fishbone Diagram](image)

Figure 9 - Fishbone diagram.

When reviewing the processes involved, one of the main shortcomings discovered by the writer was the lack of guidelines regarding the approach and management of patients with possible SIS and RCT. It was the conclusion of the writer of this QIP.
that a tool to improve this shortcoming was needed to successfully assess patients in an objective and systematic manner, an idea that was also supported by the sponsor of this project. It also became apparent that as a result of cancellations to facilitate trauma cases, patients for elective surgery were consequently returned to the waiting list, contributing further to an increase in waiting times. This constraining situation for both healthcare professionals and patients cannot be easily addressed and is out of the scope of this QIP.

In the category ‘people’, a shortage of healthcare professional across the HSE has also been noted. The minister for health in Ireland reported the HSE is experiencing challenges in recruiting and retaining healthcare professional, especially skilled staff, such as doctors and nurses [67]. This is a finding supported by the European commission which estimates a potential shortfall of 1 million health workers by 2020 [68]. Additionally, a high volume of patients awaiting for orthopaedic procedures are identified, a development that is also supported by the Slaintecare report [8] and the National Treatment Purchase Fund (NTPF) [69]. The high number of patients also impact on the ‘environment’ issues, as it creates competition amongst orthopaedic Consultants and other specialities for theatre space.

When reviewing the causes related to resources, it is important to note that the previous factors mentioned earlier are interlinked with the resource and environment category. This includes multi-specialities in a shared space competing for theatre rooms, which may have repercussions on the supply and demand for theatre slots. In addition, the shortage of healthcare professionals can be extrapolated to the theatre setting and specifically to theatre staff. Overall and according to the sponsor, it seems that the shortage of theatre staff is having a negative impact on the procedures undertaken, namely ASD and RCR’s. The sponsor also highlighted that
the shortage of recovery staff could extending patients LOS after ASD and RCR surgeries.

### 3.4.4 Improve

Based on the above results it is the aim of the QIP to introduce a Fast Tract programme to reduce the overall LOS for patients undergoing ASD and RCR. To achieve this, a process flow improvement tool is needed to modify a patient’s journey to reflect the introduction of a Fast Track programme. The aim of the improved process flow map is to allow for more ASD and RCR procedures to be performed as Day Case and set a new target of reducing patient LOS by 50% within six months. The revised process map can be viewed in figure 16. There are two significant changes made to the original process map, firstly, the introduction of a pre-operative scoring system (see Appendices C and D) to provide a systematic assessment tool for orthopaedic staff.

This assessment tool was designed by the sponsor, his specialist registrar (SpR) and the writer of this QIP. The pre-operative scoring sheet was based on the literature review findings and was divided into three parts. First was designated ASD criteria as seen in figure 10 and designed in 2016 by Seigh et al. The ASD criteria used for this pre-operative scoring sheet has already been successfully applied in an orthopaedic department in a university hospital in the United Kingdom [40].
The second part includes the RCR criteria, as seen in figure 11, was designed by the sponsor, his SpR and the writer of this QIP based on the literature review findings. This criteria has never been tried before, however substantial evidence in the literature appears to support it.

Figure 10 - ASD Criteria.

Figure 11 - RCR Criteria.
Finally, the Contributory Medical Conditions were selected in response to literature proving them to have a negative impact on the outcome of patients undergoing ASD and RCR. Furthermore, the research available also establishes strong links between these medical conditions and increased rate of complications [45,46,47,48,49]. See figure 12 below.

Figure 12 - Contributory Medical Conditions.

The VAS (See below figure 13), Constant score (See below figure 14) and Oxford Score (See below figure 15 and 16) were added, as they are extensively used in the orthopaedic setting as a specific measure of function and will be used in the follow up of patients after surgery. The other modification involves performing ASD and RCR procedures as Day Case rather than as inpatients. These changes are part of the Fast Track approach that will commence at the pre-operative stage of the revised process flow, but only if deemed a suitable pathway for the patient.

Figure 13 - Visual Analogue Scale (VAS)
During the past 4 weeks....

1. Pain
   - Severe
   - Moderate
   - Mild
   - None

2. Activity Level (check all that apply)
   - Yes: Unaffected Sleep
   - No: Full Recreation/Sport
   - No: Full Work

3. Arm Positioning
   - Up to Waist
   - Up to Xiphoid
   - Up to Neck
   - Up to Top of Head
   - Above Head

RANGE OF MOTION

4. Strength of Abduction [Pounds]
   - 0: 13-15
   - 1-3: 15-18
   - 4-6: 19-21
   - 7-9: 22-24
   - 10-12: >24

5. Forward Flexion
   - 31-60 degrees
   - 61-90 degrees
   - 91-120 degrees
   - 121-150 degrees
   - 151-180 degrees

6. Lateral Elevation
   - 31-60 degrees
   - 61-90 degrees
   - 91-120 degrees
   - 121-150 degrees
   - 151-180 degrees

7. External Rotation
   - Hand behind Head, Elbow forward
   - Hand behind Head, Elbow back
   - Hand to top of Head, Elbow forward
   - Hand to top of Head, Elbow back - Full Elevation

8. Internal Rotation
   - Lateral Thigh
   - Buttock
   - Lumbosacral Junction
   - Waist (L3)
   - T12 Vertebra
   - Interscapular (T7)

Figure 14 - Constant Score.
## During the past 4 weeks......

### 1. How would you describe the worst pain you had from your shoulder?
- None
- Mild
- Moderate
- Severe
- Unbearable

### 2. Have you had any trouble dressing yourself because of your shoulder?
- No trouble at all
- Little trouble
- Moderate trouble
- Extreme difficulty
- Impossible to do

### 3. Have you had any trouble getting in and out of a car or using public transport because of your shoulder?
- No trouble at all
- Very little trouble
- Moderate trouble
- Extreme difficulty
- Impossible to do

### 4. Have you been able to use a knife and fork at the same time?
- Yes, easily
- With little difficulty
- With moderate difficulty
- With extreme difficulty
- No, impossible

### 5. Could you do the household shopping on your own?
- Yes, easily
- With little difficulty
- With moderate difficulty
- With extreme difficulty
- No, impossible

### 6. Could you carry a tray containing a plate of food across a room?
- Yes, easily
- With little difficulty
- With moderate difficulty
- With extreme difficulty
- No, impossible

### 7. Could you brush/comb your hair with the affected arm?
- Yes, easily
- With little difficulty
- With moderate difficulty
- With extreme difficulty
- No, impossible
8. How would you describe the pain you usually had from your shoulder?

- None
- Very mild
- Mild
- Moderate
- Severe

9. Could you hang your clothes up in a wardrobe, using the affected arm? (whichever you tend to use)

- Yes, easily
- With little difficulty
- With moderate difficulty
- With great difficulty
- No, impossible

10. Have you been able to wash and dry yourself under both arms?

- Yes, easily
- With little difficulty
- With moderate difficulty
- With extreme difficulty
- No, impossible

11. How much has pain from your shoulder interfered with your usual work (including housework)?

- Not at all
- A little bit
- Moderately
- Greatly
- Totally

12. Have you been troubled by pain from your shoulder in bed at night?

- No nights
- Only 1 or 2 nights
- Some nights
- Most nights
- Every night

Figure 15 - Oxford Score.
3.4.4.1 The Role of Fast Track

A recent review of data on the implication of waiting lists on a patient’s health indicates a positive correlation between lengthy waiting lists and an increase in patient mortality and morbidity \cite{70,71}. Research into either or both ASD and RCR surgery found the outcomes to be noticeably poorer when treatment was delayed \cite{15,19}. In comparison, patients waiting longer than six months on the same procedure did not display the same outcome, defined by Constant score, Oxford score and VAS, irrespective of rehabilitation prior to the intervention \cite{8,19,20}. Research has also indicated the prevalence of SIS and RCT has drastically increased in the last decade and this has impacted on the need for more ASD and RCR \cite{25,26}. This growing demand, in turn has led to a noticeable increase in waiting times \cite{72}. Introducing a Fast Track programme will offer ASD and RCR as Day Case and subsequently begin to address waiting time concerns by allowing more surgeries to take place within a shorter waiting time by reducing LOS after surgery.

Fast track surgery is an approach that aims to offer patients a multi-disciplinary and person centred practice, which creates guidelines for patient care \cite{72}. The aim is to secure an early post-surgery discharge and an early functional recovery \cite{73}. These Fast Track guidelines are defined by the collaborative use of techniques that target a patient before, during and after surgery, consequently allowing for an early recovery \cite{74}. Patients undergoing an elective operative procedure will experience a high level of integrated care that involves using localised anaesthesia, minimally invasive techniques, effective pain management and a strenuous recovery plan. Uniting these approaches reduce stress responses and organ impairment, consequently, minimising the time needed for a full recovery \cite{73}.  

45
Ambulatory surgery has now become more routine for a range of procedures, offering a comprehensive record for safety and low morbidity, even in patients deemed as high risk \cite{75}. Further studies of Fast Track system using non-random trials evaluated the use of similar approaches in larger and higher risk surgeries, with initial results indicating a positive outcome including patient satisfaction, maintaining safety, and cost and waiting list reductions \cite{75}. For Fast Track to be successful it is paramount to implement a collaborative and multidisciplinary person centred approach in which nursing, physiotherapy and anaesthesia will play a key role\cite{72,73,74}. The impact of Fast Track could be further exemplified by the high satisfaction amongst surgeons delivering a highly specialized service, improved health and experience of patients, reducing potential for future complications therefore decreasing healthcare expenditure and of course, reducing waiting lists \cite{75}. It is also important to use the existing skills and expertise of staff from within the HSE services to successfully improve the outcomes for those patients after surgery as shown in other specialities \cite{76,77}. Additionally, the budget impact is zero as no additional staff or resources will be needed to implement the Fast Track system.

To initiate the Fast Track approach, it will be important to gather key stakeholder for a meeting to discuss the potential benefits of introducing a Fast Track programme into the orthopaedic Department, using the new process flow map (See figure 17 for the revised process flow map). It will allow for all relevant people to be informed of a new purposed improvement plan, as well as recognise the need for it and agree with the proposal. Using a comprehensive power point presentation outlining data collected on LOS and waiting times, stakeholders will be informed that patients can wait up to 24 months on an ASD or RCR procedure and remain in hospital for an average of 2.1 days. Further information will be reported on the limited use of Day
Case for ASD and RCR, with only three Day Case surgeries reported in 2017 in comparison to 27 Inpatient procedures. It is important to analyse data from a range of sources to ensure Day Case procedures for ASD and RCR provides a cost effective service that will reduce the LOS of patient. The next stage will be to arrange a meeting to agree when the Fast Track approach will be implemented using the guidelines set in the revised process flow map and it will be recommended that this could commence in 2019, with a trial period of six months to one year.\textsuperscript{[78]}.
Figure 16 - Revised process flow map
A review of the patient journey highlights key changes to the process flow. This includes the introduction of a pre-operative scoring system, at the assessment stage. Patients assigned to the waiting list for surgery at the pre-procedure stage will receive their treatment at the project hospital, as part of the Fast Track programme. Procedures will now be on a Day Case basis, rather than Inpatient. This ensures patients will be discharged on the same day of surgery, following a Physiotherapy assessment and a follow-up appointment at OPD arranged within two weeks after surgery.

3.4.5 Control

The control phase of DMAIC aims to appraise the changes made in the improvement stage to ensure sustained progress. At this phase of the QIP the goal is to ensure any future work will allow for sustained progress and present to key stakeholder a clear control plan that reinforces a commitment to maintaining progress\textsuperscript{[78]}. The QIP aim to reduce LOS after ASD/RCR requires the implementation of a Fast Track system. To achieve this, highly trained medical professionals will be necessary in order supervise the Fast Track throughout the programme. In addition, other highly skilled professional, such as Department Nurses, Theatre and Recovery Nurses working together will increase the flow of patients requiring ASD and RCR, improve quality of care delivered to patients and in turn reduce waiting lists. New staff will not be required at this stage and the Fast Track programme will have neutral budget impact.

The Fast Track system will begin at the pre-procedure stage of a patient’s journey with the initial stages remaining the same. The patient will be referred for an
assessment from either a GP or as part of an ED referral. Once the MRI scan has been completed and conservative management therapy has been offered without success, a pre-operative assessment will take place to select patients that will benefit from ASD and/or RCR surgery as Day Case. The pre-operative scoring sheet can be viewed in Appendices C and D. It is during the pre-procedure stage that Fast Track system will be implemented for patients assessed as suitable candidates. Trauma cases will continue to be given priority with all other cases entering the Fast Track system automatically placed on a waiting list. If patients continue on the Fast Track pathway at the facilitating hospital they will be offered surgery as a Day Case procedure, with treatment and discharge on the same day. It is hoped that this QIP will allow for more procedures to be performed with less patients needing to stay overnight, this may help free beds for more serious cases and ensure patients on the waiting list for ASD and RCR are being treated sooner. The pre-operative scoring sheet will also be used as a data collection tool, as it contains all the necessary fields to estimate the new LOS after surgery and determine the complication rates associated with the implementation of the proposed Fast Track system.

3.5 Summary

This chapter began by introducing models for QI, described each model for QI individually in section 3.2 before providing a rational for the selecting the DMAIC (Define, Measure, Analyse, Improve and Control) framework for QI in section 3.3. It was decided the DMAIC framework provided the necessary improvement tools to identify the ‘root cause’ of prolonged LOS and to develop a plan to target this
concern. Section 3.4 aimed to provide a comprehensive breakdown of the DMAIC steps and how it was used in this QIP. The use of a process flow map was introduced in section 3.4.1.2 to highlight the journey of a patient from point of referral to post procedure. This process map was created together with the project supervisor during the rotation in orthopaedics. A stakeholder’s analysis soon followed to identify all key stakeholders, which was presented in section 3.4.1.3. In section 3.4.2 data collected was presented, which showed on average patients stayed in hospital for up to 2.1 days, with 20 out of 37 waiting up to twelve months for ASD or RCR procedures. On further inspection of data collated on 30 patients recorded as receiving ASD or RCR procedures, 27 were Inpatients, with only 3 as Day Case. This was followed by an analysis of the data in section 3.4.3, with the creation of a fishbone diagram to identify factors which may be contributing to LOS.

After highlighting that 60% of patients are waiting more than twelve months on surgery with a LOS on average of 2.1 days post-procedure, the focus of this QIP became clear. In section 3.4.4, the implementation of a Fast Track programme supervised by an orthopaedic surgeon was discussed with stakeholders. The final section 3.4.5 identified the control stage of the process to review how improvements could be sustained, this included the continuous involvement from Physiotherapists Theatre and Recovery nurses and a review of progress with stakeholders. A revised process flow map was created to visually represent how patients will access this new Fast Track programme. The following chapter will discuss how the QIP can be evaluated.
The expected results of this QIP were identified as reducing the LOS of patients by at least 50%, without compromising patient safety. This is to maintain complication rates under 2% as per international guidelines. To ensure this target has been met, it is important to review data and provide a new baseline regarding average LOS, post Fast Track. As part of the dissemination plan, sponsor, stakeholders and directly involved participants will be instructed of the Fast Track and pre-operative scoring sheet and consulted periodically to address any concerns arising from the implementation of QIP. When the QIP is completed all the participants will be informed of the outcome.
Chapter 4.0 Evaluation

4.1 Introduction

The aim of this chapter is to assess the proposed QIP. It will provide an overview of the QIP and its expected outcomes in section 4.2, followed by an evaluation in section 4.3, to determine if changes have led to improvements while providing an overview of the tools needed to do this. Details of how the DMAIC framework control stage was used to evaluate the process will be discussed in section. Finally ideas will be recommended to promote dissemination of the QIP to the orthopaedic department. The chapter will end with a summary of the tools employed to evaluate the QIP.

4.2 Overview of QI and expected outcomes

To guide the planning of this QIP the DMAIC framework incorporating Lean Six Sigma change model was used. A selection of improvement tools, specific for planning were introduced during each stage of the DMAIC. The main aim of this QIP was to reduce the LOS for patients undergoing ASD and/or RCR by 50% by increasing the number of patients performed as Day Case surgery within six months from the implementation of the Fast Track. The plan began with a comprehensive literature review in an effort to ascertain the predictors of a good outcome for ASD and RCR and early and delayed complications. This would offer invaluable information when determining which patient would most likely benefit from Day Case surgery and reduce the need for a hospital stay. It was evident in the literature that a number of factors could impact on the outcome of surgery, with the most prevalent
literature guiding the creation of a pre-operative scoring system. In the literature review, a theme emerged suggesting the incidence of ASD and RCR were dramatically increasing. A selection of tools were used throughout this plan to gather an insight into this problem from the patient’s perspective but also from an organisational one. It began with the creation of a process flow map to represent a patient’s journey before the introduction of Fast Track. The process map highlighted the many stages a patient is required to experience before surgical intervention is offered and the use of a fishbone diagram clarified the myriad of factors within the organisation that were affecting waiting times and LOS. The extent of the problem became clear after the collection of data, which revealed the number of people waiting for ASD and RCR stands at 37. At first glance this figure may seem small, but it is important to point out that in concordance with the process map patients were also sent to an alternative hospital as well as the project hospital. It is the belief of the writer of this QIP and of the sponsor, that these numbers are considerably greater than the ones reflected.

The identification of stakeholders was key in identifying the interests of the organisation and communicating the benefits of introducing Day Case procedures for ASD and RCR. During a meeting with stakeholders the agenda will be set on addressing the LOS of patients after ASD and/or RCR. The range of solutions to select from is limited due to budget restrictions, and according to the sponsor any solution proposed needs to be budget neutral. A two phased approach will be adopted, beginning by creating a Fast Track pathway to reduce LOS for patients undergoing ASD and/or RCR. Once the Fast Track has been proven as a valid approach, the second phase involves presenting the results of the current QIP to the Hospital Directorate in order to gather the necessary resources of theatre staff,
theatre slots and recovery staff to help increase the number of procedures performed in the project hospital. A pre-operative scoring sheet was designed and will be deployed in the OPD with the intention of identifying patients appropriate for ASD and/or RCR as Day Case. It will be proposed for a one year Fast Track trial to be introduced, with two review intervals taking place at six months and twelve months and for the current process flow map in operation to be revised. The revised process flow map will highlight the proposed reality of a patient’s journey whilst using Fast Track and the impact this will have on the pace and access to much needed surgery. The following sections aim to ascertain if the QIP will be successful.

4.3 Evaluation

The aim of any QIP in healthcare is to provide a patient centred plan that will enhance quality of care and patient’s experiences. In the DMAIC framework, evaluation is the final stage of the process, also known as the Control stage. In order to evaluate this QIP, it is important to measure success. The use of a pre-operative scoring sheet will provide a valid tool to help identify patients suitable for ASD and/or RCR as Day Case. After the pre-operative scoring sheet is in place, the necessary data will be collected from every patient who undergoes these procedures. Once the data is collected and reviewed the writer of this QIP will determine if Fast Track has reduced the LOS by 50% as per aim, without increasing the rate of morbidity and mortality within 30 and 90 days post-operatively. Overall, the pre-operative scoring system allows for a systematic and accurate collection of data and contains all the necessary fields to obtain a measure of success. Initially this will be done over a period of six months to allow for a valid interval of time. It is important to ensure all
relevant and interested stakeholders are involved throughout this process and for a review of progress to take place within six months. This will involve regular feedback to key stakeholders throughout the data collection and evaluate what more is needed to ensure progress is sustainable.

### 4.3.1. Aim of control phase of DMAIC framework

The intention of the control phase of the DMAIC framework is to provide an overview of how the proposed project plan will be monitored and maintained.

### 4.3.2. Monitoring and Review

To achieve continued success, communication amongst stakeholders and staff is vital during the monitoring and review stage. To keep this project moving forward, it is important to provide continuous goals and targets for the department to reach. The use of a GANTT chart is a useful tool in setting clear goals and provide a visual indication of what could be achieved by using a bar-chart style diagram. An example of a GANTT chart is the one used during this project to clarify targets to be reached (See appendix E). It also helps keep the project on task and maintain the drive to move forward. This is a simple way of acknowledging achievements and creating job satisfaction by highlighting targets that have been met $^{[63]}$. It is important these targets remain realistic in order to maintain long-term success $^{[55]}$.

To ensure the success of this QIP it is important for all staff to be invested in meeting the aim of the project and provide updates on progress. It is important for monthly team meeting to be arranged to discuss any issues emerging from the new
project and to set goals for the month ahead. It is also vital to review with staff the new recommendations and processes in place and allow staff time to adjust to the new changes. The use of visual management tools, such as bar-chart, to display the percentage of patients staying in hospitals compared to Day Case under the Fast Track programme, maybe beneficial in highlighting progression and promoting change. It is also important to review progress by continually collecting data to determine if LOS has been reduced and to recollect data on waiting times to assess if a positive impact is emerging. Designating a member of staff to liaise with, to ensure questions are answered and concerns are addressed could help sustain the momentum of this project. Repeating a process flow map will also allow healthcare professionals to compare the patient’s previous journey with the revised patient’s journey as part of the new Fast Track system in place.

### 4.3.3 Expected Results

The expectation of this plan is to introduce a pre-operative scoring system to accurately identify patients suitable for ASD and/or RCR as a Day Case and permit early discharge and early functional recovery in a way that will reduce the LOS to 1.05 days. Once the reduction of LOS has been confirmed and international standards for complication rates has been corroborated by data, the next logical step would be to increase the number of procedures performed in order to reduce the waiting times. When Fast Track is optimally applied it has been proven to be a cost effective tool [51]. For this QIP the budget impact on the project hospital will be neutral during the first stage.
4.4 Dissemination Plan

The dissemination phase in this QIP will involve a series of meetings with all relevant participants. The first meeting will include key stakeholders and sponsor to present the pre-operative scoring sheet and the revised patient flow map for the Fast Track approach. The next stage will be to organise a tutorial session to introduce the pre-operative scoring sheet and instruct staff in its use. This tutorial session will also offer staff a platform to discuss their opinions on the objectives of the QIP, address any of their concerns and clarify any medical or technical details arising from the Fast Track programme. It is also useful to select one member of staff from each professional group to liaise with the writer during this tutorial session. Once the pre-operative scoring sheet is introduced in the OPD it will be kept inside individual medical files as per hospital policy. In order to record which patients have been selected for Fast Track, the relevant professional involved will be required to add patient details to a newly log created and maintain a trace on those selected for data processing purposes. After the six month trial period is over, the high power stakeholders will be informed of the results and conclusions taken from the data.

4.5 Summary

This chapter commenced with an overview of the impact of the DMAIC framework and its expected outcomes, highlighting the importance of the control phase for sustaining the changes recommended as part of the QIP. It was the introduction of a Fast Track system to reduce LOS for patients undergoing ASD and/or RCR that was the change recommended by this QIP. This also included the introduction of a pre-operative scoring system to identify patients likely to experience a good outcome.
The importance of measuring success is paramount to ensuring the changes implemented positively impact on LOS and subsequently on waiting times.

As part of the monitoring and review of this QIP it was suggested for a GANTT chart to be introduced as a way of highlighting targets to be achieved within a given time frame. It was purposed a GANTT chart would keep staff motivated and on track to maintain the changes needed for Fast Track to continue. However, the importance of allowing staff time to adjust to new changes and the allocation of a staff representative* to address concerns and questions, were also identified. Visual management systems such as bar-charts to display monthly progress of LOS as they reduce, along with monthly staff meeting to address any concerns were reported to be effective ways of informing staff of progress. The introduction of a new process flow map will provide a means to directly compare the new system with the system originally in operation.

The expected results of this QIP were identified as reducing the LOS of patients by at least 50%, without compromising patient safety. This is to maintain complication rates under 2% as per international guidelines. To ensure this target will be met, it is important to review data and provide a new baseline regarding average LOS, post Fast Track. As part of the dissemination plan the sponsor, stakeholders and other participants will be instructed on the Fast Track and pre-operative scoring sheet and consulted periodically to address any concerns arising from the implementation of this QIP. When this QIP is completed all the participants will be informed of the outcome.
Chapter 5.0 Discussions and Conclusions

5.1 Introduction

The final chapter begins by discussing the impact of the QI project on stakeholders and practices in section 5.2. This will be followed by reflecting on the strengths of the project in section 5.3, before identifying its limitations in section 5.4. Recommendations for the future research and practice will be presented in section 5.5. Section 5.6 will describe aspects of the writer learning experience throughout this QIP. The chapter will conclude with a summary and conclusion.

5.2 Impact of project

The impact of this QIP is to reduce the LOS for patients undergoing ASD and RCR procedures, with potential to reduce waiting times. The QIP proposed the new system to involve a pre-operative assessment using a newly devised scoring tool. This allows for a systematic assessment and review of patients to take place, a process that is not currently in operation. The use of a pre-operative scoring sheet will assist medical and allied health professionals in identifying those patients more likely to benefit from Fast Track surgery. Overall, it is expected that the introduction of a Fast Track system will have a positive impact on patient care and experience, with staff, stakeholders and hospital practice also benefiting. The following section will review how this plan could impact on stakeholders and practices within the facilitating hospital.
5.2.1 Patients

It is important to recognise that patients awaiting surgical procedures are the main focus of this QIP and have been identified as one of the key stakeholders. The increase in demand for ASD and RCR have led to delays in patients receiving treatment. Moreover, the concurrent trauma cases provoke further delays that, as previously stated, can lead to an increase in complications due to a deterioration of their condition, which in turn results in an increase in a patient’s LOS in hospital, and can be associated with poor outcomes \cite{9,70,71}. The implementation of a Fast Track system could allow for patients to be treated promptly, reducing the risk for complications and promoting early functional recovery \cite{72,75}. Fast also advocates for patients no longer needing to stay in hospital beyond the time it takes to complete an ASD or RCR procedure, inclusive of post-operative recovery, which is less than a day. Patients’ satisfaction of the health service will improve alongside their own health and wellbeing \cite{79}.

5.2.2 Staff

For staff, there will be clear guidelines in operation for the use of Fast Track and may also allow for specialisation and continuity of care. The impact could be a higher level of job satisfaction amongst healthcare providers, as highly specialised care is associated with a higher level of satisfaction in work in general \cite{80}. The new process involving the pre-operative scoring system is user friendly and allows staff to access the patient’s information promptly. For the QIP to be implemented, the appointment of a clinical lead is required. This will offer additional staff to the orthopaedic department and provide existing staff with a representative of the Fast Track
programme to liaise with. This ensures any concerns or queries regarding the new recommendations are addressed promptly, therefore, limiting the potential for delays in crucial decision making regarding patient care. The involvement of Physiotherapists and Advance Nurse Practitioners during the Fast Track scheme may help create a more cohesive relationship with allied health professionals. This can lead to a reduction of work load currently experienced in this area, by decreasing the amount of patients in need of a second course of conservative management, whilst offering these professionals a crucial role in the pre-operative care of patients. Moreover, the introduction of Fast Track ensures professionals at every level of patient care, work and communicate together for the greater goal of providing a safe and efficient service.

5.2.3 Stakeholders and hospital practice

Reducing the LOS for patients undergoing ASD and RCR procedures, could positively affect the hospital, as this is an improvement to the service they are providing for patients. Once Fast Track is fully operational there will be an opportunity to address the extensive waiting list in operation. This could be achieved through scheduling a greater number of patient for ASD and/or RCR as their expected LOS will be shorter. It will provide new standards of care for patients by meeting the criteria proposed in the Irish (Slainte) Health Act reported in the Slaintecare report, which indicates that patients should not wait more than twelve weeks for an Inpatient procedure and ten weeks for Day Case[8]. The development of the pre-operative scoring sheet will be the tool to accurately identify those patients suitable for Fast Track ASD or RCR procedures and help identify those patients at
higher risk of complications and in need of a different treatment pathway. The QIP will facilitate the effective use of resources and staff time and provide an efficient and cost effective service to the hospital. By increasing job satisfaction amongst staff, the healthcare service will be composed of highly motivated and focused healthcare providers, positively impacting on patient experience and care.

5.3 Strengths of the project

This QIP harnesses the support of high powered stakeholders, altogether indicating a willingness to make changes for the benefit of patients. This support is further echoed by staff in the orthopaedic department. The amount of the data collected over a twelve months period clearly emphasised the need to reduce LOS for patients undergoing an ASD and/or RCR procedures, given the increase in waiting times currently experienced. This helped to identify where improvements should be made. Another strength of this project lies in the extensive literature review which helped to identify the parameters governing the proposed pre-scoring scoring sheet (See appendices C and D).

The writer was not gainfully employed by the hospital and therefore displayed no bias during the evaluation of the patient flow system in operation and also allowed for an objective view of the problem and recommendations for improvement. The implications of the plan, if successful, could change hospital practice for the better. Fast Track could allow more patients to be treated in a shorter time frame, by creating a Day Case pathway for ASD and RCR procedures. Fast Track programme could be a cost effective method of implementing change, as the literature has largely proven that Fast Track applied in any setting or speciality will always provide
a safe tool for treating patients and simultaneously reducing the healthcare expenditure by shortening the LOS of patients in hospital [72,81]. It is a proven expectation that an early functional recovery is another of the strengths of a Fast Track programme [75,82].

5.4 Limitations

There are a number of reasons why this QIP is limited, firstly the data collected is specific to one orthopaedic department in the project hospital, this could restrict the application of this QIP to another hospital, given the staff, patient’s profile and hospital practice may be different. Secondly, the writer acknowledge that bias may be occur in the role of sponsor, who is an orthopaedic consultant and may benefit from the implementation of this QIP. In addition, the writer of this QIP have a background in orthopaedics and their previous experienced and knowledge may bias their opinion on the problem. Lastly another limitation is the lack of follow up for the implementation of the programme, which may reduce any opportunities for progress to be made in the future.

5.5 Recommendations

To determine the success of this system a survey for healthcare professionals and patients should be created to enquire if improvements were made to patient experience and if professionals associated with project experienced a higher level of satisfaction. It would also be important to begin register the amount of patients using Fast Track and measure this against the conventional pathway in operation at the
times of this QIP. This may help determine how successful the revised patient flow map has been in gaining patient access to the relevant treatment quicker and with a shorter stay in hospital.

5.6 Learning and Quality Improvement

There were many learning benefits that emerged during the designing of this QIP. Given the writer of this QIP have held various positions during his career as a healthcare professional, this was the first QIP to be completed the new role as a PA student. This offered a new opportunity for the writer to experience the healthcare system from a different perspective and undertake the position of identifying a problem area and recommending changes. A role the author may never have experienced without involvement in a QIP. However, the writer also recognise the lectures received during their training programme and advice given by other health workers provided an invaluable insight into addressing the problems facing the orthopaedic department targeted in this QIP. Participating in the design of a QIP also allowed the writer to access and methodically review a comprehensive array of literature to help understand the problem. This in itself reinforced the value of continuous and up to date research for the purpose of improving medical practice and patient care. The writer recognised the importance and usefulness of the range of tools provided under the QI framework in ensuring a rational and systematic process guided the QIP and lead to quantifiable and measurable change.

While progressing through the QIP it became evident to the writer that the problems identified were multifactorial in nature and therefore needed a multidisciplinary approach. Due to the intricate mix of factors linked to the area for improvement it
became paramount for other healthcare professionals to contribute their specialised knowledge and skills. This invaluable input assisted the writer of this QIP in recommending improvements that will positive impact on patient outcome. The importance of communication was essential for this QIP and identified by the author as crucial for maintaining progress, this included communication with key stakeholders and with staff as the QIP progressed. However, there were practices that the writer would be keen to change if repeating the QIP. In the first place, it would have been desirable to liaise earlier with the Enhanced Recovery Nurse of the project hospital, as their expertise would have given extremely relevant information for the initial design of this QI intervention.

Additionally accessing the opinions of the Department of Rehabilitation and Physiotherapy during the early stages of the QIP would have granted a more accurate perspective into the conservative management of patient suffering from SIS and RCT. Both of these professionals would have provided the necessary scientific resources to expand the scope of the literature review and hugely facilitated the design of the pre-operative scoring system.

5.7 Summary and conclusion

It became evident in the literature review that the prevalence of ASD and RCR procedures, not only in Ireland but in other countries around the world, were significantly increasing. The premise of this QIP was to make an impact on the LOS of patients undergoing ASD and/or RCR procedures by introducing a pre-operative scoring system that allows more patients to access treatment through the Fast Track programme. It is expected that staff will experience higher levels of motivation and
morale, due to the systematic and comprehensive approach offered by Fast Track [83], as well as clear guidelines to reduce potential mistakes [84]. Hospital practice is also envisaged to benefit by introducing revised guidelines in the treatment of patients through the utilisation of a cost effective Fast Track programme [85], which simultaneously demonstrates a proactive response to the recommendations made by the Slaintecare report [8]. This QIP gathered extensive data in an effort to identify where effective changes could be made and gained the support of not only the high power stakeholders but also those placed in the lower power category, namely the staff responsible for the implementation of the new Fast Track programme.

Limitations of the QIP were identified, such as the inability to generalise the changes to a different hospital, due to differences in staff, patient profile and hospital practice. Concerns were also raised regarding potential bias from the writer and sponsor, as well as the lack of follow up once the QIP ends, which may hinder future implementation. This was followed by recommendations that included offering a survey for healthcare professionals and patients and also registering the number of patients treated using the Fast Track approach in comparison to the conventional way.

This chapter ended with a brief overview of what the author learnt during the QIP, which ranged from a renewed value for research in the advancement of medical practice and care of patients, followed by recognising the importance of a multidisciplinary contribution to a multifactorial problem and of communication at all professional levels, to ensure the success and sustainability of the proposed improvements.
In conclusion this QIP offers a potential solution to improving LOS after ASD and/or RCR. Alongside the proposed changes for improvement is the creation of a working document, the preoperative scoring sheet, that if successful could be adopted into other orthopaedic departments across Ireland that are experiencing similar LOS concerns. This QIP could subsequently develop into a potential tool to guide future research into patient care. It is the final expression of the writer that the design of this QIP has indisputably developed my skills for analytical appraisal of patient care and procedures in a real time setting. The outcome for the writer is a clearer understanding and appreciation of the processes needed for change to become an improvement. As a writer I am ready to generalise this new knowledge and skills during my future role as a PA.
6.0 References


66. Ilie G, Ciocoiu CN. Application of fishbone diagram to determine the risk of an event with multiple causes. Management research and practice. 2010; 2(1)


70. Khan SM, Malviya A et al. Reduced short-term complications and mortality following Enhanced Recovery primary hip and knee arthroplasty: results from 6,000


81. Starks I, Wainwright TW. Older patients have the most to gain from orthopaedic enhanced recovery programmes. Age and Ageing. 2014; 43(5). doi:10.1093/ageing/afu014.

82. Simha S, Sayeed Z et al. Professional Formation of Physicians Focused on Improving Care. How Do We Get There? The Orthopedic clinics of North America.


APPENDICES

APPENDIX A. American Society of Anesthesiologist Physical Status Score.

<table>
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<tr>
<th>ASA PS Category</th>
<th>Preoperative Health Status</th>
<th>Comments, Examples</th>
</tr>
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<tbody>
<tr>
<td>ASA PS 1</td>
<td>Normal healthy patient</td>
<td>No organic, physiologic, or psychiatric disturbance; excludes the very young and very old; healthy with good exercise tolerance</td>
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<tr>
<td>ASA PS 2</td>
<td>Patients with mild systemic disease</td>
<td>No functional limitations; has a well-controlled disease of one body system; controlled hypertension or diabetes without systemic effects, cigarette smoking without chronic obstructive pulmonary disease (COPD); mild obesity, pregnancy</td>
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<td>ASA PS 3</td>
<td>Patients with severe systemic disease</td>
<td>Some functional limitation; has a controlled disease of more than one body system or one major system; no immediate danger of death; controlled congestive heart failure (CHF), stable angina, old heart attack, poorly controlled hypertension, morbid obesity, chronic renal failure; bronchospastic disease with intermittent symptoms</td>
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<td>ASA PS 4</td>
<td>Patients with severe systemic disease that is a constant threat to life</td>
<td>Has at least one severe disease that is poorly controlled or at end stage; possible risk of death; unstable angina, symptomatic COPD, symptomatic CHF, hepatorenal failure</td>
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<tr>
<td>ASA PS 5</td>
<td>Moribund patients who are not expected to survive without the operation</td>
<td>Not expected to survive &gt; 24 hours without surgery; imminent risk of death; multorgan failure, sepsis syndrome with hemodynamic instability, hypothermia, poorly controlled coagulopathy</td>
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<tr>
<td>ASA PS 6</td>
<td>A declared brain-dead patient who organs are being removed for donor purposes</td>
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*ASA PS classifications from the American Society of Anesthesiologists
# APPENDIX B. DATA

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APPENDIX C. Proposed pre-operative scoring sheet. Front page

**Proposed Pre-operative Scoring Sheet**

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<th>Name:</th>
<th>D.O.B:</th>
<th>Profession:</th>
<th>MRN:</th>
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<table>
<thead>
<tr>
<th>VAS</th>
<th>Constant Score</th>
<th>Oxford Score</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

**ASD Criteria**

1. Shoulder pain with overhead activities [ ]
2. Persistent shoulder pain for more than 6 months [ ]
3. Improvement after 1 week of subacromial steroid injections. [ ]
4. Reoccurring symptoms after a course of physiotherapy [ ]
5. Persistently positive Hawkins test [ ]
6. Radiological changes of impingement of both acromial and humeral regions in the subacromial space [ ]

**RCR Criteria**

1. Persistent shoulder pain for more than 6 months [ ]
2. Reoccurring symptoms after a course of Physiotherapy [ ]
3. Full thickness tear on MRI (tick as appropriate)
   - Yes [ ]
   - No [ ]
   - If answer is Yes, continue to section 3A

3A. Is the tear >2cms (tick as appropriate)
   - Yes [ ]
   - No [ ]

**Past Medical History**

If applicable, please tick for contributory medical conditions:

- COPD: [ ]
- CFF: [ ]
- Steroid Use: [ ]
- Smoker: [ ]
- BMI: [ ]

**Post Operative Checklist (Please tick)**

- Shoulder X-Ray [ ]
- Blood Test [ ]
- Chest X-Ray [ ]
- MRI [ ]

Please Circle as appropriate: ED Referral/GP Referral

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<thead>
<tr>
<th>Date of Procedure</th>
<th>Duration of procedure (in minutes)</th>
<th>Date of Discharge</th>
<th>Complications (specify)</th>
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APPENDIX D. Proposed pre-operative scoring sheet. Back page

Instructions to complete pre-operative scoring sheet

1. Complete pre-operative VAS
2. Complete both pre-operative Oxford and Constant Score for each patient using www.orthopaedicscore.com
3. Register results obtained on patient’s clinical notes.

VAS (0-10)

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<td>Moderate</td>
<td>4-6</td>
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<td>Severe</td>
<td>7-10</td>
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Oxford Scoring System (0-48)

1. How would you describe the worst pain from your shoulder?
   - None
   - Mild
   - Moderate
   - Severe
   - Unbearable

2. How would you describe the pain you usually have with your shoulder?
   - No pain
   - Mild
   - Moderate
   - Severe
   - Unbearable

3. Were you able to use a knife and fork at the same time?
   - Yes
   - Yes, but with difficulty
   - No
   - No, impossible

4. Could you complete household shopping on your own?
   - Yes
   - Yes, but with difficulty
   - No
   - No, impossible

5. Could you do the household shopping on your own?
   - Yes
   - Yes, but with difficulty
   - No
   - No, impossible

6. Could you carry a plate of food across the room?
   - Yes
   - Yes, but with difficulty
   - No
   - No, impossible

7. Could you brush your hair with the affected arm?
   - Yes
   - Yes, but with difficulty
   - No
   - No, impossible

Constant Scoring System (8-100)

1. Pain
   - None
   - Mild
   - Moderate
   - Severe
   - Unbearable

2. Activity Level (Tick all that apply)
   - No Activity
   - Full Recreation/Sport
   - Full Work
   - Unaffected Shoulder
   - Partial

3. Arm Positioning
   - Up to Head
   - Up to Shoulder
   - Up to Head of Thorax
   - Axillary Head

4. Range of Motion
   - Forward Flexion
   - Lateral Elevation
   - Internal Rotation
   - External Rotation

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<td>17</td>
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   - 40 degrees
   - 50 degrees
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   - 70 degrees
   - 80 degrees
   - 90 degrees
   - 100 degrees
   - 110 degrees
   - 120 degrees
   - 130 degrees
   - 140 degrees
   - 150 degrees
   - 160 degrees
   - 170 degrees
   - >180 degrees

6. Internal Rotation
   - 0 degrees
   - 5 degrees
   - 10 degrees
   - 15 degrees
   - 20 degrees
   - 25 degrees
   - 30 degrees
   - 35 degrees
   - 40 degrees
   - 45 degrees
   - 50 degrees
   - 55 degrees
   - 60 degrees
   - 65 degrees
   - 70 degrees
   - 75 degrees
   - 80 degrees
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   - 90 degrees
   - 95 degrees
   - 100 degrees
   - 105 degrees
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   - 115 degrees
   - 120 degrees
   - 125 degrees
   - 130 degrees
   - 135 degrees
   - 140 degrees
   - 145 degrees
   - 150 degrees
   - 155 degrees
   - 160 degrees
   - 165 degrees
   - 170 degrees
   - >180 degrees

7. External Rotation
   - 0 degrees
   - 5 degrees
   - 10 degrees
   - 15 degrees
   - 20 degrees
   - 25 degrees
   - 30 degrees
   - 35 degrees
   - 40 degrees
   - 45 degrees
   - 50 degrees
   - 55 degrees
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   - 150 degrees
   - 155 degrees
   - 160 degrees
   - 165 degrees
   - 170 degrees
   - >180 degrees

8. Internal Rotation
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   - 5 degrees
   - 10 degrees
   - 15 degrees
   - 20 degrees
   - 25 degrees
   - 30 degrees
   - 35 degrees
   - 40 degrees
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   - 155 degrees
   - 160 degrees
   - 165 degrees
   - 170 degrees
   - >180 degrees

9. External Rotation
   - 0 degrees
   - 5 degrees
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   - 15 degrees
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   - 170 degrees
   - >180 degrees
## APPENDIX E. GANTT Chart

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| Issue Monitor                                                                 |
|-----------------------------------------------------------------------------|----------------|
|基本外科                                                                 |
|inner shift                                                                |

| Sponsor                                                                 |
|--------------------------------------------------------------------------|----------------|
|武汉军                                                                |

80