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Improving the Prescription of Antibiotics in Acute Exacerbations of Chronic Obstructive Pulmonary Disease

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CITATION

Sartini-Bhreathnach, Aoife (2018): Improving the Prescription of Antibiotics in Acute Exacerbations of Chronic Obstructive Pulmonary Disease. Royal College of Surgeons in Ireland. Thesis.
<https://doi.org/10.25419/rcsi.10810964.v1>

DOI

[10.25419/rcsi.10810964.v1](https://doi.org/10.25419/rcsi.10810964.v1)

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Improving the prescription of antibiotics in acute exacerbations of Chronic Obstructive Pulmonary Disease

MSc Physician Associate Studies Year 2018

Submitted in part fulfilment of the degree of
MSc in Physician Associate Studies, RCSI.

Student ID: 13127527

Submission Date: 19th September 2018

Word Count: 11,814

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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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Acknowledgement

This dissertation would not have been possible without the help of a number of people.

Firstly, I would like to thank Professor Costello for his guidance and encouragement in completing this project. I would also like to thank my supervisor Dr. Pauline Joyce for her help and advice.

To team INCA, a special thank you to Dr. Breda Cushen for her support. You have gone above and beyond to help, without which this thesis would not have been possible. To Ms. Elaine MacHale, thank you for always believing in me, I would never be where I am today without your advice, guidance, and gentle reminders to slow down.

I would also like to thank all the stakeholders especially Ms. Mary Ann Thi Thai, for helping me with data collection and Ms. Leah Gaughen for her advice and encouragement.

To my family and friends, thank you for your support especially over the past two years. It hasn't always been easy but you never let me give up on myself, especially to my sister Sadhbh for helping me remain positive and to Maeve, without your friendship I can't imagine I would be at this point.

Finally to my QIP girls, we have had such a journey together so far and at the lowest points we always managed to pick each other up.

Abstract

The proposed quality improvement (QI) project aims to improve the prescription of antibiotics in acute exacerbations of COPD. The literature states that there is overprescription of antibiotics in AECOPD. Data was collected to review the management of AECOPD in an emergency department in Dublin. The management of patients admitted with AECOPD, over a set period of time, was reviewed with a detailed focus on the prescription of antibiotics in patients with no infiltrate on chest x-ray. Results from the data collection showed that there was overprescription of antibiotics in this population in accordance to Beaumont AECOPD guidelines. Quality improvement tools such as the fishbone diagram and DMAIC were used to identify the root causes and identify improvement measures that could be put in place. The results of the data collection has led to the development of a QI plan that targets both the healthcare professional and the patient. This QI project aims to improve the prescription of antibiotics in AECOPD.

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CHAPTER 1.0 Introduction

1.1 Introduction

In this chapter, I outline the organisational context for this Quality Improvement Project (QIP). I discuss the rationale for choosing the overprescription of antibiotics in Acute Exacerbations of COPD (AECOPD) as the subject matter for this dissertation, and outline the project aims and objectives. Finally, I summarise the steps I have taken in my role as a physician associate student to carry out this QIP and to develop a plan for improvement.

1.2 Organisational Context

This QIP was conducted in a large urban hospital with a catchment of 290,000 patients, approximately 3,000 staff and 820 inpatient beds. Emergency and acute care services are provided across 54 medical specialties and the hospital is a designated National Cancer Centre. In addition it serves as the Regional Treatment Centre for Ear, Nose and Throat, and Gastroenterology specialities, and it is the National Referral Centre for Neurosurgery and Neurology, Renal Transplantation, and Cochlear Implantation.

1.3 Rationale for Quality Improvement

The proposed QI plan aims to improve antibiotic prescribing in acute exacerbations of chronic obstructive pulmonary disease (AECOPD). Chronic obstructive pulmonary disease (COPD) is a common disease of the airways that results in respiratory symptoms (GOLD, 2018). Exacerbations are common events that result in an increase in symptoms due to an inciting

agent such as a respiratory viral infection, bacterial infection or environmental factors (Leung et al., 2017). This is important as exacerbations are associated with increase patient morbidity, mortality and significant healthcare costs (Qureshi et al., 2014). Ireland has the highest hospital admission rate for AECOPD. Re-admission post hospitalisation for AECOPD is common. The rate in Ireland is above European average at 40% vs. 35% (Crinion et al., 2013).

The recommended management of AECOPD includes administration of bronchodilator therapy, oral steroids and a single oral agent antibiotic where possible however, these recommendations are not always adhered to. In a review of the management of AECOPD at their institution, Butler et al. (2004) found that the management of AECOPDs was often suboptimal. In particular patients were frequently prescribed unnecessary antibiotics and more conservative use of antibiotics were recommended. More recent data from the project site again showed that antibiotics were overprescribed in patients admitted with an AECOPD (Cushen et al., 2017).

Ireland has the highest percentage of patients treated with antibiotics for exacerbations across all European countries (Crinion et al., 2013). The health information and quality authority (HIQA) annual report (HIQA, 2017b) highlighted the importance of best usage of antimicrobial medicine following a national review in public acute hospitals. It suggests that correct antimicrobial use results in reduced resistance, better patient outcomes and reduced treatment cost. Llor and Bjerrum (2014) also discussed the risks

associated with the overuse of antibiotics of which can increase the mortality rate, risk of adverse effects and re-attendance due to infections. Together, this data highlights the need for a QIP in this area.

1.4 Aim & Objectives

The aim of the project is to reduce the overprescribing of antibiotics in patients admitted to the project site with an AECOPD.

The objectives of the project are :

- 1) To quantify the problem by collecting data and creating process flow maps of the patient journey from time of presentation to the emergency department in AECOPD by March 2018
- 2) To identify and meet key stakeholders by April 2018
- 3) To identify the cause of overprescribing of antibiotics by analysing data by May 2018
- 4) To develop a plan for improvement based on the cause of the problem by July 2018

1.5 Role of the student

My role in this QIP was as a second year Physician Associate student. I worked as part of the medical team collecting data for the project and also liaising with appropriate staff members involved in the care of patients with AECOPD. I have no authority to implement the change but I shared the results of my QIP with the medical team and I discussed my proposed implementation plan with them. Firstly, I carried out a literature review to

critically analyse published resources surrounding the QI topic. I identified and met with the key stakeholders to discuss the proposed QI project and to get their support and engagement. I defined the problem by studying the patient journey from time of presentation to the emergency department (ED) to the time of antibiotic prescribing. This helped me to establish which healthcare professionals were involved in clinical decision making. I developed a list of parameters for data collection and reviewed the patient medical records and hospital data systems such as PIPE, BHIS and Mckeeson to collect all relevant data. Using this information I analysed the data and prepared a fishbone diagram. This allowed me to identify possible factors contributing to overprescribing which could be targeted as part of a QIP. The identification of issues contributing to the overprescribing of antibiotics were reviewed, such as; influence of environment, equipment, education and staff. Upon identifying the contributing factors, a plan of improvement was developed.

1.6 Summary

In this chapter I have discussed the rationale for this QI project and I have outlined the project aims and objectives and my role as a student within it. In Chapter 2, I present the results of a literature review. The review focuses on the overprescribing of antibiotics in AECOPD and some initiatives that have been used to improve the management of AECOPD. In Chapter 3, I detail the methodology and QI tools I used for this QI project. Chapter 4, focuses on evaluating the QI project. Chapter 5 comprises of a discussion of the QI plan including the strengths, limitations of the project and potential barriers to implementation.

CHAPTER 2.0 Literature Review

2.1 Introduction

The main focus of this QIP is to improve overprescribing of antibiotics in AECOPD. In order to do this, it was necessary to perform a review of the published literature in this area. In this chapter, I will present a review of the published literature concerning the overprescription of antibiotics in AECOPD. I also include a review of some of the initiatives that have been used to improve the management of AECOPD including the use of management bundles, digital technology and formal education.

2.2 Search Strategy

A search of PubMed, Cochrane library, Scopus databases and of Google Scholar was performed. Search terms included 'management of acute exacerbation of COPD', 'chronic obstructive pulmonary disease', 'AECOPD', 'guidelines', 'antibiotic', 'physician associate or physician assistant' and 'smartphone apps'. A number of papers were yielded by a search of 'management of acute exacerbations of COPD' and 'guidelines for the management of acute exacerbations of COPD' in Scopus and Pubmed. Relevant papers were downloaded and entered into endnote. Further search terms were applied to Google scholar along with the earlier described search terms. The number of studies obtained for the literature review was 45. Further literature were identified through a search of key websites including that of the Health Service Executive (HSE), www.hse.ie and from published national reports such as National Standards for the prevention and control of healthcare-associated infections in acute healthcare services

(HIQA, 2017), SlainteCare report (Houses of the Oireachtas, 2017) and Beaumont annual report (Beaumont Hospital, 2017). A review of recent literature published in the past five years was conducted. The search strategy was then extended to include studies from the previous five years (2008-2013). The only exception was the inclusion of a seminal paper by Butler et al. (2004), of which refers to Irish figures.

2.3 Review of Themes

The literature is organised into four themes:

- 1) Overprescribing of antibiotics in AECOPD
- 2) Management bundles to improve prescribing in AECOPD
- 3) Use of smartphone apps for antibiotic prescribing
- 4) Education to improve prescribing

2.3.1 Overprescribing of antibiotics in AECOPD

There were approximately 15.7 million people with a diagnosis of COPD in the United States in 2013 (Bogart et al., 2018). Exacerbations of COPD can lead to unplanned hospital admissions that account for more than 10% of all acute hospital admissions (Chalder et al., 2016). There are cost implications associated with COPD admissions and the HSE National COPD quality in clinical care programme (HSE, 2012) reported that there were 11,000

AECOPD admissions per year in 2006. The average cost of COPD inpatient care was 6,212 euro per admission amounting to 68,332,000 euro per annum (HSE, 2012). There are four main aetiologies of exacerbation namely bacterial, viral, eosinophilic and inflammatory cause. Bacterial and viral infections are the most common and are responsible for 55% and 30% of AECOPD respectively (Santos et al., 2016). Bacterial infections require antimicrobial intervention. Guidelines for the management of AECOPD recommend the use of oral single agent antibiotics when evidence of bacterial infection is present. In those patients who have evidence of pneumonia on chest x-ray, intravenous (IV) dual antibiotic treatment is recommended (McCarthy et al., 2013).

However, despite the presence of clear guidelines antibiotics are overprescribed in COPD (Santos et al., 2016). Numerous studies have shown that antibiotics are overprescribed with rates ranging from 38-86%. International, European and national data has shown that there is overprescription of antibiotics. An international study by Tang et al. (2014), found that antibiotics were overprescribed at a rate of 45% in AECOPD, while auditing the adherence to GOLD guidelines. European studies have also highlighted the overprescribing of antibiotics in AECOPD. A European COPD audit by Lopez-Campos et al. (2015), audited the adherence to GOLD guidelines and found that antibiotics were overprescribed in 86% of all admissions were only 61.4% met the criteria. Markun et al. (2017) highlighted the overprescribing of antibiotics in AECOPD in another European study. This 24-month retrospective chart review found that there was overprescribing of

antibiotics in 38% of cases and underprescribing in 6% of patients. In this study, of all acute interventions in AECOPD, appropriate prescribing of antibiotics had the lowest rate of correct implementation at 56% in the acute setting of AECOPD. On a National level data has shown that there is overprescribing of antibiotics in AECOPD. Ireland has the highest percentage of patients treated with antibiotics for exacerbations across all European countries (Crinion et al., 2013), with an antimicrobial prescribing rate of 95.4% in AECOPD. A seminal paper by Butler et al. (2004) audited the management of 62 patients admitted with AECOPD in a Dublin hospital. There was overprescribing of antibiotics in 32% of patients with no evidence of pneumonia on chest x-ray. The paper described the current care as suboptimal and that improvements were required in the management of AECOPD in Irish hospitals, identifying that more conservative use of antibiotics should be recommended.

Overprescribing of antibiotics is an important issue that is highlighted in the literature and can create problems. The overprescribing of antibiotics in AECOPD may hinder schemes such as the COPD outreach. This government driven scheme, as described in the national COPD programme, has been developed to provide patient centered care offering early supported discharge options if eligible. Patients prescribed antibiotics by IV route are not eligible for management by COPD outreach (HSE, 2012). Overprescribing of antibiotics therefore may affect this scheme as patients unnecessarily prescribed antibiotics by IV route are not eligible for management by COPD outreach and must remain in the hospital setting. Overprescribing could also affect the

medical directorates goal to reduce the medical LOS, where it was noted that the average LOS per patient is 9.1 days (Beaumont hospital, 2016). The SláinteCare report (Houses of the oireachtas, 2017) outlined that a significant amount of care is provided in the acute setting and where appropriate the patient should be managed at the lowest level of complexity with a focus on integrated care. Reducing the unnecessary prescription of dual or IV antibiotics may provide opportunities for the patient to be managed at the lowest level of complexity. Alongside the effect that overprescribing of antibiotics has on pre-existing hospital schemes, overprescribing can also have a larger effect to the patient by increasing the mortality rate, the risk of adverse effects and re-attendance due to infections (Llor and Bjerrum (2014). The HIQA (2016) report highlighted the importance of best usage of antimicrobial medicines with a national review in public acute hospitals. It stated that correct antimicrobial use results in reduced resistance, better patient outcomes and reduced treatment cost.

While results of studies have found that there is overprescribing of antibiotics and non-adherence to guidelines. Based on the literature review the exact causes for overprescribing are not clear and have not been evaluated. Studies have rather focused on developing initiatives to improve the prescribing of antibiotics in AECOPD. The following three themes outline the initiatives that have been used to improve the management of AECOPD.

2.3.2 Guidelines and care bundles of AECOPD management

There is disparity in the management of patients with AECOPD and adherence to guidelines has been deemed suboptimal (Masoompour et al., 2014). Appropriate prescribing of antibiotics are outlined within guidelines for AECOPD management. Poor adherence to AECOPD guidelines is a factor in overprescribing (Brownridge and Zaidi, 2017).

A pilot feasibility study by McCarthy et al. (2013) in the Irish setting, reviewed the usefulness of a COPD care bundle to improve both the management of AECOPD and patient outcomes. A prospective before and after phase determined whether the appropriate use of the care bundle improves quality of care to the patient. After the implementation of the COPD care bundle and the education of ED staff, the management of 51 patients in ED with AECOPD was reviewed. There was an improvement in the appropriate administration of medications and the timing of interventions such as ABGs, all of which have a positive outcome on patient care. A prospective observational study by Parikh et al. (2016) also reviewed the use of a care bundle in AECOPD and found it led to better outcomes for the patient with reduced LOS and decreased cost. The use of guideline-based care bundles for COPD can allow staff to observe quickly the course of action that should be taken resulting in standardisation of practice in the treatment of patients (Chalder et al. (2016).

A successful implementation strategy was outlined by Kitchlu et al. (2015) to improve the use of AECOPD guidelines. As part of a quality improvement strategy, a 'AECOPD order sheet' was developed. Outcomes of care prior and

post introduction of the new order sheet was measured. There was an improvement to guideline adherence with the introduction of the new order sheet with improvements in appropriate antibiotic prescribing (37.5% to 69.3%) and reduction in LOS from 7.7 to 5.0 days.

The introduction of prescribing guidelines on smartphone apps is another method that can be implemented to improve the prescribing of antibiotics (Haffey et al., 2013).

2.3.3 Use of smartphone apps for antibiotic prescribing

Apple's introduction of the new "Apps for Healthcare Professionals" section in the iTunes App store in 2011 demonstrated the demand of Smartphone apps for medical knowledge among healthcare professionals (Ventola, 2014). New initiatives such as pocket guidelines and electronic prescribing tools are developed to provide prescribers with local policy and guideline tools that have been shown to improve antimicrobial prescribing (Charani et al., 2013).

Findings of studies suggest that the use of smartphone apps can be a useful tool to aid in antibiotic prescribing. A prospective pre-post study was conducted by Fralick et al. (2017) to determine if a smartphone app can improve knowledge of antibiotics in medical trainees. The study design consisted of 2 groups. At week one both groups completed a survey to determine their antibiotic knowledge. The control group was provided with the antibiotic smartphone app for four weeks. The results of a second survey completed by both groups found that the control group had a greater use of hospital specific antibiotic guidelines and improvement of knowledge. This study shows that smartphone apps can be used as an additional educational

resource to improve knowledge of antibiotic prescribing. Panesar et al. (2016) also found that the introduction of a smartphone app for antibiotic prescribing was well received by users. The results of a questionnaire distributed to app users showed that the smartphone app was used more frequently than the previous pocket guidelines and it encouraged physicians to address inappropriate prescribing with their colleagues.

Mehrotra and Linder (2016) discussed strategies to encourage the prescribing of fewer antibiotics. The invited commentary discussed the use of smartphone apps and the introduction of order sheets to reduce overprescribing of antibiotics. Smartphone apps were recommended for patient use to self-triage aiding in the management of their condition, reducing the overprescribing of antibiotics. Order entry systems, in paper and electronic form, were also recommended to reduce overprescribing. These order entry systems require the physician to document why they prescribed the antibiotic and this behavioural science strategy has been recommended to reduce overprescribing of antibiotics. Smartphone apps for antibiotic prescribing have also proven to be a successful educational aid for undergraduates. A study by Nori et al. (2017) used five educational strategies to improve antibiotic prescribing and infection prevention. The use of the smartphone app for antibiotic prescribing was integrated into the learning modules for undergraduates. Paper antibiotic pocket cards were employed for use by postgraduate learners. This study showed that there are diverse ways to promote the prescribing of antibiotics and amongst other strategies the use of

smartphone apps and paper documents had positive feedback and were found to be useful for reviewing the prescribing of antibiotics.

The results of an 'app use' survey of the RCSI antimicrobial app as an antimicrobial prescribing aid was discussed in the joint antimicrobial stewardship committee annual report (RCSI, 2015). The survey found that 70% of participants surveyed had downloaded the app of which 90% were NCHD's. The survey results depicted positive feedback regarding the ease of use of the app, time saved and that the app influenced prescribing. Based on the results of the survey the antimicrobial app has had positive feedback, is widely used and can be utilised as an aid for antimicrobial prescribing. However, it has been highlighted that there is still overprescribing of antibiotics in AECOPD at site in which this app is in use (Cushen et al., 2017).

2.3.4 Education for healthcare professionals to improve antibiotic prescribing

Increasing education for non-respiratory healthcare professionals is a potential area for improvement of antibiotic prescribing in AECOPD. Pothirat et al. (2015) conducted a prospective comparative observational study to review the possible correlation of adherence to AECOPD guidelines and the corresponding team caring for the patient. The team focused on comparing pulmonologist care to internalists care and the result represented that pulmonologists adhered more closely to guidelines where the frequencies of AECOPD were lower in this group. Similarly a national study by Migone et al.

(2015), found that patients admitted with AECOPD who received care by a respiratory physician or respiratory CNS overall received more guideline based interventions. On an international level a study by Tang et al. (2014) also concluded that respiratory teams had better adherence to guidelines for AECOPD management when compared to other health care teams. This study also suggested initiatives to improve adherence to guidelines. The recommendations included; targeted education sessions, promotion of hospital clinical champions and improved communication between primary care and hospital practitioners. Providing easy access to guidelines at point of care and resources for staff training are factors that can increase adherence COPD guidelines (Sonstein et al., 2014).

2.4 Implications of the Project

It is clear from the literature that overprescribing of antibiotics in AECOPD is both a national and international issue. The appropriate prescribing of antibiotics is a complex process and involves a combination of correct knowledge, behaviours and an understanding of the patients concerns (Wong et al., 2015).

The literature review highlighted that there is overprescribing of antibiotics in AECOPD. There are many factors that may contribute to overprescribing. Based on the literature review the exact causes for overprescribing are not clear where studies have focused on developing initiatives to improve the prescribing of antibiotics in AECOPD. There are many initiatives that have been tried and tested to improve antibiotic prescribing. The introduction of a

smartphone app for antimicrobial prescribing has already been implemented at the project site to date and recent data has found that overprescribing of antibiotics in AECOPD remains a problem. The literature highlights additional strategies to improve antibiotic prescribing such as the introduction of 'order sheets', behavioural strategies and increasing education for non-respiratory healthcare professionals. This QI project will focus on why antibiotics are overprescribed and devise a QI plan to promote improved antimicrobial prescribing.

2.5 Summary

The literature reviewed four main themes; the overprescribing of antibiotics in AECOPD, management guidelines for antibiotic prescribing in AECOPD, use of smartphone apps for antibiotic prescribing and increasing education for healthcare professionals to improve antibiotic prescribing. The literature review highlighted that there is overprescribing of antibiotics in AECOPD with Ireland having the highest percentage of patients treated with antibiotics for exacerbations across all European countries. The exact causes for overprescribing are not clear where studies have focused on developing initiatives to improve the prescribing of antibiotics in AECOPD. Recommended initiatives include the promotion of AECOPD antimicrobial guidelines through both digital technology and in paper form and increased education for non-respiratory staff through targeted education sessions and promotion of hospital clinical champions.

CHAPTER 3.0: Methodology

3.1 Introduction

In this chapter I review recommended QI models, focusing in particular on the DMAIC model, which was used for this QIP. I discuss my rationale for choosing to use the DMAIC model and I will explain its applicability to the project. I outline the data collected for the QI project and present the results of the data analysis. Finally, I discuss my proposed plan to reduce the overprescription of antibiotics in AECOPD.

3.2 Approaches to Quality Improvement

There are a number of Quality improvement (QI) models available for identifying and analysing QI projects. I will describe two such models; the Lean Six Sigma DMAIC model and the Institute for Healthcare Improvement (IHI) model for improvement, Plan-Do-Study-Act (PDSA).

3.2.1 Lean Six Sigma Quality improvement Tools

Both Lean and Six Sigma are tools for QI improvement. Lean aims to eliminate waste and increase value for the patient through the reduction of cost with the optimisation of processes (Byrne et al., 2007). Lean uses a set of methods and concepts to reduce waste and encourage maximum value for the patient. The Lean concept emphasised the involvement of employed staff, considering the patients needs and promoting continuous improvement (Lawal et al., 2014). In healthcare, Lean has been helpful in eliminating waste and non-added value to the patient's journey thus improving their flow through various services. Six Sigma aims to improve quality while meeting both the patient requirements and the expectations of stakeholders. This process identifies initiatives for improvement and looks at key processes across an

entire system. The Six Sigma approach has been used successfully in healthcare organisations to improve performance both financially and operationally, with impact on clinical areas such as infection control, medication delivery and administration (Sehwail and DeYong, 2003).

Lean Six Sigma combines the principles of the Lean and Six Sigma tools using an approach called 'DMAIC'. DMAIC is a structured framework tool for quality improvement, seen in figure 1. DMAIC involves 5 phases: Define, Measure, Analyse, Improve and Control (goleansixsigma, 2018). DMAIC phases are interconnected with each phase leading into the next. Identifying a project and prioritizing the aim of the project is established in the define phase. In the measure phase, the problem is quantified through the collection of data on the existing system. Analysis of this data (analyse phase) provides an objective review of the existing system and explores the potential cause of the problem identifying ways in which the desired goal could be reached. Methods of improvement and a plan for implementation of the improvement plan are set out in the improve phase. Finally, in the control phase procedures are set in place to maintain the improvement and to reduce the re-occurrence of previous unsuccessful processes (Southard et al., 2012)

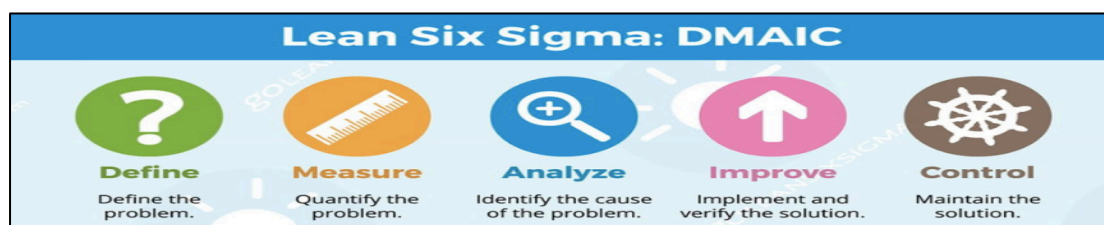


Figure 1: Lean Six Sigma DMAIC Model

3.2.2 IHI Model for improvement PDSA

The IHI Plan-Do-Study-Act (PDSA) model for Quality Improvement is an additional tool that is used to drive improvements in healthcare. The PDSA cycle is a four-stage model of improvement that was developed by Walter Shewhart and Edward Deming, Figure 2 (isixsigma, 2018). In the 'Plan' stage the change that is to be implemented is identified. The change is implemented and tested in the 'Do' phase. In the 'Study' phase, the success of the change is assessed. Finally, the 'Act' phase identifies any changes to the initial QIP that may be required moving forward.

The PDSA cycle encourages the use of small-scale approaches to test a new initiative for change and allows the quick assessment of this initiative. This approach minimises risk to all parties involved in the QIP including the patient and the organisation by starting with small scale tests that build upon the stakeholders confidence as the project increases (Taylor et al., 2014).



Figure 2: PDSA cycle

3.3 Rationale for Model Selected

I chose to use the DMAIC model for this QIP as it allowed me to identify the issues contributing to the overprescription of antibiotics in AECOPD and it helped me to identify areas of improvement.

3.4 Model Overview

As previously outlined, the DMAIC model for Quality Improvement includes five phases: Define, Measure, Analyse, Improve, and Control. Table 1 outlines the tools used to complete each phase of the DMAIC model.

DEFINE	MEASURE	ANALYSE	IMPROVE	CONTROL
Stakeholder analysis	Run charts	Fishbone diagram	Proposal of intervention	Evaluation of intervention
Process flow maps	100% Bar charts			

Table 1: Outline of DMAIC tools used in the QI project

3.4.1 Define

The define phase of the DMAIC model is a crucial step in the improvement process where the focus of the project is defined by developing both a problem statement and a goal statement. This QI project focused on the overprescription of antibiotics in AECOPD in a public hospital in North County

Dublin. The problem statement is 'The overprescription of antibiotics in AECOPD'. The goal statement, which is a reflection of the problem statement, is 'Improve prescription of antibiotics in AECOPD'. An important step included in the Define phase is to assign a project sponsor. The project sponsor for this QIP is a respiratory consultant with a keen interest in the area of improving quality of care for COPD patients. The sponsor assumed a leadership role in the project by spending time working on the issue and encouraging the progression and implementation of the project plan. Following consultation with the project sponsor, those involved directly in the clinical care of the patient (e.g. Emergency Department (ED) and medical staff, pharmacy and microbiology staff) a process map of the patient's journey from arrival to the ED through to the decision to admit with an exacerbation of COPD was created. This helped to identify the areas of clinical decision-making and the potential factors contributing to the problem of over-prescribing in this population, which could be targeted in a quality improvement plan.

3.4.1.2 Stakeholder analysis

An early process of any QIP is to carry out a stakeholder analysis. Stakeholder analysis is a process in which the project lead identifies and engages people involved in the management of the patient, who may influence the success of the QIP. Engaging the relevant stakeholders early reduces the possibility of encountering delays and conflicts.

With the help of the project sponsor a list of potential stakeholders was generated. Stakeholders were categorised in one of 4 groups based on the individual's level of power and interest in regards to the QI project;

- 1.High power and low interest
- 2.High power and high interest
- 3.Low power and low interest
- 4.Low power and high interest

Figure 3, details the stakeholder analysis for this QI project. A number of health care professionals and administrative staff were identified as important stakeholders. The respiratory and microbiology consultants were deemed to have the highest power and the highest level of interest. Individuals involved in the initial management of the patient with AECOPD and directly involved in clinical decision making were identified. These individuals have high power and low interest. It is important to increase their interest as the project cannot be a success without them. There were a number of individuals categorized into the low power/ high interest. Examples of this include the patient; they have high interest as the project relates to their health but they have little power to change the outcome. A focus was not placed on the low power/ low interest group as they won't influence the project outcome. Concerns from all individuals were addressed to establish a good relationship and create cooperation to progress with the QIP.

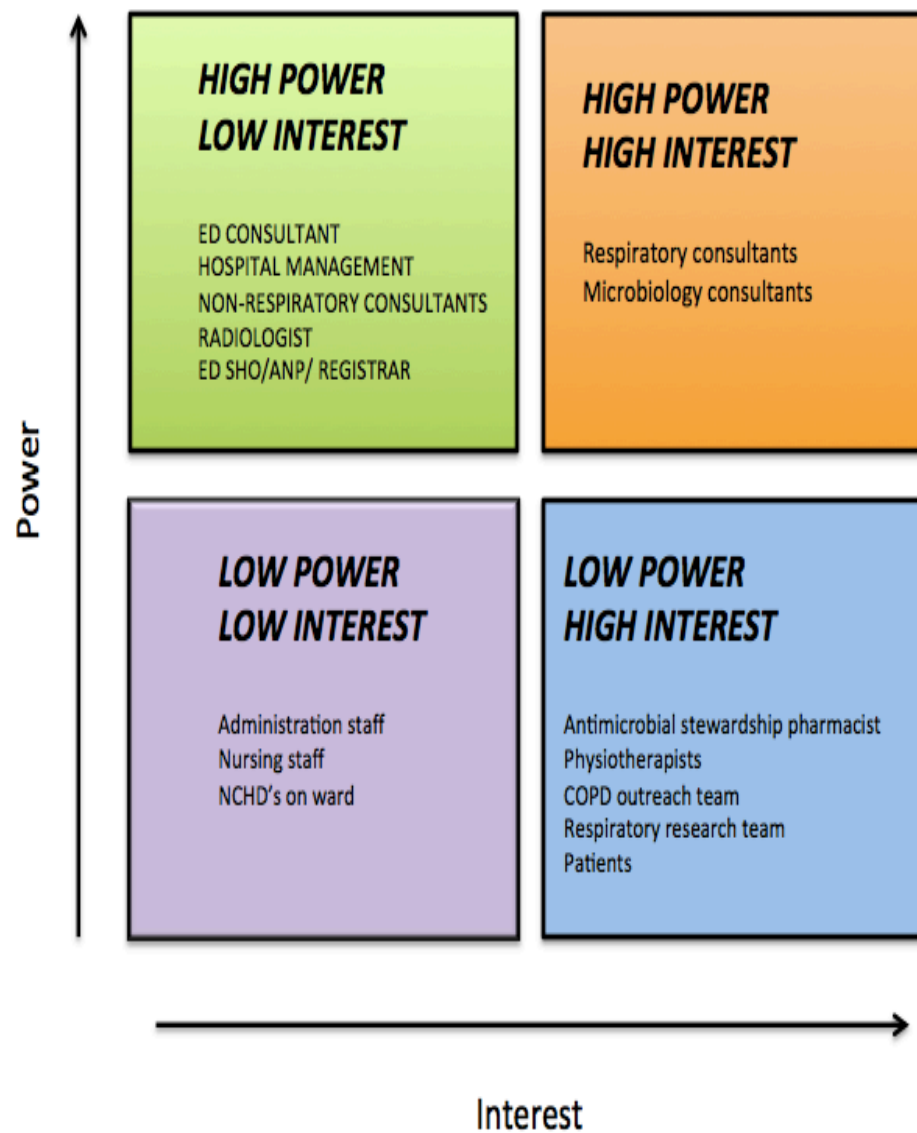


Figure 3: Stakeholder analysis

3.4.1.2 Process flow map

A process flow map was designed to look at the patient's journey through ED. It helped to visualise the process leading to antibiotic prescribing in AECOPD and established the points in which clinical decisions were made. This allowed me to identify who was involved in the patients care, which data parameters should be collected and the focus of a QI plan to improve the prescribing of antibiotics in AECOPD. Figure 4, displays a process map of the ideal flow of a patient through ED from time of presentation with an AECOPD to time of clinical decision making regarding administration of antibiotics. At the project site it is recommended that antibiotics should be administered based on chest x-ray results. If new infiltrates are present on chest x-ray then the patient should be treated for severe community acquired pneumonia (CAP). If new infiltrates are not present on chest x-ray then the patient should be treated with oral single antibiotics; of which there is a choice of three antibiotics.

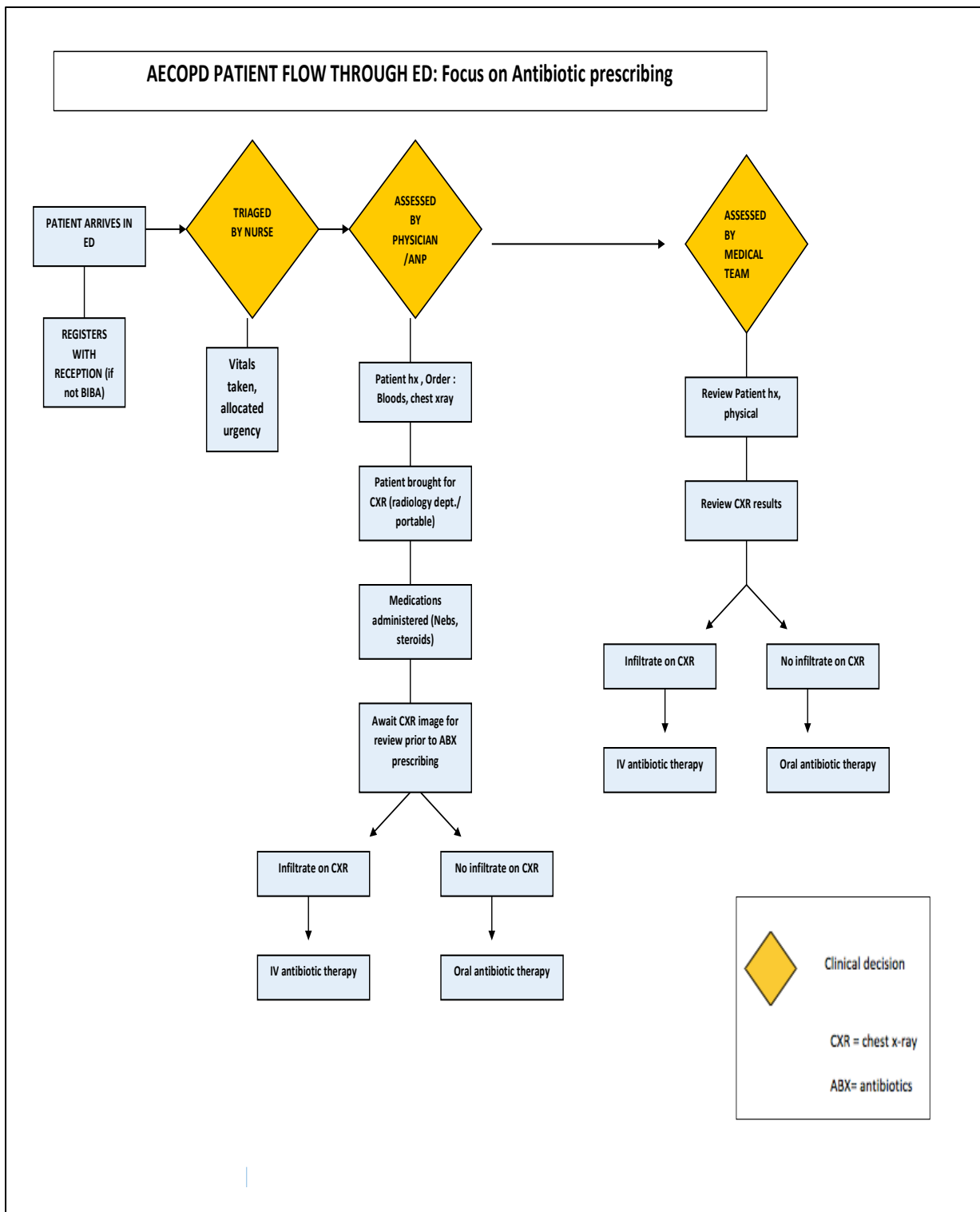


Figure 4: Process flow map: Ideal flow through ED

The process flow map, figure 5, outlines the actual flow of patient's from presentation with AECOPD to clinical decision making. This process map was developed based on a review of the ED and medical notes of patients that were admitted to hospital with an AECOPD from Jan-July 2017. It highlighted the healthcare professionals involved in the patients journey through ED, the process of antibiotic prescribing in AECOPD and was used to help identify data parameters that should be collected for the QI project.

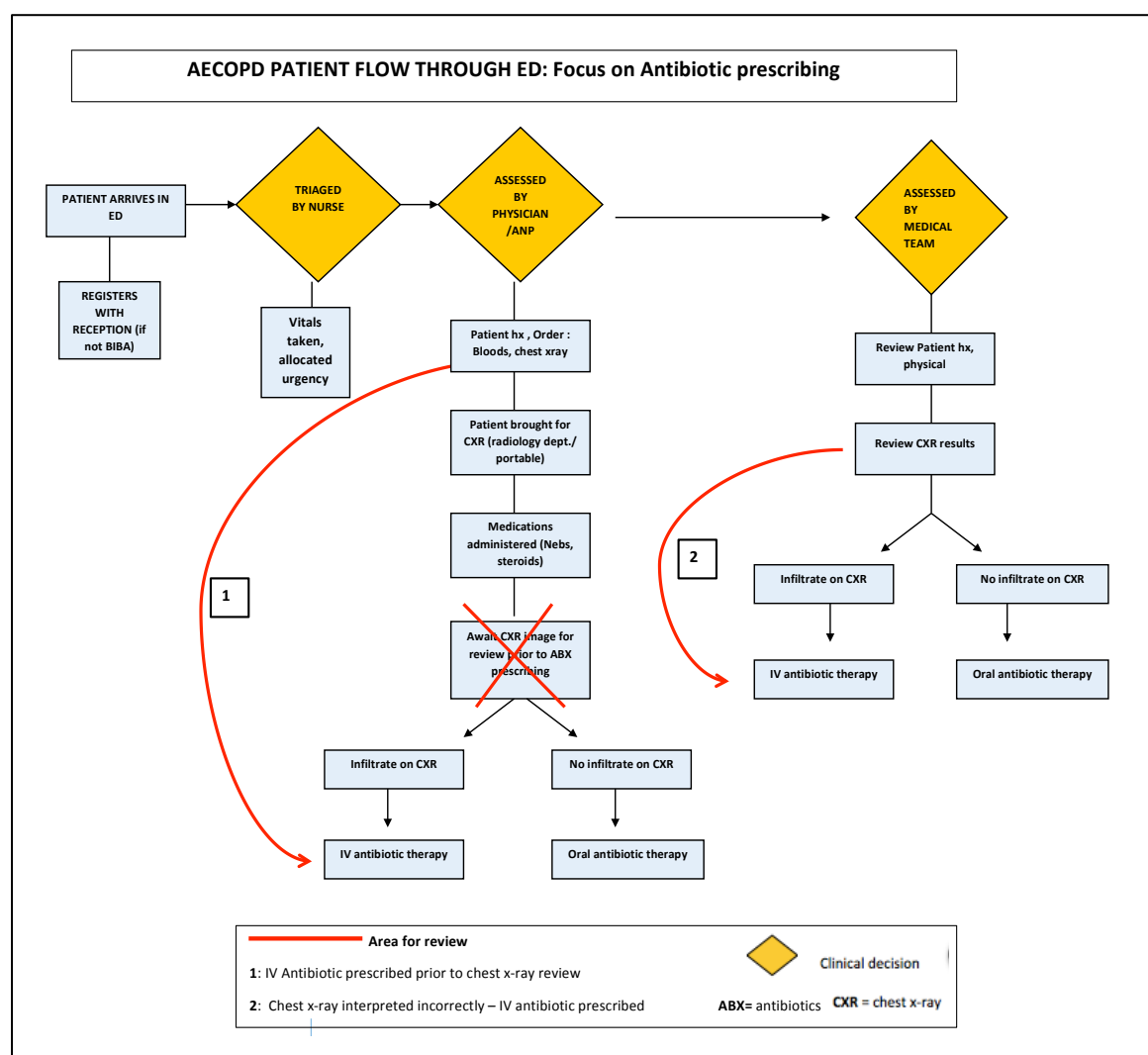


Figure 5: Process flow map: An example of patient flow through ED

3.4.2 Measure

Data collection overview:

Having identified the steps taken to reach the decision to prescribe antibiotics in my process flow map and following discussion with the project sponsor and the respiratory research team, I identified which data was required for the proposed QI project. Data was collected on patients that were admitted to the hospital following ED presentation with an acute exacerbation of COPD, between January and July 2017. I initially collected data on all patients admitted with an AECOPD. However, following review of the literature I chose to focus on patients who had no evidence of pneumonia on their admission chest X-ray as the overprescription of antibiotics is most prevalent in this cohort (Butler et al. (2004). As per the hospital's clinical and microbiological guidelines, these patients should receive treatment with an oral single antibiotic only.

At the project site it is recommended that antibiotics should be administered based on chest x-ray results. If new infiltrates are present on chest x-ray then the patient should be treated for severe community acquired pneumonia (CAP). If new infiltrates are not present on chest x-ray then the patient should be treated with oral single antibiotics; of which there is a choice of three antibiotics. This QI project focused on patients admitted with an AECOPD with an official reporting of 'no infiltrate' on chest x-ray. At the project site recommendations on the prescribing of antibiotics for AECOPD can be found on both the Beaumont antimicrobial guideline's, Appendix 1, (available in app

and on the hospital intranet) and on the Beaumont medical app, Appendix 2, under COPD acute management pathway. Both guidelines recommend the same antibiotics (dose and route of administration) based on chest x-ray result. According to the hospitals guidelines, outlined above, patients with no infiltrate on chest x-ray should be treated with single oral antibiotics, unless overt clinical symptoms are evident. They should not be initially management with intravenous (IV) or dual antibiotic therapy.

To review the prescribing of antibiotics in AECOPD, various data points were collected. Table 2, provides an outline of the data parameters collected. Collected data included the antibiotics prescribed, the route of administration and the clinical decisions associated with prescribing of antibiotics in ED. All data was collected using a combination of hospital electronic data applications such as Patient Information Profile Explorer (PIPE) and the patient's medical chart .The data application McKesson was used to collect all data relating to the chest x-ray. This included chest x-ray order time; arrive time, film time, time of official report and the result of the chest-ray (infiltrate or no infiltrate).

Data parameters:

Data collected
<ul style="list-style-type: none">❖ Admission time❖ Time of first review by ED physician❖ Oxygen saturations on arrival to ED❖ Temperature❖ Chest X-Ray (CXR) order time❖ CXR arrival time❖ CXR filmed and signed time❖ Official radiologist CXR report (infiltrate/no infiltrate)❖ Documentation of CXR interpretation by 1st ED physician/Advanced Nurse Practitioner (ANP) and admitting medical teams within the medical record❖ All bloods relevant to this admission (CRP, WCC, blood cultures)❖ Antibiotics pre-admission❖ Name of recent antibiotic❖ Date 1st Antibiotic prescribed❖ Time 1st Antibiotic prescribed❖ Indication kardex❖ Single or dual antibiotics❖ Name of antibiotic❖ Dose of antibiotic❖ Route of administration❖ Antibiotic completion date❖ Date change to oral❖ Change in dose❖ New dose❖ Date of new dose❖ Data for 2nd Antibiotic prescribed❖ Antibiotic prescribed on discharge

Table 2: Data collected for QI project

Data charts:

In total the charts of 55 patients admitted with an AECOPD were reviewed for the QIP, Figure 6. Following review of the radiologist's CXR report, 16 patients were excluded, leaving data on 39 patients admitted with AECOPD with 'no infiltrate' on CXR for analysis. There was missing antibiotic data for 4 of the 39 patients.

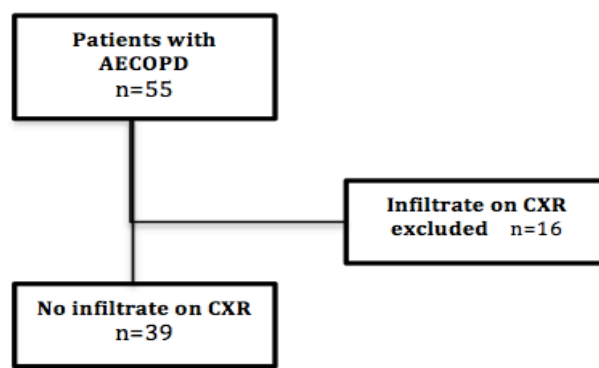


Figure 6: Patient cohort for QI project

Antibiotics prescribed for AECOPD

According to prescribing guidelines at the project site, prescription of oral single antibiotics are recommended in this patient group unless the patient displays overt systemic features of sepsis which include a combination of raised temp >38.2, raised c-reactive protein (CRP) and rigors. The recommended oral antibiotics are clarithromycin 500mg, doxycycline 200mg, or amoxicillin 500mg. Of the 35 patients studied, 100% were treated with antibiotics. The antibiotics prescribed and the method of administration are shown in Figure 7.

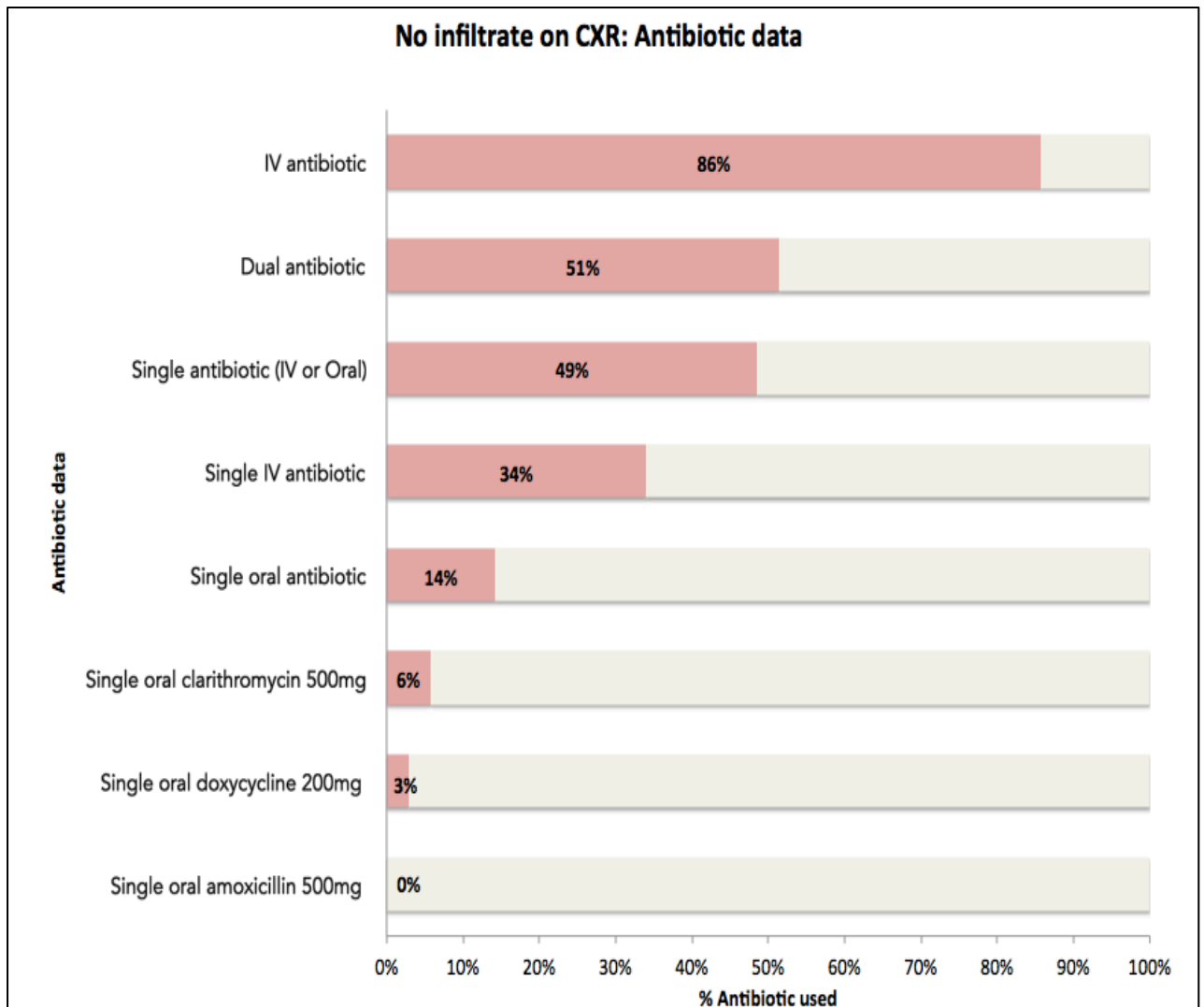


Figure 7: Antibiotic data for patients with no infiltrate on chest x-ray

The majority of patients, 86%, were treated with intravenous (IV) antibiotics in ED. The decision to prescribe antibiotics by IV and not oral route is not in accordance with the recommended treatment guidelines for this cohort of patients. Dual antibiotic therapy was prescribed in 51% of cases. I further evaluated the patient group to determine if there were any overt systemic features that may have led to the prescribing of dual antibiotics. Overt features are measured based on a raised CRP blood result and a raised temperature >38.2 . It was found that only one patient had both a raised CRP and temperature and could be considered for dual antibiotic therapy (Table 3).

Single antibiotic therapy was prescribed for 49% of patients. Of these patients only 14% were prescribed a single oral antibiotic and 9% were prescribed one of the recommended agents. The other 5% were prescribed an antibiotic that was not recommended according to the hospital antimicrobial guidelines. This data from the QI project has highlighted that there is overprescribing of antibiotics in patients admitted to ED with AECOPD and there is non-compliance to the recommended prescribing guidelines.

Overt systemic features	Number of Patients (n=35)
Temp >38.2	1
Raised CRP	26

Table 3: Overt systemic features

Interpretation of chest x-ray:

The data presented confirms that there is overprescribing of antibiotics in this cohort of patients admitted with AECOPD. In order to understand why this is happening, I looked at the ordering and interpreting of chest x-rays in ED to determine if chest x-ray interpretation had an impact on the prescribing of antibiotics. I focused on presenting three sets of data; Chest x-ray interpretation by ED, Chest x-ray interpretation by Medics and Time to Chest x-ray. Antimicrobial guidelines at the project site recommend that antibiotics are prescribed following the interpretation of the chest x-ray in AECOPD. Chest x-ray is essential to confirm or outrule pneumonia. The ordering and interpretation of chest x-rays is an important clinical decision that should guide the prescribing of antibiotics. The interpretation of the chest x-ray by ED is

presented in Figure 8. The bar chart represents results of the interpretation of the chest x-ray of which include; the correct interpretation of chest x-ray (no infiltrate), the inaccurate interpretation (infiltrate or query consolidation) or no comment made on chest x-ray results. There was no comment on 56% of the chest x-rays, 21% were interpreted as query consolidation or consolidation/infiltrate and only 23% were correctly interpreted as no infiltrate on chest x-ray. This is significant as the data collected found that the first ED physician/ANP prescribed 43% of the first antibiotics in ED. This group could be targeted to improve the prescribing of antibiotics in AECOPD by encouraging the interpretation of the chest x-ray prior to prescribing of antibiotics or by providing education on chest x-ray interpretation to reduce the number of incorrect interpretations.

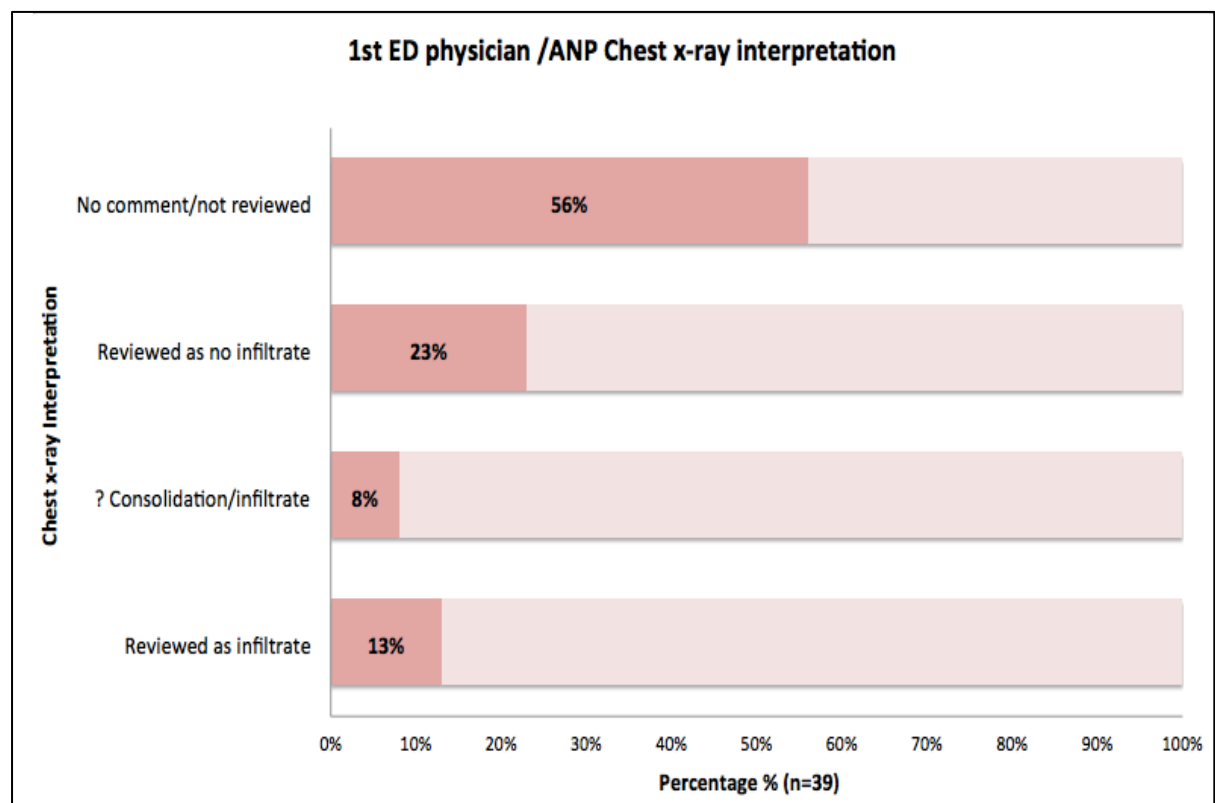


Figure 8: ED interpretation of chest x-ray

Data on the interpretation of the chest x-ray by the admitting medical team is shown in Figure 9. This data was collected as the admitting medical team also have an influence on the prescribing of antibiotics in ED as they should review the chest x-ray. The admitting medical assessment document displayed that a correct interpretation of 'no infiltrate' on the chest x-ray was documented by 62% of the admitting medical team. The remaining 38% either had no comment or inaccurately interpreted the chest x-ray; where official reports displayed there was no infiltrate on chest x-ray.

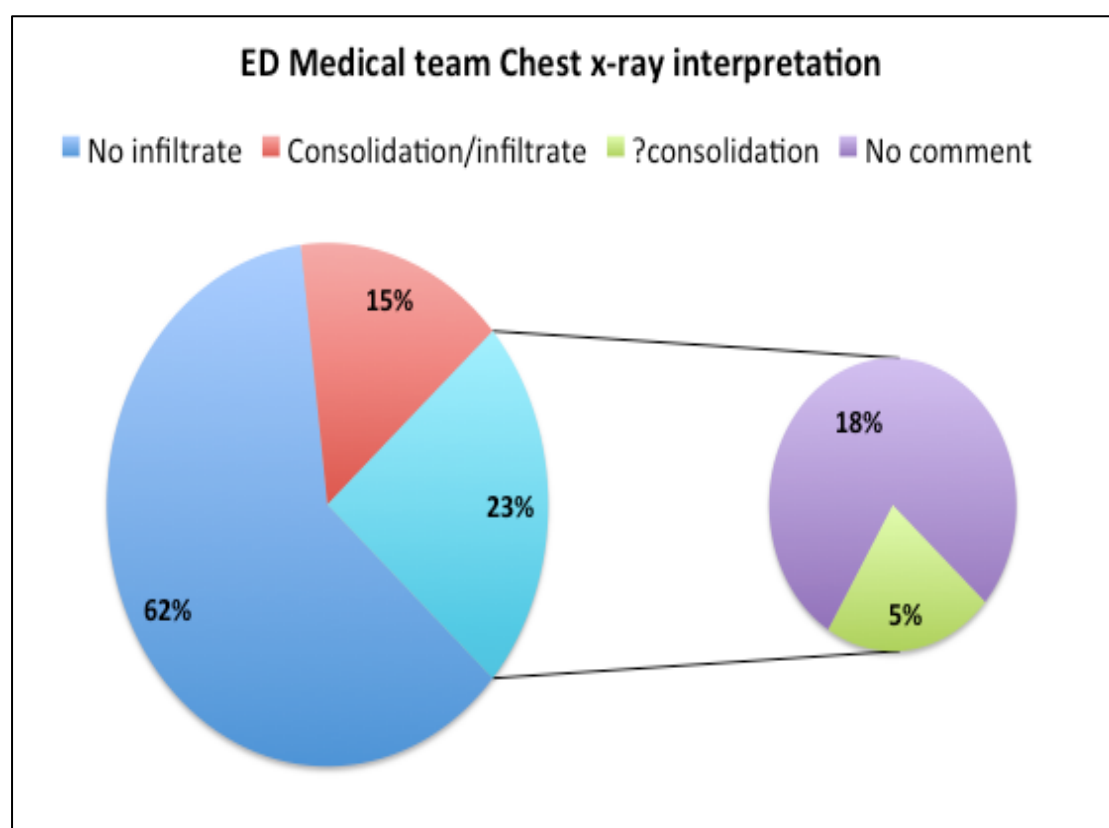


Figure 9: ED admitting medical team chest x-ray interpretation

Finally, figure 10 outlines the length of time it takes for the chest x-ray to be officially reported by the radiologist. This graph was developed to emphasise the length of time it can take for the chest x-ray to be officially reported, ranging from 20 minutes to 23 hours. Due to the possible extended wait time for official reporting, the ED physicians must be equipped to correctly interpret the chest x-ray prior to proceeding with the prescribing of antibiotics.

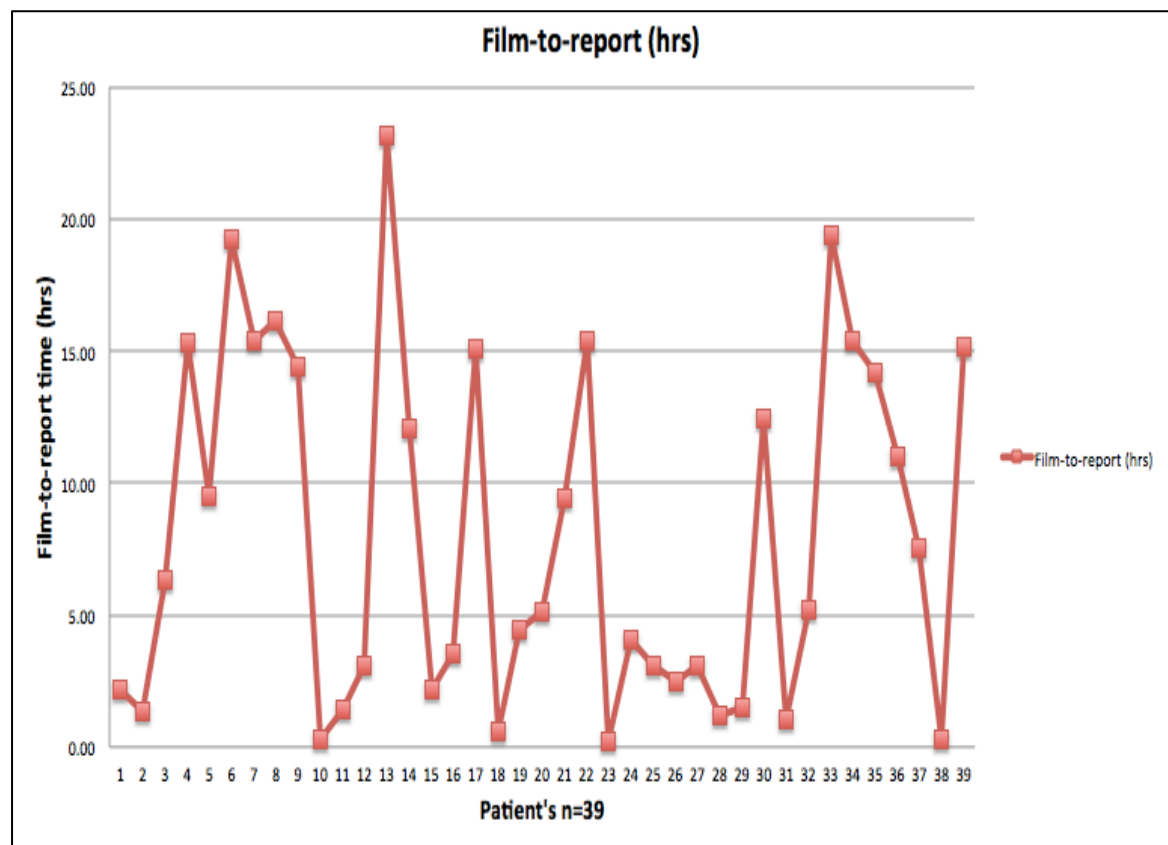


Figure 10: Time from chest x-ray film to official report

Awareness of AECOPD antibiotic prescribing guidelines:

At the project site there are currently two smartphone apps available providing antimicrobial prescribing guidelines for AECOPD. The 'Beaumont clinical app', provides a COPD acute management pathway that includes the recommended antimicrobial prescribing guidelines. This guideline was compiled by the respiratory department in 2016. The second app, RCSI antimicrobial app, was launched in 2014 and developed by the RCSI hospital group. The antimicrobial app provides access to specific antimicrobial prescribing guidelines for 6 RCSI group hospitals. The app provides access to evidence based antimicrobial guidelines, empiric treatment, dose information and dose calculators (RCSI, 2018). Both apps have the same guidelines for antimicrobial prescribing in AECOPD.

Through informal verbal discussions with ED staff it seemed that healthcare professionals in ED are aware of the availability of prescribing guidelines for AECOPD on the Beaumont antimicrobial prescribing app. The results of an 'app use' survey of the RCSI antimicrobial app as an antimicrobial prescribing aid was discussed in the RCSI joint antimicrobial stewardship committee report (RCSI, 2015). Based on the results of the survey the antimicrobial app has had positive feedback, is widely used and can be used as an aid for antimicrobial prescribing. There was less knowledge and use of the COPD acute management pathway, available on the Beaumont clinical app. Both guidelines provide the same antibiotic prescription recommendations in AECOPD. It was discussed that other management guidelines, dyspnoea or sepsis guidelines, have also been referred to when managing AECOPD in ED.

3.4.3 Analyse

The data collected for the QI project aimed to quantify the problem and identify potential issues's contributing to the overprescribing of antibiotics in AECOPD. Results from the data collected demonstrate that there is overprescribing of antibiotics in AECOPD. Whilst reviewing potential causes contributing to the overprescribing of antibiotics, the data also highlighted that the misinterpretation of chest x-ray and the prescription of antibiotics prior to chest x-ray interpretation may be factors in overprescribing. Based on informal conversations there is an awareness of the AECOPD antimicrobial app for the prescribing of antibiotics in AECOPD. There was less awareness of the COPD acute management pathway that is available on the Beaumont clinical app. Both app's recommend the same antibiotic prescribing guidelines for AECOPD. A fishbone diagram was developed to further identify causes associated with the overprescribing of antibiotics in AECOPD.

3.4.3.1 Fishbone diagram

The fishbone diagram may also be referred to as the Ishikawa diagram (Gartlehner et al., 2017). It is a useful QI tool to identify possible causes for a problem and it can aid in sorting contributing factors into specific categories. The fishbone diagram for this QI project, as seen in fig 11, divided possible problems into one of four categories of which include; people, environment, methods or materials. This was a helpful process, acknowledging areas for improvement identified from the data collected.

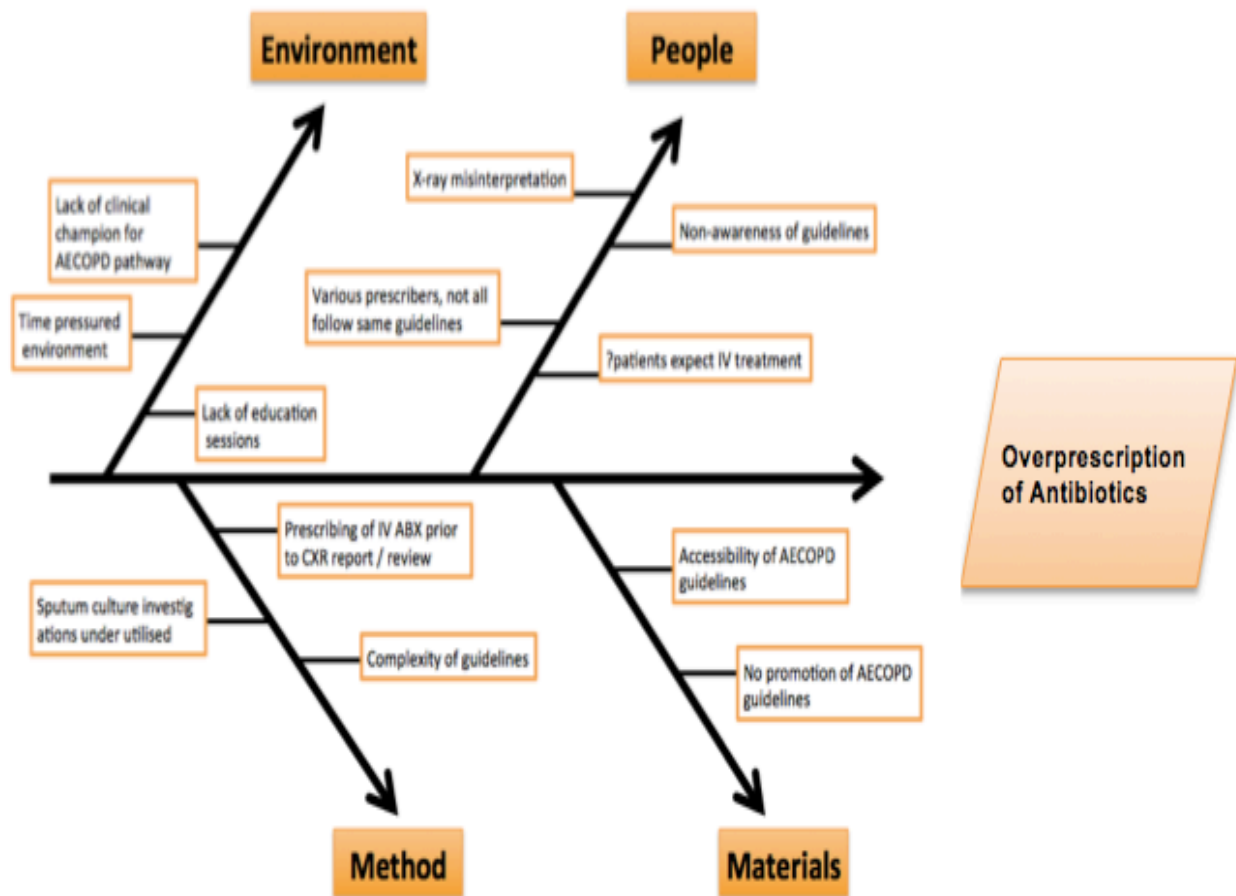


Figure 11: Fishbone diagram

3.4.4 Improve

Evidence from the literature review and from the data analysis highlighted that there is overprescription of antibiotics in AECOPD. The literature was reviewed to identify factors contributing to the problem and initiatives that could be implemented to improve the prescribing of antibiotics in AECOPD. Meetings and discussions were held with the project sponsor, respiratory research registrar, antimicrobial stewardship pharmacist, physiotherapists and ED staff. The results from the literature review and data collection were discussed to help guide the direction the QI project could take and a strategy was put in place. To improve the prescribing of antibiotics it was determined that it would be best to utilise a variety of methods. Areas to be targeted are displayed on the process map in Figure 12. These aim to target both the healthcare professionals and the patient and in doing so improve the clinical decisions, and reduce overprescribing of antibiotics.

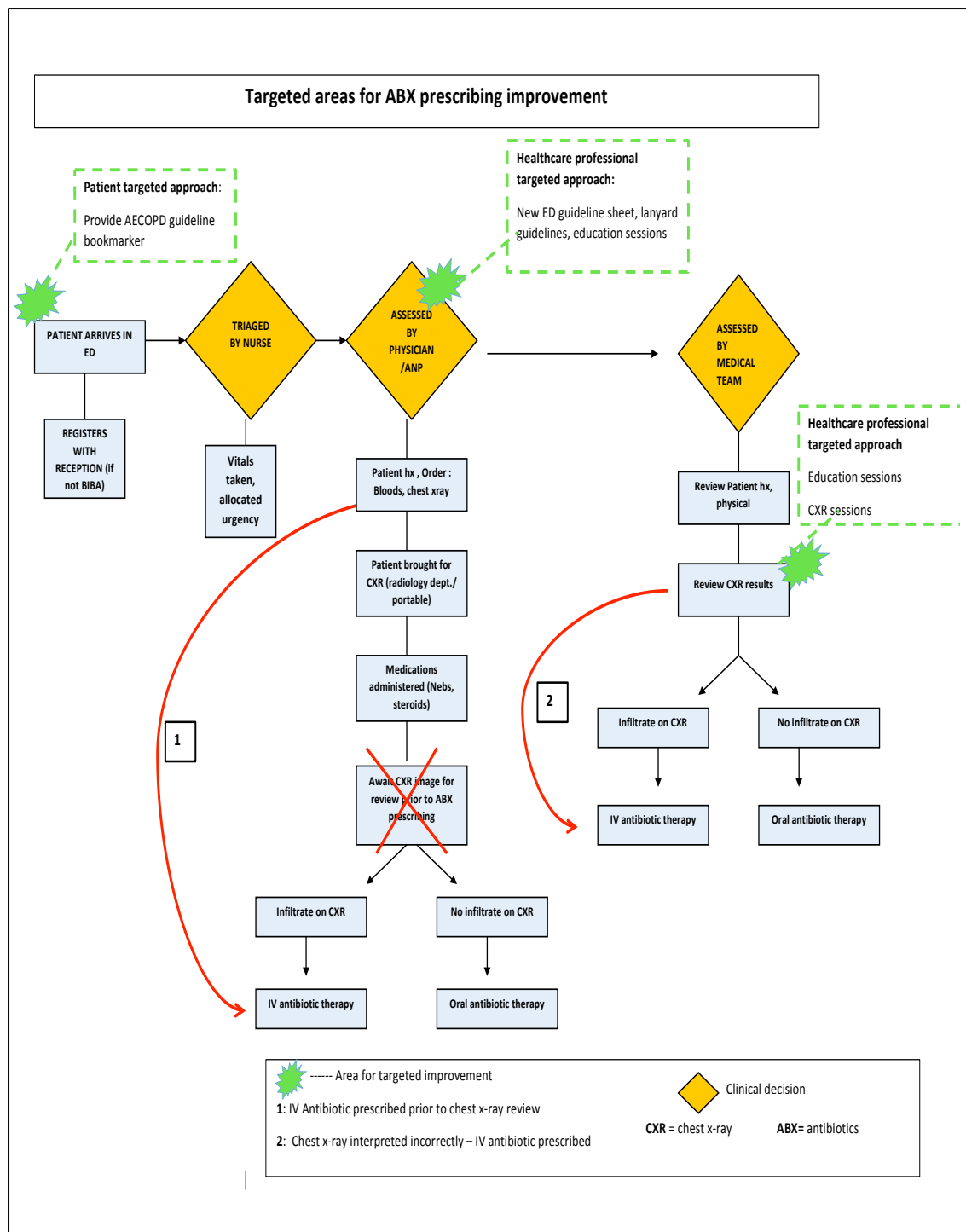


Figure 12: Process flow map with QI plan outline

As an antimicrobial prescribing app has already been implemented at the project site and a survey in 2015 highlighted that the app received positive feedback and is currently being promoted, the team decided to use additional methods to improve prescribing of antibiotics. These include the promotion of management bundles for AECOPD, in paper document form, that outline the management of AECOPD, the provision of targeted education sessions for staff and the appointment a clinical champion.

Healthcare professional targeted approach:

This part of the QI plan aims to target healthcare professionals (triage nurse, ED intern, SHO or registrar) who are directly involved in patient care. The aim is to promote initiatives that have shown previous success from the literature. While the use of smartapps have shown positive results in improving antibiotics prescribing, following team discussions they were not the focus of this QIP. These include strategies recommended from both the literature and QI meetings. These include the development of an order sheet to be made available to staff in ED outlining the AECOPD guidelines and educational strategies to promote the correct use of the guidelines, targeted education sessions and appointing a clinical champion.

1) AECOPD guideline order sheet for ED:

A new, one page, AECOPD guideline order sheet has been developed for use by healthcare professionals managing patients with AECOPD in ED. Following literature review, the use of order sheets outlining the clinical decisions have helped to improve prescribing in AECOPD. The document outlines the current guidelines for the management of AECOPD adapted from the Beaumont COPD acute management pathway that is available on the medical app. The document is in a clear structured format to aid the healthcare professional reviewing the patient. The idea is to provide easy access to the guidelines and a clear flow of the recommended management. The use of paper-based AECOPD pathways have been shown to reduce patient anxiety, reduce test ordering, medication prescription and LOS (Kitchlu et al., 2015). The aim is to pilot the paper document in ED as a prescribing aid in AECOPD.

Through the use of process flow maps it was recognised that clinical decisions, for example; the prescribing of antibiotics, are often made by the first ED physician or ANP reviewing the patient. The document in Figure 13, is targeted for use by healthcare professionals making those clinical decisions in ED. It aims to improve antibiotic prescription by prompting the physician to follow the recommended guidelines and outline why they deviated from recommendations. As discussed in the literature review, Mehrotra and Linder (2016), recommended the use of order sheets to reduce overprescribing. The document also serves to improve the documentation of the AECOPD

management in ED as each step of the patient's management can be accounted for on the document. Whilst collecting the data for the QI project it was highlighted that management of the patient was often unclear from the current ED notes. There were missing times of drug administration information regarding chest x-ray review. To promote use of the document it could ideally be attached to the ED notes by the triage nurse who first reviews the patient.

Acute Exacerbation of COPD (AECOPD): Guidelines for patient care

Date: _____ Time: _____ Reviewed by: _____
(Print name)

Previous exacerbation/when? Yes ☐ No ☐ If yes, when _____

Recent/Current Antibiotics? Name and dose _____
Start date _____ End date _____

Sputum production/colour? Yes ☐ No ☐ If yes, colour _____

Time of admission: _____

ORDER: (Please tick what is ordered) Chest x-ray ☐ Bloods ☐

1	OXYGEN On presentation Maintain sats between 88-92%	Time prescribed: Oxygen therapy:
2	ABG Within 30 minutes	Time taken: Results:
3	Nebulizer Within 30 minutes Beta2agonist+/Anticholinergic	Time prescribed:
4	Steroids Within 2 hours ORAL prednisone 30 mg <small>(Avoid IV Hydrocortisone 100mg TDS only if patient unable to take steroids orally)</small>	Time ORAL steroids prescribed: Reason for IV?
5	Antibiotics Within 4 hours ORAL amoxicillin/clarithromycin/ doxycycline ** IV antibiotics if new infiltrate on cxr or temp >38.2, rigors & elevated CRP] <small>* Beaumont antimicrobial app</small>	**BEFORE PRESCRIBING: CXR reviewed: Infiltrate <input type="checkbox"/> No infiltrate <input type="checkbox"/> CRP: TEMP: Reason for IV therapy if no infiltrate on cxr: <div style="border: 1px solid black; height: 20px; width: 100%;"></div>
6	Involve MDT: Resp CNS & chest physio	YES <input type="checkbox"/> NO <input type="checkbox"/>

Please Sign: _____

Circle as applicable:

Intern, SHO, Registrar, ANP, Consultant

Figure 13: AECOPD guideline order sheet for ED

2) Education initiatives

Education initiatives were included in the QI plan to promote the correct management of AECOPD and to improve the interpretation of chest x-rays. In reference to the literature review and staff meeting, initiatives to improve both adherence to prescribing guidelines and chest x-ray interpretation include:

Grand rounds presentation

The QI project could be presented at medical grand rounds to create awareness of the overprescribing of antibiotics in AECOPD, to promote the existing smartphone apps and also the QI plan. The data findings from the QI project will be discussed. This could also target physicians from additional specialties.

Education sessions

To further drive the improvement of antibiotic prescribing, education sessions could be provided for healthcare professionals working in ED. Educational sessions could be provided at the Thursday morning ED teaching sessions between 8am-10am. These sessions could have a focus on improving antibiotic prescribing and the interpretation of chest x-rays. The radiology department could be involved in providing teaching on chest x-ray interpretation.

Nomination of a clinical champion in ED

A clinical champion could be nominated to promote the QI plan that includes the use of the new ED documentations and be involved in organising education sessions. The clinical champion could be a physician, ANP or ED nurse.

AECOPD guideline lanyard attachment

A 2-sided laminated 'clip-on' attachment of the guidelines has been developed to attach to a lanyard and is shown in Figure 14. The attachment uses the Beaumont antimicrobial prescribing guidelines adapted from the smartapp on one side and the COPD acute management pathway on the other side. The ease of access to these guidelines, which is a replicate of those available in paper format and on the hospitals clinical and microbiology app, is anticipated to improve the prescribing of antibiotics. The attachment could be distributed to ED and medical healthcare professionals to improve the knowledge of appropriate antimicrobial guidelines.

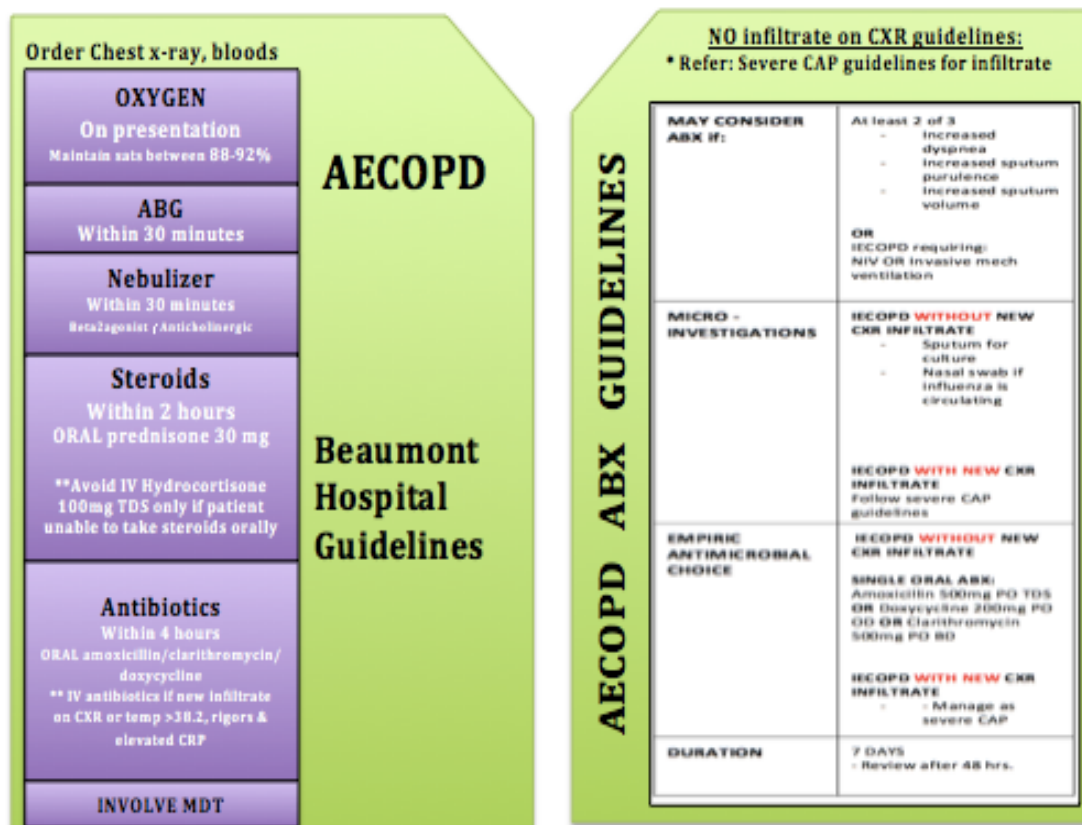


Figure 14: AECOPD guideline lanyard attachment

Patient targeted approach:

Providing a bookmarker that details the antibiotic management plan

The incorporation of the patient in the QI plan was suggested following a presentation of the data at a specific hospital led QI meeting. Staff and consultants in attendance recommended the integration of the patient into the QI plan enabling them to take a role in their health. Similar to the previously discussed AECOPD guideline lanyard attachment, the same layout has been developed for patient use in the design of a bookmarker, Figure 15. The patient could be encouraged to bring the guidelines with them if they attend ED for an exacerbation. The patient can have a role in his or her own health and this QI project will encourage the patient to raise awareness of the antimicrobial guidelines.

Acute Exacerbation of COPD	
**Order Chest x-ray & bloods	
OXYGEN On presentation Maintain sats between 88-92%	
ABG Within 30 minutes	
Nebulizer Within 30 minutes Beta2agonist+/Anticholinergic	
Steroids Within 2 hours <u>ORAL</u> prednisone 30 mg **Avoid IV Hydrocortisone 100mg TDS only if patient unable to take steroids orally	
Antibiotics Within 4 hours <u>ORAL</u> amoxicillin or clarithromycin or doxycycline ** IV antibiotics if new infiltrate on CXR or temp >38.2, rigors & elevated CRP)	
INVOLVE MDT: Resp CNS & Chest physio	

Acute Exacerbation of COPD	
MAY CONSIDER ABX	At least 2 of 3: <ul style="list-style-type: none"> - Increased dyspnea - Increased sputum purulence - Increased sputum volume OR IECOPD requiring: NIV OR Invasive mech ventilation
MICRO-INVESTIGATIONS	IECOPD WITHOUT NEW CXR INFILTRATE - Sputum for culture - Nasal swab if influenza circulating IECOPD WITH NEW CXR INFILTRATE Follow severe CAP guidelines
EMPIRIC ANTIMICROBIAL CHOICE	IECOPD WITHOUT NEW CXR INFILTRATE SINGLE ORAL ABX: Amoxicillin 500mg PO TDS OR Doxycycline 200mg PO OD OR Clarithromycin 500mg PO BD IECOPD WITH NEW CXR INFILTRATE Follow severe CAP guidelines
DURATION	7 DAYS Review after 48hrs
* If Infiltrate on CXR – SEVERE CAP guidelines	

Figure 15: Bookmark detailing AECOPD management

Summary of QI plan:

QI project plan	Healthcare professional targeted approach	Patient targeted approach
AECOPD guideline order sheet for ED	✓	
Guideline detailed lanyard attachment	✓	
Nominate an ED clinical champion	✓	
Grand rounds presentation	✓	
Education sessions	✓	
Guideline detailed Bookmarker		✓

Table 4: Summary of QI plan

3.5 Summary

This chapter focused on using the DMAIC model to identify the problems associated with the overprescribing of antibiotics in ED. The five phases of the model were discussed in detail. In section 3.4.1, QI tools such as process flow maps were used to identify the patient's journey and also examine the possible causes for the problem. Section 3.4.2, outlined the data parameters that were collected for the QI project. Section 3.4.3, analysed the data and created a fishbone diagram. It was clear from the data analyse that there was overprescribing of antibiotics. The QI plan was finally discussed in section 3.4.4, detailed the initiatives that have been developed to target healthcare professionals in ED and the patient.

CHAPTER 4.0: Evaluation

4.0 Introduction

In this chapter I discuss how the proposed QI plan could be evaluated. I provide an overview of the plan and the expected outcomes. I describe the aim of the control phase of the DMAIC model and focus on how to review the plan and maintain change. Finally I outline the dissemination plan.

4.1 Overview of QI plan and expected outcome

The aim of the project is to reduce the overprescribing of antibiotics in patients admitted to this hospital with an AECOPD. The first objective was to quantify the problem of overprescribing of antibiotics. In order to achieve this ,data parameters associated with the overprescription of antibiotics in AECOPD were collected. The development of process maps regarding the patient's journey through ED was crucial. This process helped to identify areas where clinical decisions are made and determine who was involved in the care of the patient. A review of the literature was also crucial at this point to explore the overprescribing of antibiotics in AECOPD and identify initiatives that have been used to improve the management of AECOPD.

A stakeholder analysis was developed to identify the key stakeholders in the QIP and meetings were organised with the stakeholders. The first meeting was with the project sponsor, a respiratory consultant, to outline what data should be collected for the QIP. Following this, weekly meetings were arranged with the research registrar to promote project progression and answer any queries. To identify the cause of overprescribing, the collected data was analysed and reviewed. The project focused on the overprescription

of antibiotics in patients with no infiltrate on chest x-ray. It was clear that there was a need for an improvement in the prescription of antibiotics in this cohort of patients. Further analysis of the cause found that it may be multi-factorial. Lack of adherence to recommended antimicrobial guidelines was a contributing factor, where the appropriate antibiotic was not prescribed, the antibiotic was prescribed prior to chest x-ray interpretation and inaccurate interpretation of the chest x-ray. Following the analysis of the data a QI plan was developed. The QI plan was developed following additional meetings with the stakeholders including ED staff. Various initiatives were outlined to improve antibiotic prescribing. Studies in the literature review highlighted that the use of management bundles , smartphone apps and staff education for AECOPD improved prescribing of antibiotics.

The use of smartphones as a prescribing aid has been proven beneficial to improve prescribing. At this current hospital, a survey in 2015 highlighted that an antimicrobial smartapp is already used by a high proportion of healthcare professionals and has received positive feedback. Following discussions with the project sponsor it was decided to pilot additional initiatives to improve antibiotic prescribing, where the use of smartapps was not the focus of this QI plan. The QI plan will promote the correct use of antibiotics through the promotion of management guidelines for AECOPD and education. The literature highlighted that use of bundle care packages and increased education promotes improved antibiotic prescription. The introduction of an ED sheet to promote the use of management guidelines and targetted education strategies were outlined as the QI plan. In order to achieve this, the

QI project targets the ED healthcare professionals and the patient. Introduction of the AECOPD guideline order sheet for ED will promote use of management guidelines. This paper document is for use by the triage nurse, ED SHO, Registrar or ANP in ED. The recommended antibiotic prescribing guidelines are clearly documented and deviation from this will require written justification. The social psychology of justifying your decision has been shown to reduce the overprescribing of antibiotics (Mehrotra and Linder, 2016). This document will be piloted in ED.

Education initiatives have also been developed to promote the correct management of AECOPD and to increase education in the interpretation of chest x-rays. These initiatives include the appointment a clinical champion in ED. The clinical champion in ED will promote the improved prescription of antibiotics by encouraging adherence to AECOPD guidelines and promote the introduction of the initiatives. Healthcare professionals will be targeted at medical grand round teaching of which are attended each Tuesday in the hospital. The QI project's aim and initiatives will be discussed and promoted and this is hoped to also reach physicians in other specialties, who often care for these patients during their inpatient admission. Education sessions will also be provided for ED staff. In these sessions, the management of AECOPD will be reviewed with an emphasis on correct antibiotic prescribing and there will also be interpretation of chest x-ray reviews. Finally a lanyard attachment of the management guidelines for AECOPD will be distributed to ED staff. This is expected to reduce the overprescribing of antibiotics by providing easy access to the recommended antimicrobial guidelines. It is expected that by

implementing the above plan in relation to ED staff there will be a reduction in the overprescribing of antibiotics. The QI project also focuses on targeting the patient. Bookmarkers will be developed that outline the management of the patient in ED and these will be distributed to COPD patients. The aim here is to include the patient in the management of their own health and to possibly provide the physician with another point of access to the guidelines when the patient arrives in ED. The following sections will detail how to evaluate whether the proposed QI project has been successful in reducing the overprescription of antibiotics in AECOPD.

4.2 Evaluation

4.2.1 Aim of Control Phase of DMAIC

This section will outline the methods used to monitor, review and sustain the QI project plan.

4.2.2 Monitoring & Review

In reference to the IHI model for improvement (Institute for healthcare improvement, 2018) the question of how to assess whether a change is an improvement and how to sustain this improvement will be discussed in this section. In order to monitor and review the proposed QI plan it is important to maintain communication between the stakeholders and the staff involved in the project. A communication plan will be drafted to ensure any successes of the project were distributed among the QI contributors and any arising issues could be recognised and resolved in order to sustain success of the project. An ED-based clinical champion will be nominated to monitor the project and to promote the QI initiatives such as new AECOPD guideline order sheet for ED.

Six months following introduction of the QI initiatives, I will recollect data from the medical charts .The recollection dates will correspond with the dates of the original data collection ruling out seasonal variation in the data and allow for a more comprehensive comparison of the data. The chart review will focus on the antibiotics prescribed to patients with no infiltrate on chest x-ray and the documentation and interpretation of the chest x-ray over the 6 month period. This is to determine if there has been a reduction in overprescribing and if the recommended antimicrobial guidelines were adhered to. Data will also be collected on the use of the newly introduced AECOPD guideline order sheet in ED and any feedback on the document. This measurement and review of the interventions aims to ensure that the implemented changes will become part of the standard management and practice. Following on from the introduction of the AECOPD document for ED, the guideline lanyard attachment and the education sessions ,an online anonymous survey will be developed on survey monkey for ED and medical staff to provide feedback on the QI initiatives.

Ethical approval will be sought and the online survey will be distributed to ED staff by email . The anonymous survey will ask the participant to tick a box to outline their job role, their awareness of the initiatives , their use of the new ED document and their opinion regarding the usefulness of the lanyard information and educational sessions . This will also be conducted 6 months post QI plan commencement. Following this time period the project could be re-evaluated and repeated .This second phase of the QI project, will be

undertaken by an appointed member from the QI team who will implement any necessary changes or improvements suggested for the QI initiatives. This would further the overall aim of the project, to continue to reduce the overprescription of antibiotics.

4.3 Expected Results

It is expected that in introducing the QI plan that there will be a reduction in the overprescription of antibiotics. It is expected that the promotion of the AECOPD guidelines and introduction of education initiatives will improve antibiotic prescribing in AECOPD. The implementation of a clinical champion in ED will provide an extra source of encouragement to promote the QI initiatives over the 6-month pilot period. Finally the education sessions and presentations at grand rounds will aim to improve prescribing of antibiotics in exacerbations of COPD. In relation to the patient, by providing an option for their involvement in raising awareness to the guidelines through the distribution of AECOPD guideline bookmarkers, this initiative will be reviewed post implementation to determine if patient inclusion effects adherence to guidelines.

4.4 Dissemination plan

Initiating the dissemination plan is a crucial step in the QI project. The development of a dissemination plan will help to facilitate the transition of the findings from the data collected and the proposed QI project from plan into practice. I will introduce the dissemination plan to key stakeholders and ED staff. It is important to know what will be disseminated as presenting a clear representation of the data findings, outline of proposed plan and evaluation

methods are key. With this in mind I will meet with the project sponsor prior to the dissemination plan meeting to ensure they are happy to proceed with the plan and the developed documents. A face-to-face meeting will then be organised with key stakeholders and ED staff. The QI plan will be outlined with the aid of a power point presentation. The presentation will outline the process flow maps designed; the findings from the data collected and finally detail the proposed QI plan. Documentations such as the AECOPD guideline lanyard attachment, the bookmark, and AECOPD ED document will be printed and available for members of the meeting to review. The documents will be discussed and a date will be set to implement the plan. If any issues arise at the dissemination meeting, an additional meeting will be organised to ensure that both stakeholders and ED staff are set to proceed and methods in which the proposed plan will be evaluated are discussed.

4.5 Summary

In summary, the methods used to monitor, review and sustain the QI project plan were discussed in this chapter. By designing process flow maps of the patients journey through ED points at which clinical decisions were made in the management of AECOPD were highlighted. By presenting the project plan at QI meetings the potential influence of patient in the plan was also highlighted. This led to the proposed QI plan including a healthcare professional and patient targeted approach to increase the awareness of AECOPD guidelines. The success of the plan will be reviewed 6 months post implementation. It is expected that the introduction of the project plan will improve the prescription of antibiotics.

CHAPTER 5.0 Discussion & Conclusion

5.1 Introduction

This chapter outlines the potential impact the QI project will have on the stakeholders involved in the project and the practice. The strengths and limitations of the project will be discussed in section 5.3 and 5.4. Recommendations for the future of the QI project will be discussed and other initiatives that could reduce the overprescription of antibiotics will be outlined. The writer will outline the learning points acquired from their involvement in the quality improvement project. Finally a summary will detail the concluding points of the project.

5.2 Project Impact

The proposed QIP has yet to be implemented and therefore the potential impact of the project can only be discussed. The aim of the QIP is to reduce the overprescribing of antibiotics in patients admitted to the project site with an AECOPD. The use of QI tools such as the Lean six sigma quality model, DMAIC framework and fishbone diagram aided in highlighting causes for the problem and identifying areas of possible improvement.

The plan proposes to introduce healthcare professional and patient-targeted approaches to reduce the overprescription of antibiotics. The introduction of the QI plan overall has one goal; to improve the prescription of antibiotics in patients with acute exacerbations of COPD. Critical analysis of the potential impact of the QI plan on stakeholders, ED staff and patients will be discussed in the following sections.

5.2.1 Impact on Stakeholders and practice

It is hoped that the introduction of the QI plan will have a positive impact on many of the stakeholders without preference to level of power or influence. It is envisaged that there will be an overlapping impact from the outcome of the QI project for patients, healthcare professionals and hospital management alike. The QI plan will start a campaign to improve the prescription of antibiotics in AECOPD.

A detailed account of the healthcare professional and patient targeted approaches was discussed in chapter 3 and 4 of which included; the introduction of an AECOPD guideline order sheet for ED staff, education initiatives such as staff education sessions, clinical champions, AECOPD guideline lanyard attachment, presenting at hospital led meetings such as grand rounds, and finally patient involvement. Data collected for this QIP demonstrate that there is overprescribing of antibiotics in AECOPD at the project site. It is envisaged that there will be a positive organisational implication to patient centred care following the implementation of the plan.

Identifying and proposing initiatives that could reduce the overprescription of antibiotics is the most important aspect of our QI project. The literature focused on both the implications of overprescribing of antibiotics and the positive implications of appropriate prescribing, to both the patient and the hospital. Appropriate prescribing of antibiotics can decrease patients LOS and hospital costs (Kitchlu et al., 2015) where inappropriate prescribing may increase the mortality rate, risk of adverse effects and re-attendance due to

infections (Llor and Bjerrum (2014)). By increasing awareness of recommended antimicrobial prescribing guidelines and increasing education in aspects of the management of AECOPD it is hoped that the patient will receive the best recommended care.

Appropriately prescribed antibiotics may result in shorter stay in hospital for patients; thus helping to relieve the strain on hospital bed wait times. This could also lead to earlier discharge of the patient to the appropriate services such as COPD outreach. As reviewed in the literature it is clear that COPD is a disease associated with increase cost to the healthcare system. There is a cost implication to the organisation due to the increased cost of prescribing dual versus single antibiotics or antibiotic administration by IV route. The promotion, introduction and adherence to the various QI initiatives could lead to a reduction in the overprescribing of antibiotics in patients with no infiltrate on chest x-ray. Overall for both patient and physician there can be positive outcomes from the introduction of the QI plan.

5.3 Strengths of the Project

Firstly, the stakeholders with high interest and power have had a keen interest in the project where monthly meetings were organised with the project sponsor. This helped to maintain progress in the QI plan and the current level of interest should progress to result in implementation of the recommendations. The respiratory research team and members from the ED department are eager to get involved to help improve patient management

and reduce overprescribing of antibiotics in AECOPD. There is also consistent support from the antimicrobial stewardship pharmacist who is engaged with the aim to reduce overprescribing of antibiotics. This is a strength as the successful work of QI strategies can rely on having motivated teams (Hughes, 2008).

This project is also strengthened by the fact that the HSE are actively trying to improve the management of AECOPD. This QI plan and its implementation will complement the strategy by the HSE to improve care for COPD patients in the national COPD programme (HSE, 2012). Another strength of the project is associated with the cost effective aspect of the plan. The recommended QI plan, if implemented, will require minimal printing cost for the proposed documents and will seek voluntary teaching for education sessions. The cost effective nature of the QI plan is a strength as the possible overall impact could reduce hospital costs. The reduction in hospital costs could be seen by a reduction in LOS, IV antibiotic use and the more efficient use of readily available services such as COPD outreach. Overall the project outlines many simple and cost effective ways to improve the prescription of antibiotics.

5.4 Limitations of the Project

There are limitations associated with the QI project. The first limitation relates to the student leading the project. It was not possible to have a placement in ED during the data collected phase of the project. Therefore it was not possible to directly observe the management of patients admitted with an

AECOPD. Another limitation was that it would have been useful to seek the patient's opinion on their willingness to use the developed bookmark. There were limitations in the evaluation phase of the QI plan. The evaluation phase was based on the desired outcome from the QI project plan.

5.5 Recommendations

Following a final presentation of the QI project to the respiratory research group the team discussed recommendations for the project.

These include;

- 1) Re-collect data 6 months post implementation to identify if the QI plan has had any success. The successes will be determined by chart review to see if there has been an improvement in the prescription of antibiotics.
- 2) Apply for ethical approval to design and distribute a survey for the patient and healthcare professional to identify their opinion on the QI plan. The healthcare professional survey aims to gauge their opinion on the initiatives that have been introduced e.g: education sessions
- 3) A new role, respiratory ANP, is being introduced to the project site and there has been recommendations to involve the new ANP in the QI initiatives. They could possibly continue as the clinical champion as they have patient contact from admission in ED until the patient is discharged and they could promote the initiatives to ED staff.

- 4) Future QI plans could involve reviewing the current smartapps available at the project site. Project meetings involving the microbiology team, could be held to discuss improvements that could be made to continually improve the prescription of antibiotics using the smartapps as a prescribing aid.

5.6 Learning about Quality Improvement

Reflecting on the process of developing the QI plan I realise how much I have learnt throughout this process. I have always had an interest in clinical research but this was my first introduction into developing a structured quality improvement project. At first glance it is easy to overlook the detail that is involved in developing and potentially implementing a QI plan.

In chapter 3, I discussed QI models that can be utilised when analysing a QI project. It was decided to focus on the DMAIC model. I found the DMAIC model useful in identifying the possible causes of the problem and in designing a QI plan. I was new to QI tools such as the stakeholder analysis diagram and I found that in using these tools it helped to define the problem and identify who is important to target. From early on in the project I engaged with key stakeholders, which in retrospect I realise has had a positive influence on the progression of the project. I also developed a Gantt chart (Appendix 5) that was a valuable aid for time management and project progression. Following each step in the DMAIC model gave a clear outline for what to focus on next. I improved on my analysis of data and interpretation of

the data collected. I mostly enjoyed the improve section of the DMAIC model, exploring ideas for improvement and creating documents targeting the healthcare professional and the patient. Overall my experience of learning about QI throughout this project has been positive and will help me in any future QI projects, of which I hope to one day lead.

5.7 Summary and Conclusion

This QI project aimed to reduce the overprescription of antibiotics in AECOPD. The literature review highlighted that there was overprescribing of antibiotics in AECOPD. A QI project was developed to improve the prescription of antibiotics in patient's admitted with an AECOPD. Through the use of QI models and tools the problem was analysed to determine the root causes. Data collection and analysis also highlighted overprescribing of antibiotics at the project site. A cost effective QI plan was developed to target both the healthcare professional and the patient to improve prescription of antibiotics. As defined by the framework for improving quality (HSE, 2016), QI is the combined efforts of everyone; including the healthcare professionals and patients to make changes that will lead to better patient outcomes, better experience of care and continued support of staff in delivering this care. The outlined QI plan aims to achieve those outcomes by improving the prescription of antibiotics in patient's with AECOPD.

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CHAPTER 7.0 Appendices

Appendix 1 - Beaumont antimicrobial guidelines for AECOPD

Beaumont Hospital Antimicrobial Guidelines			
CONDITION	Microbiological investigations:	EMPIRIC ANTIMICROBIAL CHOICE	ANTICIPATED DURATION
<p>1.1.5 INFECTIVE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE (IE-COPD)</p> <p>Antimicrobials are not always indicated. Exacerbations are often due to viral infection or environmental pollutants</p> <p>Antimicrobials may be considered in the following circumstances: Patient has at least two of the following: - Increased dyspnoea - Increased sputum purulence - Increased sputum volume</p> <p align="center">OR</p> <p>Severe exacerbation requiring non-</p>	<p><u>IECOPD without new CXR infiltrate :</u></p> <ul style="list-style-type: none"> Sputum for culture If influenza circulating in community, send nasal swab for influenza PCR <p><u>IECOPD with new infiltrate on CXR: Investigations same as for CAP:</u></p> <ul style="list-style-type: none"> Sputum for culture or BAL (if intubated) Urine for legionella antigen & <i>Streptococcus pneumoniae</i> antigen Blood cultures If influenza circulating in community (typically from October to May) send nasal swab 	<p><u>IECOPD without new CXR infiltrate:</u> AMOXICILLIN 500mg PO TDS OR DOXYCYCLINE 200mg PO OD OR CLARITHROMYCIN 500mg PO BD #5</p> <p><u>IECOPD with new infiltrate on CXR - Manage as * CAP- Severe 1.1.1d*</u></p> <p>Contact microbiologist if:</p> <ul style="list-style-type: none"> ICU admission Risk factors for infection with <i>Pseudomonas aeruginosa</i>, penicillin-resistant pneumococci, MRSA or resistant <i>Enterobacteriaceae</i> <p>Refer to * Guidelines on evaluation of patient with suspected antimicrobial allergy*</p> <p># Consider potential for interactions with other drugs which</p>	<p>7 DAYS</p> <p>7 DAYS</p> <p>ALWAYS REVIEW empiric antimicrobial therapy in conjunction with microbiology result after 48 hours</p> <ul style="list-style-type: none"> Can treatment be rationalised to narrow spectrum agent? Is patient a candidate for IV to oral switch therapy? <p>Prior to discharge: Refer to national immunisation</p>

Appendix 2 – Beaumont medical app AECOPD guidelines

COPD acute Management pathway

Oxygen On presentation	Maintain sats >88 <92% O2 IS POTENTIALLY HARMFUL IF GIVEN TO PATIENTS WITH COPD WHO HAVE A SATURATION > 92%
ABG Within 30 minutes of presentation	pH < 7.35 Pco ₂ > 6 kpa refer to BiPaP pathway
Nebulizer Within 30 minutes of presentation	Start beta 2 agonist +/- Anticholinergic
Steroids Within 2 hours of presentation	ORAL prednisone 30 mg Avoid using IV Hydrocortisone unless patient unable to take steroids orally (no more than 100mg TDS)
Antibiotics Within 4 hours of presentation	ORAL Amoxicillin/Clarithromycin/Doxycycline AVOID IV ANTIBIOTICS UNLESS OVERT FEATURES OF SYSTEMIC ILLNESS (eg: T > 38.2, rigors, & elevated CRP) If pneumonia on CXR refer to the appropriate pneumonia management guidelines
Involvement of Multidisciplinary team	Consider respiratory CNS referral Referral to Chest physiotherapy (for early rehabilitation or airway clearance)

Appendix 3 –Antibiotic data

DATE FIRST AB prescribed	Time first AB	INDICATION - ed medic notes (1- Infective)	INDICATION ON KARDEX 0- not on kardex, . I	Single or Dual Antibiotic (s-1 D-2)	Name AB 1	DOSE AB 1	AB 1 : PO (0) IV (1)	STOPPED /COMPLETION DATE	DATE CHANGE TO PO (if no change .)	CHANGE IN DOSE (Y-1, N-0)	NEW DOSE	DATE OF NEW DOSE	frequency (od-1, bd-2, tds-3)
12/02/17	ed sheet	.	.	2	TAZOCIN	4.5g	1	no kardex	.	.	AMOXICILIN	625MG	.
21/02/17	14.00	.	.	1	AMOXICILIN AND CLAVULANATE	1.2g	1	22-Feb	.	.	.	.	.
22/02/17	11.05	iecopd	iecopd	1	AMOXICILIN AND CLAVULANAT	1.2	1	28/02/17	28-Feb	.	625mg	.	3
28/02/17	20:00:00	.	0	1	AMOXICILIN AND CLAVULANAT	625mg	0	01/03/17	.	0	.	.	3
28-Feb	2.45	iecopd	exac copd	1	AMOXICILIN AND CLAVULANAT	1.2g	1	02-Mar	02-Mar	.	625mg	02-Mar	3
01/03/17	2nd medic	iecopd	not found	2	AMOXICILIN AND CLAVULANAT	.	1	02/03/17	02/03/17	.	.	.	.
06/03/17	23.55	2	.	1	AMOXICILIN AND CLAVULANAT	625MG	0	.	.	1	1.2 g	07/03/17	03/01/00
11/03/17	22.30	.	IECOPD	1	amoxicillin and clavulanic	1.2	1	13-Mar	13/03/17	1	625mg	13/03/17	3
11/03/17	13.30	.	0	1	amoxicillin and clavulanic	1.2g	1	.	.	.	.	.	.
12/03/17	14.30	.	.	1	levofloxacin	500mg	1	10/03/17	.	.	.	.	.
20/03/17	16.00	1	.	1	tazocyn	4.5g	1	.	.	.	.	.	.
25/03/17	.	?exac copd	0	2	AMOXICILIN AND CLAVULANAT	1.2g	1	27/03/17	27/03/17	1	625mg	27/03/17	3
27/03/17	19.55	.	LRTI	2	AMOXICILIN AND CLAVULANAT	1.2 g	1	03/04/17	.	.	.	.	3
02/03/17	14.45	not written	not written	1	tazocin	4.5g	1	06-Mar	.	.	.	.	.
02/04/17	19.00	1	.	1	AMOXICILIN AND CLAVULANAT	1.2g	1	04-Mar	04-Mar	1	625mg	.	3
03/04/17	.	IECOPD	0	2	amoxicillin and clavulonic acid	1.2g	1	06/04/17	06/04/17	1	625MG	.	3
03/04/17	15.20	.	.	1	AMOXICILIN AND CLAVULANAT	1.2 g	1	03-Apr	03-Apr	1	625MG	.	3
21/04/17	2.30	iecopd	NIECOPD DUPP/PCU NOT ON KARDEX,	1	amoxicillin and clavulonic acid	1.2g	1	21/04/17	.	.	.	.	.
26/04/17	no kardex	exac copd	no kardex	2	amoxicillin and clavulonic acid	.	1	01/05/17	unknownsn	.	.	.	.
29/04/17	first medic BPM	hap/iecopd resp sepsis/ IECOPD	.	2	tazocin	4.5g	1	6 days on it	.	.	.	.	.
30/04/17	16.30	.	resp sepsis	2	amoxicillin and clavulonic acid	1.2g	1	30/04/17	03/05/17	1	625MG	03/05/17	3
04/05/17	1.20	1	0	2	Amoxicillin and clavulonic acid	1.2g	1	07/05/17	.	0	.	.	.
07/05/17	2nd clinican	1	.	1	clarithromycin	500mg	0	11-May	.	.	.	.	.
10/05/17	13.25	iecopd	.	1	Amoxicillin and clavulonic acid	1.2g	1	10-May	.	1	625mg	.	.
12/06/17	post w/r	?iecopd	.	1	doxycycline	200mg	0	16-May	.	.	.	.	.
23/05/17	.	.	NIECOPD	1	clarithromycin	500mg	0	.	.	.	.	.	.
28/05/17	13.00	1	iecopd	2	Amoxicillin and clavulonic acid	1.2g	1	31/05/17	.	1	625mg	31/05/17	3
30/05/17	22.10	1	LRTI	2	Amoxicillin and clavulonic acid	1.2g	1	.	.	0	0	0	3
31/05/17	.	lrti	.	2	cefotaxime AMOXICILIN AND CLAVULANATE	2 625mg	1 0	01-Jun 09-Jun	.	.	.	.	.
09/06/17	could not fin	.	.	2	AMOXICILIN AND CLAVULANAT	1.2g	1	18-Jun	.	.	.	.	.
16/06/17	22.00	.	iecopd	2	Amoxicillin and clavulonic acid	1.2g	1	20/06/17	20/06/17	0	.	.	3
16/06/17	.	1	iecopd	2	AMOXICILIN AND CLAVULANAT	1.2g	1	22-Jun	22-Jun	1	625mg	22-Jun	2
19/06/17	22.20	.	.	2	AMOXICILIN AND CLAVULANAT	1.2g	1	21-Jun	21-Jun	1	626mg	21-Jun	3
26/06/17	.	.	UTI	2	AMOXICILIN AND CLAVULANAT	1.2g	1	29-Jun	29-Jun	1	625mg	.	3
02/06/17	11.10	1	0	2	Amoxicillin and clavulonic acid	1.2g	1	05/07/17	05/07/17	1	625mg	05/07/17	3
04/07/17	.	iecopd	.	2	AMOXICILIN AND CLAVULANAT	1.2g	1	05-Jul	05-Jul	1	625mg	05-Jul	3

Name 2nd antibiotic	when started? 1- post ward round, 2-	indication	AB 2 : PO (0) IV (1)	DOSE AB 2	frequency (od-1, bd-2, tds-3)	Date of PO switch	COMPLETION DATE 2	CHANGE OF AB (Y-1 N-0)	start date new AB	Reason for change	NEW AB name and dose	Duration of new ab	IV OR PO (0-PO, 1-IV)	AB prescribed on discharge
CLARITHROMYCIN	3		0	500mg										
tazocyn	.	.	1	4.5g	3									
CLARITHROMYCIN	23/03/27	IECOPD	0	500MG	2	.	05-Mar	0	09-Mar	.	azithromycin 250MG 3 A WEEK (on long term) held while on	LONG TERM	0	.
metronidazole	2	commenced by dentist	0	400MG	3	.	01/03/17	.	.	.	.	.	.	NOT NOT FOUND IN CHART
clarithromycin	5	iecopd	0	500mg	2		07-Mar							aug and klaci
Clarithromycin	5	iecopd	1	.	.	02/03/17								
CLARITHROMYCIN	1	.	0	500mg	3	.	10/03/17	0	.	.	.	.	.	clarithromycin 500mg BD PO 7/7
clarithromycin	1		0	500mg	2	.	on d/c conti	.	.	.	.	.	.	d/c complete
CLARITHROMYCIN	10th/3/17 in kardex,	.	0	500mg	2	.	15/03/17	...	.	.	.	.	.
clarithromycin	5	.	0	500mg	2	.	25/03/17	.	.	.	.	.	.
CLARITHROMYCIN	3	LRTI	0	500mg	.	.	03/04/17	.	.	.	.	.	.
.
clarithromycin	5	iecopd	0	500mg	2									
clarithromycin	3	IECOPD	0	600MG	2	.	.	.	.	.	.	.	.	CLARITH 500
.
.	.	.	.	.	.	.	.	..	.	.	.	.	.	NO
larithromycin	5	iecopd	0											
LARITHROMYCIN	3	iecopd	0				11days							
larithromycin	3	resp sepsis	0	500	2	.	30/04/17	1	30/04/17	resp sepsis	Tazocin	04/05/17	1	Amoxicillin an
LARITHROMYCIN	3	iecopd	0	500mg	1	.	08/05/17	1	08/05/17	.	Tazocin	12/05/17	1	no
.
.
.
larithromycin	3	iecopd	0	500mg	2	.	prescribed o	0	.	.	.	.	.	500mg po bd, 7/7 augmentin 625mg po tds 4/7
larithromycin	2	LRTI	0	500mg	2	.	02/06/17	0		.	.	.	.
amoxicillin and clavulonic acid		HAP	0	625mg	2	.	.	.	.	.	.	.	.	levofloxacin 500mg po
larithromycin	09-Jun	lrti	0	500mg	2	.	09-Jun	1	10-Jun	.	levofloclon	13-Jun	o	
LARITHROMYCIN	both abx pre	.	0	500mg	2							finished 17/06		amoxicillin and clav 625mg po
larithromycin	5	iecopd	0	500mg	2	.	20/06/17	.	.	no change started	azithromycin 250mg	long term	0	no abx on d/t
larithromycin	5	iecopd	0	500mg	2		23-Jun		27-Jun					on d/c klacid and
larithromycin	3	.	0	500mg			22-Jun							
efuroxime	in ward few days post	uti	0	250mg	2		30/06-5/07							co amox 625mg tds3/7,
larithromycin	3	iecopd	1	500mg	2	.	prescribed o	0	.	.	.	.	.
LARITHROMYCIN		iecopd	0	500mg			04-Jul							

Appendix 4 –Complete set of data collected for chest x-ray reports

ED Triage admission time	Time of first note made by ED physician	Time from triage to med	CXR order time	CXR time from admission	CXR filmed	CXR film time from admission	CXR signed	CXR report time from filmed time (turn around time)
.	.	.	11:21	.	12:51	.	15:05	02:14
.	.	.	15:08	.	15:16	.	16:50	01:34
10:42	.	.	11:15	00:33	11:44	01:02	18:14	06:30
14:14	16:30:00	2:16	17:06	02:52	18:01	03:47	09:29	15:28
21:49	.	.	23:26	01:37	02:25	04:36	12:13	09:48
14:37	15:50:00	1:13	14:57	00:20	16:30	01:53	11:54	19:24
17:50	.	.	18:58	01:08	20:56	03:06	12:34	15:38
21:11	.	.	22:37	01:26	22:58	01:47	15:10	16:12
17:12	22:20:00	5:08	22:23	05:11	22:33	05:21	13:14	14:41
11:00	13:30:00	2:30	11:29	00:29	11:54	00:54	12:26	00:32
14:20:00	.	.	09:40	19:20	10:33	20:13	12:18	01:45
11:30	16:00:00	4:30	14:59	03:29	15:42	04:12	18:48	03:06
14:33	.	.	17:15	02:42	17:43	03:10	16:58	23:15
15:56	16:30:00	0:34	17:02	01:06	19:37	03:41	07:42	12:05
13:42	14:10:00	0:28	14:15	00:33	15:51	02:09	18:05	02:14
11:19	12:15:00	0:56	12:24	01:05	14:34	03:15	18:30	03:56
13:30	.	.	13:43	00:13	16:33	03:03	07:40	15:07
12:43	13:10:00	0:27	13:38	00:55	14:19	01:36	15:15	00:56
02:35	.	.	02:18	23:43	02:31	23:56	07:14	04:43
20:54	04:25:00	.	04:35	07:41	04:56	08:02	10:05	05:09
19:08	00:55:00	.	01:01	05:53	01:12	06:04	10:54	09:42
15:58	.	.	19:24	03:26	19:38	03:40	11:20	15:42
15:19	16:30:00	1:11	15:51	00:32	17:02	01:43	17:22	00:20
19:58	.	.	01:28	05:30	02:57	06:59	07:01	04:04
21:54	.	.	23:17	01:23	23:46	01:52	02:56	03:10
11:26	.	.	10:37	23:11	10:52	23:26	13:41	02:49
.	13:00:00	.	13:09	.	13:43	.	16:50	03:07
09:40	09:57:00	0:17	10:05	00:25	13:04	03:24	14:22	01:18
07:44	13:00:00	5:16	11:32	03:48	12:34	04:50	14:25	01:51
16:28	21:10:00	4:42	19:32	03:04	20:17	03:49	09:02	12:45
.	.	.	12:35	.	13:07	.	14:08	01:01
09:47	10:27:00	0:40	10:32	00:45	11:39	01:52	16:56	05:17
18:20	.	.	18:36	00:16	20:16	01:56	15:55	19:39
18:57	.	.	20:55	07:14	20:59	07:18	12:37	15:38
19:10	.	.	22:06	02:56	22:29	03:19	12:48	14:19
18:59	.	.	20:01	05:51	20:50	06:40	07:51	11:01
15:45	.	.	22:54	07:09	23:29	07:44	07:21	07:52
09:55	11:00:00	1:05	13:21	03:26	13:43	03:48	14:13	00:30
17:15	22:50:00	5:35	22:58	05:43	23:21	06:06	14:37	15:16

Appendix 5 – Project plan gantt chart

Project Plan	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18
Define									
Arrange meeting with sponsor									
Submit signed sponsorship form									
Project aim & objectives									
Carry out Stakeholder Analysis									
Acquire access to relevant databases (PIPE,BHIS)									
Contact the HIPE department									
Monthly meeting Antimicrobial stewardship pharmacist									
Organise meeting with ED staff and ambulance staff									
First draft literature review									
introduction section									
Methodology section									
Measure									
Develop a list of quantifiable data for collection									
Develop list of medical charts for review , identify location on BHIS									
Order medical charts from hatch, DFU,DRM,									
Collect data from PIPE									
Retrospective review of charts									
Organise and have monthly meeting with sponsor for updates and guidance									
Develop bookmark COPD management plan for									
Analyse									
Submit signed sponsorship form									
Present at better beaumont - have slides ready									
analyse collected data									
write methods									
Improve									
Develop QI ED documents									
evaluation section written									
Discussion section written									
Submit draft of thesis									
Submit thesis									
Submit signed sponsorship form									
Key:	Done								