Improving the Time to Antibiotic Administration in Paediatric Febrile Neutropenia: Implementation of a Clinical Care Pathway in Saudi Arabia

Maddi Pole

A Thesis submitted to Auckland University of Technology in partial fulfilment of the requirements for the degree of Master of Health Sciences, MHSC

Faculty of Health and Environmental Sciences

Auckland University of Technology

2021

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Attestation of Authorship

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning."

Signed: Maddi Pole

Date: 23/03/2021

Abstract

Febrile neutropenia is a commonly experienced condition in patients undergoing chemotherapy treatment or immunosuppressive therapies. Most chemotherapy patients will experience febrile neutropenia at least once in their treatment course. Febrile neutropenic infections develop and spread faster in those with inadequate immunity. In the paediatric population, timeliness and effective antibiotic treatment is paramount to avoiding long term organ damage, and septic related deaths. Best evidence suggests that antibiotic treatment, intravenous fluid resuscitation and blood test investigations should be completed within an hour of arrival to an emergency department for febrile neutropenic patients. This time frame is crucial, in the prevention of potential organ damage which can occur with as little as 3 hours of uncontrolled and untreated febrile neutropenia.

The aim of this project was to develop and implement a clinical care pathway, to guide health care professionals to adequately treat febrile neutropenia in the paediatric population in Saudi Arabia. Through a synthesis of current evidence, international best care practice and local guidelines, a pathway was developed. This pathway was implemented and reviewed in accordance with Rosswurm and Larrabee's (1999) model for change to evidence practice.

This 6-step model focuses on identifying a problem and developing a change to improve outcomes through current best practice evidence and implementing and maintaining a proposed change. Through the initial assessment and investigation phases, treatment times for febrile neutropenic children were found to be significantly longer than current best practice guidelines. Further investigation revealed multiple factors influencing delayed treatment times, including poor nursing knowledge and confidence, a lack of specifically trained nurses and delayed antibiotic prescription times. Previous studies have shown that clinician's adherence to a structured guideline or clinical care pathway significantly improved

patient antibiotic administration times and health outcomes, reduced overall hospital stay, and increased patient and health care professional satisfaction.

With supportive evidence from approved paediatric febrile neutropenia pathways including The Royal Children's Hospital Melbourne (2020), Starship Hospital (Skeen & Teague, 2020) and the Children's Hospital of Philadelphia (2019), and alongside supporting articles and studies, I developed a clinical care pathway for King Faisal Hospital. This report will discuss the course of the project, following the phases of Rosswurm and Larrabee's (1999) model for evidence-based practice change. It will cover initiation of the pathway, the process of reviews and alterations with key stakeholders, and final implementation into practice. As well as a review of current literature and supportive evidence for improving treatment times for febrile neutropenic patients. Finally, a summary the results from clinical audits including pre-pathway implementation, post-pathway implementation and a discussion on the implications for the paediatric emergency department and future opportunities for King Faisal Hospital.

CHAPTER ONE

In this chapter I will introduce and define Febrile Neutropenia (FN), discuss the importance of clinical care pathways in the management of treatment, and describe the rationale for the setting of Saudi Arabia for this project. Furthermore, through looking to the history of clinical care pathways and the relevance of these in healthcare, this chapter will outline why this was an appropriate tool to utilise for this project. It is important to note the ethical decisions made for this project. Following Auckland University of Technology's Ethical Committee guidelines this project does not involve the collection of personal data, human tissue, animals, or requires health research funding, and therefore did not require ethical approval through the Health and Disability Ethics Committee (Auckland University of Technology, 2019). Furthermore, through discussions with the clinical educators at King Faisal Specialist Hospital and Research Centre (KFSH&RC), this project was considered a quality improvement initiative which would not breach patient or staff confidentiality and required time-stamp clinical data and not individual patient information. As well, patients are not exposed to new treatments or testing, and staff were provided anonymous channels of communication, therefore eliminating the need for KFSH&RC review. The conversations were had with the clinical educators and key stakeholders discussing the ethical processes, and as it appeared we would not be exposing staff and patients to new medicine, the hospital was happy to proceed following guidelines of a quality improvement practice, therefore not requiring approval from the KFSH&RC ethical committee.

Febrile Neutropenia

Febrile Neutropenia is a serious complication frequently associated with chemotherapy or any immunosuppressive therapy, and is one of the most common reasons for presentation or non-elective hospitalisation of paediatric oncology patients (Paolino et al., 2019). Patients undergoing cancer treatments are of highest risk of developing febrile

neutropenia due to the sudden loss in immunity, caused by chemotherapy. According to Weycker et al. (2013) 95% of chemotherapy patients experience febrile neutropenia at least once during their chemotherapy course, and consequently has a mortality rate of 8.1%.

Neutropenia

The Infectious Diseases Society of America and American Society of Clinical Oncology defines neutropenia as an absolute neutrophil count (ANC) of 500 cells/mm3 or less than 1000c/mm3 with an anticipated reduction to less than 500c/mm3 within 48 hours, despite everchanging medical practice, this neutropenic definition has remained constant through the years (Hughes et al., 2002; Taplitz, et al. 2018). Chemotherapy and cytotoxic medications are given to patients with cancer and dramatically reduce the number of white blood cells in the body, which are imperative to fighting and preventing infections. Therefore, if a patient suddenly loses the vast majority of their white blood cells due to chemotherapy, they are at higher risk of developing serious infections (Stephens, 2020). They are not only more at risk of getting the common cold, but because of this reduced immunity, do not have the ability to fight off viruses and bacteria once contracted. Therefore, viruses like the common cold, or influenza spread faster, more powerfully and have a greater impact on health outcomes. Adverse effects of febrile neutropenia can lead to irreversible organ damage, multi-organ failure, and in some cases, death (Stephens, 2020; Weycker et al., 2013). More commonly it results in chemotherapy dose reductions, delayed cytotoxic therapy and thus substantial impact on overall morbidity and mortality (Stephens, 2020). A reduction in chemotherapy dose may have devastating effects on the effectiveness in cancer treatment (Stephens, 2020; Taplitz et al., 2018).

Febrile Illness

The word febrile, in medical terms means ‘fever’ (Stephens, 2020). Definitions of a fever and ways to treat a fever vary from organisation to organisation, and from clinician to

clinician. The Infectious Diseases Society of America and The American Society of Clinical Oncology determine a febrile illness in relation to neutropenic patients with a single oral or tympanic temperature equal to or greater than 38.3°C or a temperature of >38.0°C maintained over a one-hour period (Taplitz et al., 2018). However alternating definitions from major organisations include: two recorded temperatures equal or greater to 38.3°C within 1-3 hours, or unrelieved for over one hour (Bow & Wingard, 2020; Hughes et al., 2002), or subjective temperature with supporting clinical evidence such as flushed cheeks, tachycardia or lethargy (Lucas et al., 2018). For patients with entirely supressed immune systems, a fever may be the only indication of an underlying infection (Hughes et al., 2002). UpToDate, and current best practice guidelines support the definition provided from The Infectious Diseases Society of America, which defines a fever as a single recorded temperature of equal or greater than 38.3°C (Bow & Wingard, 2020; Taplitz et al., 2018). Therefore, this is the definition utilised for this practice project.

There is consensus among current best care guidelines that state patients are deemed appropriate for a febrile neutropenic treatment pathway if they:

- are actively on chemotherapy or have been within a few months (depending on organisational guidelines) (Bow & Wingard, 2020) and,
- experience a febrile illness, requiring one recording of a temperature to warrant treatment.

Therefore, use of the absolute neutrophil count and white blood cell count to formally determine if neutropenia is present is not initially required to initiate treatment. Leading oncology organisations such as The Infectious Diseases Society of America and The American Society of Clinical Oncology (Taplitz et al., 2018), The Cancer Institute NSW (2020) and Australian and New Zealand Children's Haematology/Oncology Group (2020) therefore recommend not waiting for laboratory results prior to antibiotic administration.

They acknowledge that the speed and intensity at which viruses and bacteria can develop in an immunosuppressed patient can turn what might normally be a common cold, into severe sepsis and are potentially fatal (Stephens, 2020; Taplitz et al., 2018). It is also accepted that those presenting with a fever whilst currently immunosuppressed are likely to have reduced neutrophil count leading to neutropenia (Bow & Wingard, 2020). An imperative goal in treating febrile neutropenia is to get effective antibiotics administered as soon as medically possible. This is because serious organ damage begins to occur with every hour passed of untreated febrile neutropenia, and irreversible damage evident after three hours without treatment (Weiss et al., 2014).

In summary, the treatment options and definitions of febrile neutropenia vary between different health care settings. However, most practitioners understand that with every hospital visit or delays in treatment, the patients are at an increased risk of developing and worsening infections (Stephens, 2020; Taplitz et al., 2018; Weiss et al., 2014). Furthermore, effective treatment times and antibiotic treatment is prioritised over waiting for laboratory results, and other delaying factors to avoid potential deterioration (Klastersky et al., 2016; Rhodes et al., 2017; Stephens, 2020; Taplitz et al., 2018; Weiss et al., 2018).

Febrile Neutropenia in Saudi Arabia

King Faisal Specialist Hospital and Research Centre specialises in adult oncology and liver diseases. Patients seen are of all ages and from a variety of ethnic and religious backgrounds. The hospital is the main adult oncology centre within Saudi Arabia and therefore serves the country's population of 33 million, as well as patients from neighbouring countries such as Yemen, Oman and Jordan. It is not unheard of to have patients drive from one side of the country in the south to visit King Faisal Hospital in the centre. There is a considerable lack of primary health care facilities in the Middle East and often patients present late to the hospital in critical condition, reinforcing the need for faster treatment (Van

Weel et al., 2017). In saying this, many paediatric oncology patients around the Middle East have relocated to the capital city Riyadh, specifically to be within proximity to the hospital.

There is a high incidence of consanguineous relationships in the Middle East, with 20-50% of the married population of Saudi Arabia being first cousin relatives (Al-Gazali & Hamamy, 2014). This has been linked to significant health impacts on the youth of Saudi Arabia. Saudi Arabia also reports higher amounts of metabolic diseases in children and babies, sudden infant death syndrome, and higher rates of single organ failure and congenital health disease than other Arab countries, these have all been strongly associated with inbreeding (Alharbi et al., 2015; Al-Gazali & Hamamy, 2014). Specifically, hereditary cancer was prevalent in 40% of paediatric cancer cases in Saudi Arabia and parental consanguinity being the most frequent criteria in patients with rhabdomyosarcomas and brain tumours (Jastaniah et al., 2018).

As the leading oncology hospital in Riyadh, it is not surprising that febrile neutropenia is a common presentation seen in the paediatric emergency department at King Faisal Hospital, however it would be expected that management of these patients would follow international best-practice guidelines. Given the importance of time to antibiotic treatment described throughout three clinical care pathways and current evidence-based knowledge, it was necessary to determine if in fact King Faisal Hospital was meeting these target times, to maintain their status as the leading oncology centre for Saudi Arabia. Through the months of August, September, and November 2019 a clinical audit was conducted to specifically look at the hospital stay of febrile neutropenic patients. Beginning with their arrival into the emergency department and assessing the time it took for a nurse and doctor to assess, until time it took to receive antibiotic treatment. In those three months, 97 children (aged 3 months – 12 years) presented with confirmed or suspected fever and recent immunosuppressive therapy. On average it took 3 hours 48 minutes to receive first line

antibiotics. In some cases, patients waited up to 9 hours and 10 minutes to receive appropriate initial antimicrobial treatment. These rates demonstrate a significant gap in the time between presentation to the emergency department and treatment and are not in keeping with the recommendations from international governing bodies (Klastersky et al., 2016; Rhodes et al., 2017; Stephens, 2020; Taplitz et al., 2018; Weiss et al., 2018). UpToDate, The Infectious Diseases of America and The American Society of Clinical Oncology (2018), and Weiss et al. (2014) advise that antibiotics should commence within one-hour of presentation to an emergency department, or within 30 minutes in probable sepsis cases (Bow & Wingard, 2020; Stephens, 2020).

King Faisal Hospital as leading hospital for cancer treatments in Riyadh and Saudi Arabia, should be following these evidence-based guidelines alongside other oncology treatment centres. However, this delay in treatment is not a foreign concept seen in oncology research and emergency departments, and has prompted hospitals globally to implement pathways into practice to improve this treatment time (Children's Hospital of Philadelphia, 2019; Levy et al., 2018). This project aimed to reinforce evidence-base practice at King Faisal Hospital, by implementing a clinical care pathway to reduce delay in treatment times and avoid adverse patient outcomes.

Clinical Care Pathways

A clinical care pathway is a tool used in many different scopes of healthcare globally. They are developed to meet an already predetermined criteria of patients, which will then follow the same treatment plan, with minimal room for adjustment and error (Bao et al., 2016). Clinical care pathways can provide patients and families with expectations of care, streamline tests and investigations, promote teamwork through multi-disciplinary inclusions and support utilisation of global and local policies (Evans-Lacko et al., 2010). A clinical care pathway or guideline is used to prompt testing and specific assessments, and in some cases,

support nurses to carry out assessment and interventions not usually practiced under their scope. The pathways are often set out in simple flow chart form and covers step by step points that a health care professional can follow to determine the direction of care. As a result of the streamlined and directed care provided from clinical care pathways, organisations are seeing faster patient turnaround times and treatment, shortened hospital stays, consistency with different practitioners and ultimately improved health outcomes (Browne et al., 2002).

In the early twenty first century, Browne et al. (2002) conducted a study in a paediatric emergency department for the introduction of clinical care pathways for three common presentations (gastroenteritis, asthma, and croup). Over their two-year study they compared 2854 children managed by a clinical pathway compared to 2680 children managed prior to pathways being introduced. Their aim to streamline care and create a standardised treatment plan found a significant reduction in admission rate (reduced from 23.6% to 9.1%), and similarly, the length of hospital stay itself was reduced from 32.7 hours to 17.5 hours. Additionally, 3.6% of the children treated on a clinical care pathway made an unscheduled medical visit/representation to the emergency department following discharge, compared with 4.9% of those representing without being treated on the clinical care pathways. Staff received training and regular updates during the implementation which not only aided in adherence but contributed to more confident and effective treatment being provided to patients.

An added benefit of this study conducted by Browne et al. (2002) was high parental satisfaction reported for those with children on the clinical care pathway. They summarised that the clinical care pathways in their department allowed for rapid stabilization, reduction in admission rate and hospital stay and were well accepted by both practitioners and parents. Chin et al. (2002) conducted a similar study over a 6-month period. Chin et al. focused on the presentation of croup in children between the ages of 6 months to 10 years. They had 157

participants in the pre-clinical care pathway trial, and 110 participants post implementation of the clinical pathway. Similarly, to Browne et al. (2002), they found a reduction in hospital stay from 18.9 hours to 5.2 hours, hospital admission rates dropped from 52.9% to 18.0%, and additionally found that there were zero intensive care admissions compared to the 15 admitted in the pre-clinical care pathway trial. Both Browne et al. and Chin et al. found zero adverse events in the children treated on the clinical care pathways.

Clinical care pathways for oncology patients have been in use for some time, and it is widely recognised that these are an effective tool to provide evidence-based care (Chiang et al., 2017). From the perspective of healthcare professionals and healthcare organisations within oncology care they are considered useful for improving multidisciplinary communication and have the benefit of improving care planning and promoting safe quality management of the treatment and side effects of oncological presentations.

As previously stated, febrile neutropenia is a common side effect of the chemotherapy that paediatric patients receive (Lehrnbecher, 2012)**.** Due to the potential for severe complications in relation to sepsis including organ damage and death, prompt recognition and treatment is paramount (Davis & Wilson, 2020).

Several studies have found that with each hour that passed with a patient not receiving adequate treatment for febrile neutropenia, irreversible organ damage and risk of shock increased (Davis & Wilson, 2020; Stephens, 2020; Weiss et al., 2014**)**. Weiss et al. (2014) found by the third hour of failure to treat and recognize sepsis, mortality rates in the paediatric intensive care unit reached 95%. Given that rapid assessment and treatment with antibiotics for febrile neutropenia are considered critical, oncology patients are often seen and initially managed in the emergency department before they are hospitalised (Demetrios et al., 2014). Murray et al. (2017) concluded that faster recognition of sepsis in paediatric patients allows for more adequate administration of front-line antimicrobials and an avoidance of

adverse effects, can be achieved through the introduction of clinical care pathways to commence treatment in emergency departments. Currently in the King Faisal Hospital paediatric emergency department, the average time of antibiotic administration from arrival is 3 hours, 48 minutes. This average time is putting the paediatric oncology population in a high risk for life threating conditions due to delayed treatment and adequate management.

The aim of this practice project is to develop and implement a clinical care pathway that follows evidence-based practice and is adjusted to meet the needs of the King Faisal Hospital population. Using Rosswurm and Larrabee's (1999) model for evidenced-based practice, a six-step implementation and evaluation phase, I aimed to improve the treatment times for a high-risk paediatric group, overall to shorten their hospital stay, and improve morbidity and mortality.

CHAPTER TWO

In this chapter I will provide insight into my role in the paediatric department at King Faisal Hospital. Furthermore, I will discuss the rationale behind the decision to utilise Rosswurm and Larrabee's (1999) model for evidence-based practice change and begin to assess and recognise the need for a practice change initiative. This is the first phase of the framework, which has involved a clinical audit to determine internal data, as well as a nursing survey which allows for the collection of nursing data to determine where problem areas may be. Furthermore, involved the development and identification of our key stakeholder team involved in the design, planning and implementation of the project.

In the beginning of 2019, I took on a new opportunity which saw me shift from working in the adult emergency department at King Faisal Hospital. I was transferred permanently to the paediatric department alongside a few staff members and had the task of improving the quality of care and flow of patients at King Faisal Specialist Hospital and Research Centre. The paediatric department was physically linked with the adult department, however operated completely differently. The paediatric department worked in a team nursing approach, for example two nurses would be assigned a row of beds to collaborate care together. Additionally, the paediatric 'code team' was made up of the paediatric nurses in the department on the floor. This was unlike the Adult Emergency Department which had a dedicated 'code team', who were not to take a formal patient load. This meant, any paediatric code or resuscitation pulled the paediatric nurses away from their patients to care for the imminently unwell until they were stabilised. Toward the end of the 2018, it was hospital policy that staff were rotated between both adult and paediatric zones. Unfortunately, concerns were raised by parents, staff and senior management about the quality and autonomy of care delivered. Adult trained nurses who were moved to the

paediatric area found challenges in the transition as they had to adjust to the significant differences between nursing adults and nursing children in both chronic and emergent cases.

In order to reduce these challenges management created a pool of nurses who were trained in paediatrics and agreed to work exclusively in the paediatric department. There were a few dual trained nurses and nurses who expressed interest in developing skills in both adults and paediatric emergency medicine who continued to work across both departments. The paediatric department had an independent resuscitation team made up of additional nurses who worked entirely within paediatrics. This team was self-sufficient and did not rely on input from the adult department regarding equipment or communication or support during emergency care. There was an established paediatric and neonatal intensive care room, code room, and isolation room all staffed by the paediatric nursing team.

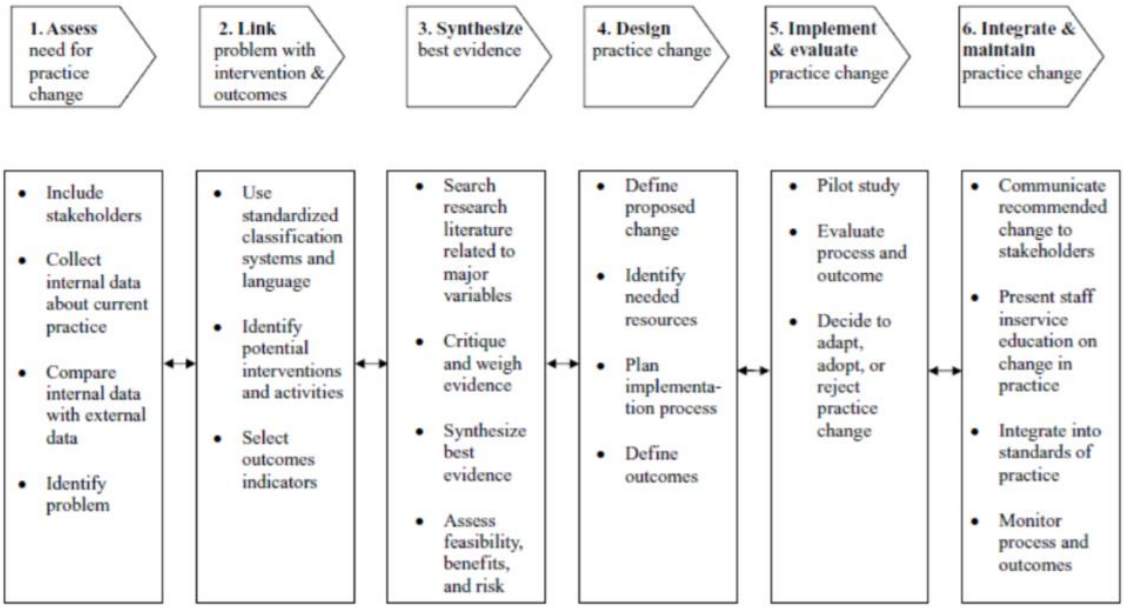
My role as the paediatric nurse team lead, was to observe the change and oversee current practice. It became evident through observing the unit that there was a considerable lack of communication and urgency regarding the management of unwell and immunosuppressed paediatric patients that presented. The more I experienced the flow and management of febrile neutropenic patients on the floor, the more I began to question the appropriateness of care being delivered at all. Through discussion with the nursing team, independent research, and previous experience with clinical care pathways, I floated the idea of this practice project to the paediatric clinical educators. In August 2019, I put together a proposal with supporting evidence of current best practice, opportunities for the department and hospital to bring clinical care pathways to Saudi Arabia. I used Rosswurm and Larrabee's research model (1999) to develop this research project. The following chapters outline each phase of Rosswurm and Larrabee's model into individual sections which outlines and explains the process of my implementation of a change in practice at King Faisal Hospital.

Framework

The model utilised for this project was the Rosswurm and Larrabee's (1999) research model for evidence-based practice. This model was appropriate for this clinical pathway project as it focuses on an identified problem, creating changes to improve outcomes using current research and up to date literature (Rosswurm & Larrabee, 1999). It is commonly utilised in health care projects due to its detailed 6- step process that incorporates current evidence practice and solidifies change through integration and maintenance plans (Lancaster et al., 2004; Rosswurm & Larrabee, 1999). Each chapter in this report is dedicated to a phase of this model.

Figure 1:

Rosswurm and Larrabee's (1999) Model for Evidence-Based Practice Change



Phase One: Assessing the Need for Practice Change

Phase one of this research model is about assessing the need for change. Rosswurm and Larrabee (1999) suggest several ways to achieve this, including the gathering of internal data and benchmarking against external data. According to Rosswurm and Larrabee the assessment phase can be initiated through clinical audit or a clinician's recognition of a need for changing practice. Often an awareness of patient dissatisfaction can prompt a quality improvement audit, or alternatively the emergence of new evidence might prompt a department to adapt and consider a change to practice.

Phase one consists of several sub steps which include the data collection of current practice, comparing the internal data with external data, determining stakeholders, and then identifying the problem. A clinical audit was conducted in order to gather internal data as well as a nursing survey which identified key issues in current practice. This will aid with the second phase of Rosswurm and Larrabee's model which involved linking the problems discovered with interventions and outcomes.

Assessing the need for change was initiated through my own personal involvement as a staff nurse in the paediatric department at King Faisal Hospital. This was completed through exposure, actively experiencing the flow and care of the patients in the department, personal observations, and clinical interaction. This led me to question the appropriateness of care being delivered in specific cases. After several occasions I began to question if the care was following best practice guidelines at all. Children who were presenting febrile and lethargic were observed waiting without treatment and assessment for hours, with an inconsistent delivery of care between each health practitioner. For example, some practitioners treated the fever as emergent and selected antipyretics over antibiotics, others opted for intravenous fluids first, or alternative investigations such as chest x-rays and urine testing were given priority, despite active febrile neutropenia. As I have only had minimal

exposure to cases of febrile neutropenia in New Zealand, my personal clinical knowledge regarding oncology and febrile related illnesses was relatively limited. Therefore, through personal clinical reflection I began to question what could be done. Children were in pain, miserable, and febrile for hours without assistance, nonetheless febrile illnesses are very much treatable in a pharmacological and non-pharmacological sense. My own experience as an emergency department nurse taught me that prolonged fevers are dangerous in all children and can result in seizures and organ damage, however I did not understand the risks involved for those who were immunosuppressed.

This led me to undertake a brief review of the current evidence relating to management of febrile neutropenia in children. It became evident through a review of external data in the form of the literature that immunosuppressed children are at higher risk of developing infections with irreversible consequences if left untreated (Bow & Wingard, 2020; Taplitz et al., 2018). I began to understand how imperative it was to avoid any delay in antibiotic treatment for febrile and neutropenic patients. I investigated leading cancer organisations and articles that provided evidence-based guidelines, such as the Cancer Institute NSW (2020), and American Society of Oncology and the Infectious Diseases Society of America (Taplitz et al., 2018) to determine current best practice. Furthermore, I explored paediatric hospitals and emergency departments which currently treat febrile neutropenia using clinical care pathways, such as the Royal Children's Hospital Melbourne (2020), and the Children's Hospital of Philadelphia (2019), both of which have been endorsed by local oncology societies, and government organisations. The findings from this review are explained in greater detail in Chapter 3.

Clinical Audit

As part of the process of collecting internal data, I completed a clinical audit to assess the current context and to determine if my suspicion that patients were experiencing delays in

treatment were warranted. I wanted to find out if my personal experiences on the floor, were reflected in documentation, and how prevalent the delayed care potentially was. The aim of a clinical audit is to highlight discrepancies in healthcare by measuring current and ongoing practice against hospital standards or evidence-based medicine (Shankar et al., 2011). It is utilised in continuous quality improvement processes that focus on targeted areas of clinical practice (Esposito & Dal Canton, 2014). A clinical audit of patient data was deemed to be an effective tool to utilise for this phase of the project as my goal was to establish a need for change. By accessing data that outlined the course of a patient's hospital stay, I was able to compare this data with current evidence-based guidelines, and best care practice. This audit appropriately contributes to the first phase of Rosswurm and Larrabee's (1999) research model.

Method. Fortunately, Saudi Arabia utilizes an online system which stores capacity management, and all interventions, assessments, vital signs, and medication administration are recorded, and time stamped online. This capacity management tool saves patient data and medical history which each presentation and is the main source of patient records. King Faisal Hospital is generally a paperless system with a few exceptions of electrocardiogram print outs, urine dip testing results, and arterial blood gas results.

The first process of the clinical audit was determining a time frame. I entered 01/08/19 into the search frame which showed every patient that presented in that month. I then entered the criteria as single search terms, which bought up every patient that related to that search term, through triage codes and diagnoses. From there I was able to obtain a patient's national health number. I individually searched each patient that matched the criteria to determine if febrile neutropenia was present during their stay. Following this, I was able to investigate the exact time the antibiotics were prescribed and administered. I was also able to observe at what time the doctor assessed the patient and when blood samples were obtained.

Patients who would meet a clinical care pathway criterion from previous months were examined. The criteria for the patients, met the guidelines and definitions set out by the Infectious Diseases Society of America and the American Society of Clinical Oncology.

Criteria. Patients were included in the clinical audit if they met the following presenting symptoms:

- Febrile (38.0 sustained over an hour, or a single recording above 38.3)
- Recent chemotherapy within 3 months
- Neutropenia present on laboratory results
- Lethargy, tachycardia and/or flushed cheeks on presentation
- Admitted under Oncology/Haematology
- Age 3 months – 13 years

(Bow & Wingard, 2020; Taplitz et al., 2018)

Patients were excluded if there was no evidence of fever or neutropenia. The two other important comparable factors moving forward for the project was to determine when the medication was prescribed, and when the antibiotics was administered. Given the aim of the project overall is to ensure effective and timely antibiotic administration, for the future clinical audits, these are the key factors assessed.

Results. The first audit took place in August 2019 and 36 patients were identified that would meet the international criteria for being placed on a clinical pathway. For appropriate pathway candidates, the average time it took for an antibiotic to be prescribed (TAP = Time for antibiotics prescription) was 1 hour, 48 minutes. The average time it took for the antibiotics to be administered, from time of arrival (TAA = Time for antibiotics administration) was 3 hours, 7 minutes. The audit was then repeated for September 2019 and November 2019. The month of October was excluded for cultural holidays having direct impact on nursing care. This was due to Ramadan, which reduces staff numbers significantly,

inhibits medication administration between day light hours, and for the month would be an inaccurate representation of patient data to accurately represent regular treatment times. September showed an average TAP of 2 hours and 20 minutes, and TAA of 4 hours and 8 minutes. The month of November showed an average TAP of 2 hours 40 minutes and a TAA 4 hours and 10 minutes. This prolonged period confirmed my initial thoughts and recognition that there was a significant delay in treatment for these patients. In comparison to best care practice the current TAA for King Faisal Hospital averaging at 3 hours 48 minutes, was significantly behind the recommended TAA of 60 minutes (Taplitz et al., 2018).

Identifying Stakeholders

Another important factor in the first phase of Rosswurm and Larrabee's research model (1999) is to determine a group of stakeholders. According to Rosswurm and Larrabee, key stakeholders are a group of individuals or team members who are imperative to approving, designing, and aiding with the project. Furthermore, stakeholder engagement has additionally been described as essential for shifting knowledge and ideas into action, in the healthcare setting (Norris et al., 2017). By obtaining stakeholders across hierarchical groups that differ in power, knowledge, motives and status, multiple views and ideals can be discussed and considered. As well, stakeholder groups comprised of multiple disciplines tend to secure a deeper analysis of research and implementation (Clarke et al., 2010; Norris et al., 2017).

Identifying stakeholders also involved determining staff who would provide medical advice, ideas, and appropriate critique. According to Clarke et al. (2010) and Norris et al. (2017) a stakeholder is anyone who has a vested interest in the process or potential outcome. They should vary in their level of interest regarding goals, motivations, and concerns. Key stakeholders are those who are significantly invested either by direct outcome, or influence (Greenhalgh et al., 2004). I began speaking with colleagues who might be open to discussing

quality of care, and who played vital roles in the treatment being delivered. Senior medical officers were recruited to oversee the safety of the project and be responsible for the other physicians involved in the implementation of the pathway. Clinical educators were included as their day-to-day role oversaw the education and upskilling of staff and could be physically present for the implementation phase, as staff support. Charge nurse manager involvement was important due to changes occurring within the department, and for nursing feasibility and safe staffing. By getting a diverse group of health care professionals as my key stakeholders I was able to obtain different viewpoints, understandings of febrile neutropenia, and priorities during the planning phases of this project. This is known as hierarchal stakeholders which provide different perspectives and challenges to consider when undertaking practice change (Clarke et al., 2010; Norris et al., 2017).

Once the key stakeholders were determined, a variety of methods were used to establish everyone's priorities and values for the project. Email was the primary method of communication with the senior management team, whereas face to face in-person discussions occurred with the paediatric nursing staff.

Key Stakeholders

- Associate Clinical Charge Nurse
- Two paediatric clinical nurse educators
- Paediatric Senior Medical Officer
- Paediatric Oncology Specialist
- Two paediatric senior nurses

After the initial clinical audit which determined that time to antibiotic administration was not meeting the recommendation of current best practice guidelines, it was concluded that a potential solution could be the implementation of a clinical care pathway (Bow and

Wingard, 2020; Taplitz et al., 2018). Following similar practice changes from The Royal Children's Melbourne Hospital (2009) and the Children's Hospital of Philadelphia (2017) who saw success in improving the time to antibiotic administration for febrile neutropenia using a clinical care pathway. I discussed this with the paediatric clinical educator initially, who was to be a co-leader and key influencer in this project. Together we developed the team of stakeholders who would collaborate on the project with us. Associate Clinical Charge nurse, senior nursing management and a paediatric senior medical officer were involved in the initial survey via email, and paediatric nursing staff were mostly consulted through group conversations, in-service sessions, and additionally through email communication. The senior medical officer facilitated surveys and conversations with the physician staff since the physician work force was too large for me to communicate with, and this person was the dedicated lead for the doctors to report too in regards to implementation, questions and medical concerns during the project.

Nursing Survey

Since the project was influencing all nurses working in paediatrics, it was also vital to include them in as stakeholders. Although not part of the key stakeholder group due to the larger number of staff nurses, the nurses were the ones explicitly implementing and utilising the care pathway. Therefore, initial surveys were sent out to the nurses through paper copy and email communication. We allowed paper copies to remain as an anonymous option for staff, to provide personal safety and reassurance if they felt necessary. We surveyed paediatric nursing staff which gauged potential support of the new pathway, current knowledge and confidence of staff treating febrile neutropenia. See Appendix for a summation of results.

The survey was undertaken in November 2019, prior to implementation of the pathway and during auditing and research phases. It was made up of scale questions, closed

questions and allowed space for nurses to make personal comments and concerns. The survey provided insight into some potential practice changes needed to be made to aid the successful implementation of the pathway and improve nursing care. There were 26 paediatric nurses that made up the nursing team at the time of survey. All nurses were surveyed and returned results within the month of November.

Survey Findings

The following section discusses the key findings that came from the survey. With some elaboration provided by the nurses themselves in the comment section of the survey, we were able to gain insight into some key areas of practice that need to be addressed prior to a clinical pathway implementation. This can be seen in the Appendix.

Lack of Port-A-Cath Access. A significant finding from the survey, was the fact that 100% of nurses surveyed did not possess the skills to access Port-a-caths. Port-a-caths are also known as Central Venous Access Device, or CVAD (VanHouwelingen et al., 2018). They allow for long term vascular access providing chemotherapy, antibiotics and intravenous medication administration and total parenteral nutrition if required (VanHouwelingen et al., 2018). For febrile neutropenic patients, port-a-caths can provide rapid intravenous access, allowing for antibiotics to be administered more efficiently than peripheral sites. Current clinical care pathways recommend utilising Port-a-Caths, this allows for fluid resuscitation and antibiotics to be commenced within 30 minutes from arrival (Children's hospital of Philadelphia, 2017; The Royal Children's hospital Melbourne, 2009). As of November 2019, at King Faisal Hospital, there was a dedicated Port-a-Cath access nurse, who was trained in the skill and contracted hospital-wide. However, this nurse operated on a schedule and therefore worked on a first come, first serve basis and emergency cases did not take priority. It was common practice at King Faisal Hospital to have children on chemotherapy to already have a port inserted, and so when they present to the emergency

department it can be accessed immediately. Therefore, this was deemed a significant contributing factor to the delay of treatment and laboratory testing among paediatric oncology patients.

With this knowledge, myself and the educator discussed teaching sessions and in-services for the paediatric staff in preparation for training nurses. In December we began the process of training and practicing, and by January 2020 during the implementation phase we had 100% of paediatric nurses signed-off in Port-a-Cath access.

Inexperience. Of the paediatric nursing staff over half felt their knowledge regarding febrile neutropenia was *'not enough to even get by'*, and a third of staff would either *'actively avoid'* the cases or *'completely rely on another nurse's full support and direction'*. More significantly, over half of the nursing team felt current practice was unsafe and were unsure if the current practice followed best practice. A common theme in the comments of the surveys saw nurses interested in learning more about febrile neutropenia and treatment, and were open to adapting to a pathway to help improve practice. However, staff suggested additional teaching sessions would be needed prior to implementation.

Prior to implementation and based on the results of this survey, the two clinical educators provided the staff with an online teaching tool, already in practice at King Faisal Hospital. They also held multiple education sessions and in-services which allowed face-to-face teaching in preparation for the pathway implementation, this is discussed further in Chapter 4.

Champions. A third key theme that was established through the survey was the interest in nursing 'champions'. At King Faisal Hospital, 'champions' are nursing staff who pick an area of interest or are chosen to be leaders in an area of focus, or during changing practice. According to White (2011) and Miech et al. (2018) nursing champions are a strategy implemented in healthcare globally. A nurse champion is a practitioner who is passionate

about improving the quality of care, either self-appointed or selected by peers. Champions feel personal ownership of the innovation and promote it throughout their daily practice. They are highly educated and skilled and are therefore able to orientate their peers to the change, and encourage adapting practice (Miech et al., 2018). This was discussed by key stakeholders during the design phase and although not approved for application during the initial implementation, it was an easily applicable option once the pathway had begun implementation to maintain momentum. Nursing champions are greatly beneficial in ensuring new change is constantly promoted and maintained once changes have ceased (White, 2011).

Phase Two: Linking a Problem with Outcomes and Interventions

The second phase in Rosswurm and Larrabee's (1999) research model is to link the problem identified in phase one, with an outcome. Practitioners need to define the problem using a standardized language, and agreement upon classifications obtained from governing bodies during this phase (Rosswurm & Larrabee, 1999). This phase will also identify the current problems, interventions to improve the established problems, and additionally select outcome indicators which will be utilised to track progress. The need for standardisation of definitions allows for consistency in the project moving forward. If members involved in the project have differing definitions of key topics, the outcome and goals of the project become affected (Clarke et al., 2010). The Infectious Diseases Society of America is a gold standard governing body for oncology definitions and treatment protocols, therefore their definitions regarding febrile neutropenia are the ones referred to throughout this project. In 2018, they partnered with the American Society of Clinical Oncology to provide unanimous definitions regarding oncological diseases, including febrile neutropenia, and aims of treatment and protocol management (Taplitz et al., 2018). Moreover, since Saudi Arabia follow an American based health care system, there was consensus among the key stakeholders that definitions provided by American Society of Clinical Oncology was the most appropriate

source for this project, as well an organisation already utilised by King Faisal Specialist Hospital and Research Centre. Therefore, the key definitions such as fever and neutropenia which are frequently differing from organisation to organisation are outlined in chapter one and supported by the Infectious Diseases Society of America.

Linking the problem to an outcome

In the first phase, we assessed a need for change. Through practitioner recognition, and a clinical audit, it became evident that antibiotics were being administered in an incredibly prolonged time frame, far from current evidenced-base guidelines. Best practice for the treatment of febrile neutropenia aims to have antibiotics administered within an hour of presentation to an emergency department (Stephens, 2020; Taplitz et al., 2018). As a leading adult oncology centre for the Middle East, our goal was to be practicing within evidence-based guidelines. Therefore, our overall outcome was to improve the time to antibiotic administration to be within 60 minutes of arrival to the Emergency Department. To commence phase two, we began linking the identified problems to our potential outcomes. We planned and initiated a nursing survey, which uncovered factors that was influencing the delay in treatment. Through this survey we determined a knowledge gap in most nurses, and an unawareness to the current best-practice guidelines for febrile neutropenia alongside a considerable lack of nurses untrained in Port-a-Cath access. Port-a-Caths are central venous access devices already implanted in patients receiving chemotherapy. Since peripheral veins are often weak and damaged, obtaining intravenous access on an immunosuppressed child can be challenging. However, Port-a-Caths give direct venous access which allows for quick access to blood samples, and medication administration with less room for error and time delay compared to intravenous access (VanHouwelingen et al., 2018). These were discussed among the educators and identified as a problem, so the clinical educators began training in Port-a-Cath access in December 2019. The lack of knowledge, and a high need for support

when caring for febrile neutropenic patients were two factors nurses commented on in the survey. These are the key problems identified for this project, the outcome we have determined will see the introduction of a clinical care pathway that will address these issues.

Clinical care pathways are utilised to streamline care, to provide autonomy to nurses and ensure consistency among practitioners (Evans-Lacko et al., 2010). A clinical care pathway has a specific algorithm to follow determined by current evidence-based practice and local guidelines. Therefore, staff utilising this can be confident that their practice is safe and up to date. Clinical care pathways have been shown to reduce patient stays through more efficient care and treatment being delivered (Browne et al., 2002). By streamlining care, and following an evidence-based protocol, nurses can advocate confidently to ensure practice is meeting the current recommendations of governing bodies. By outlining the main tasks when caring for febrile neutropenia, nurses will be able to tend to the highest priority patients and interventions, which the focus being on antibiotic administration time.

Outcome Indicators

Phase two of Rosswurm and Larrabee's (1999) research model also determines the select outcome indicators. For this project, the key indicator will be time to antibiotic administration. The overall outcome of this project is to implement an evidence-based guideline that aids nurses in decision making, and guides treatment and management of febrile neutropenia. Quick antibiotic treatment is one of the initial steps, and highest priority in treating febrile neutropenia (Bow & Wingard, 2020). We aimed to assess the success of the clinical care pathway, following implementation through the use of a clinical audit pre and post pathway implementation. Supporting factors will include time to antibiotic prescription, improved nursing knowledge, and an increase occurrence in Port-a-Cath access.

CHAPTER THREE

Phase Three: Synthesizing Best Evidence

The third phase of Rosswurm and Larrabee's (1999) model involves exploring the relevant research and synthesizing current evidence-based practice relating to the proposed change. The intention of this phase is to look outside the organisation of focus to explore the literature and determine if there is sufficient evidence to support a change in practice (Pearson, 2014; Rosswurm & Larrabee, 1999). By utilizing external sources such as specialist hospitals, leading medical organisations, and evidence-based practice research articles, clinicians may be motivated to adapt to the change. Observing hospitals who have experienced similar obstacles and problem areas and their identified solutions, can help to inspire change in the current hospital (Pearson, 2014).

In this chapter I will discuss the steps involved in synthesizing the best evidence. This includes a review of current research articles and best practice guidelines and an examination of organisations with existing febrile neutropenia pathways. I will describe the method utilised for searching literature, how decisions were made about which guidelines to focus on and what factors influences organisations to be included in the review. In the following section I will outline my process for each of these and then provide an overview of the key themes uncovered through doing this.

Search Strategy for Research Articles

I conducted a literature review using key health and medical databases including Google Scholar, UpToDate, MEDLINE and Child and Adolescent Health Services library. I was interested in a range of external data including previous practice projects exploring the topic of clinical care pathways, research studies and current best practice guidelines for the treatment of febrile neutropenia. The following key words were searched as individual and in combination: paediatric/pediatric, fever/febrile, sepsis, neutropenia/neutropaenia, oncology

management/treatment, and emergency department. Given this search was conducted while in Saudi Arabia and the online system automatically adapts to American grammar, I was conscious to include a variety of spelling options. To ensure I captured as much as possible from this review, I also used other common and accepted terms for clinical care pathways such as 'clinical guidelines' and 'bundles'. Resources were excluded if they dated prior to 1997, when the first approved guideline was introduced. Articles were selected based on their quality and use in current practice and were measured for credibility against the C.R.A.A.P method. This method determines currency, relevance, authority, accuracy, and purpose of articles (Fielding, 2019). Articles that have been endorsed by medical governing bodies and tertiary organisations were included, as well as two observational studies completed within hospitals which provided quality evidence in their original studies.

I originally planned to exclude studies that focused on adult patients, however due to the lack of suitable articles and established accredited guidelines with a strictly paediatric focus I decided to also include adult articles and guidelines in this review. I did this by looking through reference lists of accredited guidelines in the adult sector, as well as hospital developed guidelines that utilised similar resources. One of the other considerations in this review of evidence was the fact that many articles focused on the type of antibiotic being administered and on pharmacological priority rather than the time to administration. Although it was somewhat relevant to look at these to get an overall impression of the issues explored, the priority and focus of this review was the time to antibiotic administration and therefore those articles have been excluded. A summary of the findings from this literature review will be included in the subsections entitled synthesis of evidence.

Search Strategy for Guidelines

As King Faisal Specialist Hospital is heavily influenced by the American health care system, American oncology specialist organisations were initially focussed on. Guidelines

and recommendations from organisations who fund research and provide medical advice were assessed and discussed to begin with. I wanted to get a sense on the priorities in treating febrile neutropenia, and how this has changed through the years. Furthermore, because this project focusses on the treatment of febrile neutropenia in children, I then narrowed my search to paediatric only guidelines. This caused some limitations. Due to ethical and medical considerations, there are not as many trial-based articles focussed on paediatric oncology. Therefore, I investigated hospitals who have implemented their own observational studies. Articles that focus on the improvement of practice and targeting Emergency Departments have also been included. However, meeting some challenges with insufficient pathway projects in practice in America, I expanded to Australia and New Zealand. This provided two clinical care pathways, both developed within recent years and actively utilised today, and one from the United States all endorsed by governing bodies. It was important to include current pathways in use, to show the feasibility of this project, and additionally to draw inspiration from their priorities of managing febrile neutropenia.

Information was deemed to be relevant if it related to the key targets of this project. This led me to guidelines and articles from the American Society of Clinical Oncology, Infectious Diseases Society of America, and studies by Weiss et al. (2014) and Children's Hospital of Philadelphia (2017) which had similarities in their rationale for commencing febrile neutropenia pathways, as well as the Surviving Sepsis Campaign (Levy et al., 2018; Rhodes et al., 2017). Firstly, I began looking at the overall ideals and methods behind the treatment of febrile neutropenia and sepsis. I then specified my search to focus on the paediatric population by looking into hospitals actively utilising febrile neutropenia pathways in their departments and found two appropriate hospitals and their clinical care pathway (Skeen & Teague, 2020; The Royal Children's Hospital Melbourne, 2009). Specifically, I was looking for articles and guidelines that provided reference to and covered general

management of neutropenia, management of fever and sepsis in a non-oncology setting, management of febrile neutropenia, and a combination of the above, but with a paediatric specific focus. Each of these topic areas will be addressed in the following section.

Management of Fever and Sepsis in a Non-Oncology Setting. Through the guideline databases for the management of fever and sepsis I came across the 2016 update of the Surviving Sepsis Campaign (SSC) (Rhodes et al., 2017). This update, as with each SSC update was conducted independently from any funding organisations and comprised of 55 international experts utilising a modified Delphi method (Dellinger et al., 2008). The Delphi method is a consensus-based tool that creates a systematic method of collating informed ideals from a panel of experts in the field (Eubank et al., 2016). A benefit of this method is that it provides well controlled feedback from a group of selected experience personnel and decreases disadvantages of bias through anonymity, this therefore was appropriate and a credible article for this project (Dalkey & Helmer, 1963; Eubank et al., 2016). In their review they utilised a GRADE system, which scores the strength of treatment options, either valued one or two and indicates which interventions desirable effects outweigh the undesirable and should be prioritised in care. The key recommendation of the SSC administration of broad-spectrum antibiotic therapy within 1 hour of diagnosis received the highest grade and should be the most prioritised treatment. This was supported by evidence that showed with each hour that passed of active fever or sepsis the risk of mortality increased (Dellinger et al., 2008), and with evidence of a retrospective cohort study from 1989 to 2004 whereby Kumar et al. (2006) found a patient's survival rate of 79.9% is reached when antibiotics and appropriate treatments are provided in the first hour and reduced by 7.6% which each hour being left untreated.

Through the years momentum and support for rapid antibiotic treatment was gained by medical organisations, particularly by two governing bodies: Society of Critical Care

Medicine and the European Society of Intensive Care Medicine (Levy et al., 2018; Rhodes et al., 2017). In 2016, it was determined that the administration of antimicrobial therapy without any delay was best practice for the treatment of fevers and sepsis (Rhodes et al., 2017). Significant reporting's of acute kidney injury, acute lung injury, and organ injury have been noted as consequences when delays in antibiotic treatment occur (Levy et al., 2018; Rhodes et al., 2017). In 2018 'the hour-1 bundle' was created which expanded their initial antibiotic administration target time to aim for all resuscitation treatment and stabilising management to be completed within 60 minutes (Levy et al., 2018). Their new target involved the administration of antibiotics, intravenous fluid, antipyretics, completion of fluid bolus treatments, laboratory samples and cultures taken within the hour. The increased recognition regarding the critical nature of the first hour in recent years, has led to an improvement in high levels of treatments and rapid interventions within the 60 minutes of arrival, and is encouraged by Levy et al. (2018). Research has shown vast improvements in the patient's ability to recover, improved mortality outcome and shortened stays in hospital when consideration is given to the critical nature of the first hour (Kumar et al., 2006; Levy et al., 2018; Stephens 2020).

Although these improvements and recognition for fast antibiotic administration time results in positive outcomes for potentially septic patients, the surviving sepsis campaign and care bundle do not focus on the neutropenic patients. Levy et al. (2018) acknowledge that there are no published studies that have evaluated the efficacy of this hour-1 bundle in cases involving immunocompromised patients, and they acknowledge this is a significant gap that needs to be addressed in the future (Levy et al., 2018). This campaign was still beneficial and appropriate to include in this project, as even though they do not target neutropenic patients, they believe it is an accurate representation of current clinical practice that can be adapted and appropriate for burn emergencies or oncology emergencies, specifically febrile

neutropenia (Levy et al., 2018). Furthermore, as their review is conducted every 4 years, the evidence investigated is up to date and is critiqued and then agreed upon by the panel of experts in critical care, emergency, and sepsis management in healthcare (Eubank et al., 2016).

Management of Febrile Neutropenia. The next subject of the review of evidence was related to the general management of febrile neutropenia. I began the search by looking into the general recommendations for treatment and management of febrile neutropenia. Using the American Society of Clinical Oncology, UpToDate and the Agency for Healthcare Research and Quality which is supported by the Department of Health and Human Sciences in America, I searched for current evidence-based guidelines recommended by these governing bodies. There I came across over 350 articles using the search terms febrile neutropenia, treatment, and management in adults. This section takes an adult focus to determine the general practice and provide a comparison of treatment goals in adult and paediatric medicine. Guidelines were frequently excluded due to the date of publications being over two decades or taking an outpatient focus, so therefore not meeting relevant standards for this project. I narrowed down the time frame between 2010-2020, through using C.R.A.A.P and investigating which hospitals support the practice acknowledged by specific articles.

Taplitz et al. (2018) are a panel of specialist oncology physicians and researchers who write for the Journal of Clinical Oncology, on behalf of the American Society of Clinical Oncology (ASCO) and the Infectious Diseases Society of America (IDSA). The panel review current management of febrile neutropenia, highlighting changes to current evidence and aims to create a consensus among leading cancer organisations for adequate management of Febrile Neutropenia. Their recommendations for practice are utilised by the governing cancer organisations mentioned above, as well as healthcare education providers and medical

guideline platforms such as UpToDate and are treated as current best practice. In 2013, the guideline was ASCO-vetted and endorsed as an international medical guideline (Flowers et al., 2013). I chose this article as a key resource as their reviews occur approximately every seven years, and with each update the panel completed a comprehensive review of relevant studies and published literature which support or argue changes in practice. Furthermore, their reviews are widely supported in the oncology sector by IDSA, ASCO, Starship Hospital (Skeen & Teague, 2020) and the Cancer Institute NSW (2020).

Through the years, discussions have been widely had regarding specific antimicrobials, chemoprophylaxis, radiographic interventions, and culture testing, which remain heavily discussed today (Kumar et al., 2006; Rhodes et al., 2017; Stephens, 2020). When researching protocols and management of febrile neutropenia, the time to antibiotics administration is consistently reported as one of the most significant factors to consider for the successful treatment of febrile neutropenia (Rhodes et al., 2017; Stephens, 2020; Taplitz et al., 2018; Vicente et al., 2017; Weiss et al., 2018; Williams et al., 2014). The American Society of Clinical Oncology determined that antimicrobial therapy should be the first medical intervention for febrile neutropenia, and given without delay, in 1997 (Flowers et al., 2013). With evidence of potentially fatal adverse effects becoming evident through the years, ASCO enforced 60-minute antibiotic target times, and 30-minute target time for critical cases, as gold standard practice for febrile neutropenia (Taplitz et al., 2018). Since then, the Time to Antibiotics Administration (TAA) has become a well-recognized determinant of mortality in patients with febrile neutropenia and is currently being promoted as the first-line treatment in any febrile neutropenic patient (Rhodes et al., 2017; Stephens, 2020; Taplitz et al., 2018; Weiss et al., 2018).

Klastersky et al. (2016) published a guideline on behalf of the European Society for Medical Oncology (ESMO) in the Annals of Oncology providing current evidence-based

management of febrile neutropenia to health care professionals across Europe. Their summation emphasised rapid antibiotic administration, advising antibiotics should be given within 60 minutes of arrival to the hospital. Similarly, Williams et al., (2014) obtained a 100% success rate of patients receiving antibiotics within an hour of arrival to hospital, following clinical care pathway implementation after this target time was established. Their nurse led clinical pathway was developed to promote adherence to national guidelines, specifically the one-hour antibiotic administration target (Williams et al., 2014). Furthermore, they discussed the importance of local hospital guidelines pathing the way for success with the view that clear protocols to manage these patients appropriately will avoid a delay in care, and aid to promote best practice (Klastersky et al., 2016; Williams et al., 2014).

Paediatric Focus

The reviewed articles above from Taplitz et al. (2018), Klastersky et al. (2016), and supporting evidence from Flowers et al. (2013) and Stephens (2020), focus on the general treatment of febrile neutropenia rather than addressing the issues and concerns related to paediatric medicine. There is a lack of guidelines and trials that focus specifically on paediatric febrile neutropenia (Lehrnbecher et al., 2012). However, with advancing knowledge and treatment plans in adults, individual organisations and paediatric hospitals have completed independent retrospective studies within their own departments to improve outcomes for febrile neutropenia in paediatrics. Two good examples of this are the Children's Hospital of Philadelphia (2019) and Royal Children's Hospital of Melbourne (2009).

Using paediatric hospital databases and the Child and Adolescent Health Services library I searched for guidelines with a paediatric focus, specifically utilizing paediatric search terms, and paediatric specialist hospitals. This was important to consider as my project focusses on the needs of the paediatric population which differ from the adult population in several ways, including differentials in development, pharmacological needs, and

presentations of symptoms (Sung et al., 2011). Sung et al. (2011) support the validity of the febrile neutropenic guidelines from Infectious Diseases Society of America and the National Comprehensive Cancer Network for practice, even though this has an adult focus, Sung et al. (2011) support the credibility in these studies, and believe this requirement for faster treatment times should represent both adult and paediatric sectors. However, they support the push for more paediatric-only guidelines to be published due to the important differences adult and children with cancer have. There are many things not taken into consideration in adult guidelines that are important in the care of children. Family, psychological considerations, host, environment, differentials, and ethical considerations all differ and impact on the evaluation of treatment in the context of children with cancer (Sung et al., 2011).

Clinical Pathways in Practice

Clinical care pathways are healthcare tools developed to guide and streamline care for specific conditions. They are developed to focus on a specific population of patients that provides evidenced-based practice to a pre-determined criterion of symptoms (Bao et al. 2016; Evans-Lacko et al., 2010). A clinical care pathway or guideline can be utilised by any healthcare professional that prompts testing and specific assessments, and in some cases, allows nurses to carry out assessments and interventions not usually practiced under their scope. The pathways are often set out in flow chart form, that are simple and easy to follow, it covers step by step points that a health care professional can follow to determine the direction of care. As a result of the streamlined and directed care provided from clinical care pathways, organisations are seeing faster patient turnaround times and treatment, consistency with different practitioners and ultimately resulting in shorter patient stays (Browne et al., 2002). I began to look at clinical care pathways in a generic search, to obtain and understanding on the benefits and challenges met with implementation and development of

the pathways. Following C.R.A.A.P evaluations, I began looking into hospital organisations who have implemented clinical care pathways, specifically within Emergency Departments, with the goal of streamlining treatment.

I narrowed the search results down to three emergency departments in America who reported their study results. Browne et al., (2002) conducted a study in a paediatric emergency department for the introduction of clinical care pathways for three common presentations (gastroenteritis, asthma, and croup). Throughout the two-year study they compared 2854 children managed by a clinical pathway compared to 2680 children managed prior to pathways being introduced. Their aim to streamline care and create a standardised treatment plan found a significant reduction in admission rate (reduced from 23.6% to 9.1%), and similarly, the length of hospital stay itself was reduced from 32.7hr to 17.5hr. They summarised that the clinical care pathways in their department allowed for rapid stabilization, reduction in admission rate and hospital stay and were well accepted by both practitioners and parents. Chin et al. (2002) conducted a similar study however limited to only 6 months. They found a reduction in hospital stay from 18.9 hours to 5.2 hours, hospital admission rates dropped from 52.9% to 18.0%, and additionally found that there were zero intensive care admissions compared to the 15 admitted in the pre-clinical care pathway trial. Similar results presented by Bekmezian (2015) found corticosteroids administered 45 minutes faster with a clinical care pathway for Asthma in paediatric emergencies. Moreover, fewer children were exposed to chest x-rays, and more children received their first bronchodilator dose within the first hour of arrival. Overall, Bekmezian found fewer hospital admissions post-pathway intervention. They concluded the clinical pathway was directly associated with improved adherence to hospital guidelines and subsequently reduces hospital admissions and unnecessary interventions. The improvement these hospitals experienced through the clinical

care pathway implementation supported my initial proposal to the key stakeholders and determined the intervention for our defined problems in Chapter 2.

Paediatric Febrile Neutropenia Specific Clinical Care Pathways. Following the overview of general clinical care pathways in the previous section, I then investigated febrile neutropenic specific pathways and articles. Those with approved or active clinical care pathways which had supportive evidence to rationalise why they undertook their research and how this has improved practice were included. I excluded pathways that had no organisational affiliations, or clear research frameworks. I broadened the search to outside of the Middle East and United States of America to obtain policies from a global perspective and assess the potential differences in management and pathways. There were three key pathways I selected, from New Zealand, Australia, and the United States of America. I chose these as they are all supported by evidence from their independent hospital study or endorsed by governing bodies such as the Cancer Institute NSW and the Australian and New Zealand Children's Haematology/Oncology Group that oversee medical advancements in paediatric oncology. Furthermore, I have included in this section, supportive articles that specifically focus on improving the time to antibiotic administration.

Weiss et al. (2014) investigated the risk of delayed antimicrobial treatment in the paediatric intensive care unit through a retrospective observational study. Their findings show that with each hour that passed of a patient not receiving adequate treatment for a febrile illness or sepsis, organ damage and shock increased. Moreover, they found significant effects after 3 hours where mortality reached 95%. Unfortunately, there was no follow up study that implemented an improvement program. However, Weiss et al. provided a recommendation for a febrile sepsis pathway to be commenced in emergency departments to allow for faster treatment and recognition. In a separate organisation in the United States, the Children's Hospital of Philadelphia (2017) recorded rising rates of multiorgan failure and sepsis related

deaths. They recognised the need for change in the beginning of 2013, and their response to this saw the introduction of three clinical care pathways: Febrile Patient, Fever in Neutropenia, and Sepsis. Over the 5-year implementation study, rates of TAA under 90 minutes improved from 42% to 79% and overall sepsis related organ dysfunction reduced by 10%. Similarly, a prospective study compared historic patients in 2012, with patients in 2013 following the implementation of a febrile neutropenic pathway (FNP). In total, 276 non-pathway applied cases were compared with 223 pathway applied cases. Their finding was that the use of FNP reduced TAA from 235 minutes to 81 minutes, with their initial TAA target of 90 minutes after presentation. Their target TAA was 90 minutes, as the ASCO recommendation of TTA < 60 minutes had not been published until after the completion of their study. In a recent update, the Children's Hospital of Philadelphia (2017) follow the governing bodies recommendation, and now aim for a TTA of < 60 minutes (Children's hospital of Philadelphia, 2019). Their FNP gives mention to the study that Weiss et al. (2014) produced that suggested the implementation of a clinical care pathway should be the next intervention in improving treatment and outcomes for FN patients.

Across Australia and New Zealand Haeusler et al. (2018) conducted a survey assessing 16 hospitals for their current response to febrile neutropenia in paediatrics. According to the respondents, only 24% reported utilising a febrile neutropenia clinical care pathway. Potentially due to a shortage in current research into paediatric febrile neutropenia, endorsed clinical care pathways have only been implemented by a few hospitals in Australia and New Zealand. Most current, and validated research has been conducted in the United States and across Europe where the demand is higher (Haeusler et al., 2018). Despite this, of the respondents 72% reach the ASCO recommendations of a TAA < 60 minutes in febrile neutropenic patients and 64% met ASCO recommendations of TTA <30 minutes in the septic patient's category (Haeusler et al., 2018). Since a majority of hospitals in Australia and New

Zealand are meeting the current requirements for TTA with and without the support of a clinical care pathway, further initiatives to prompt faster treatment may not be deemed necessary and may be another reason why oncological clinical care pathways are not universally utilised in Australasia. This research also provided insight into the reasons why there may be a delay in the administration of antibiotics. According to the respondents there were several reasons why delays occurred. The respondents describe prolonged antibiotic treatment times were due to a lack of available Central Venous Access Device (CVAD) trained staff, patient, and family requests for specifically trained professionals, which is not always achievable in an emergency department due to rostering and other clinical duties. Arriving without topical anaesthetic cream applied, which provides numbing of the skin above a CVAD port or for peripheral punctures, and the bypassing of local hospitals, which can delay where the initial treatment commences. There are similarities between the findings from Haeusler et al. (2018) and the findings from the nursing survey conducted for this project, specifically regarding CVAD trained staff and the bypassing of local hospitals. Although the bypassing of local hospitals cannot be avoided in Saudi Arabia due to a lack of primary and local health centres, the CVAD staff training was noted as a possible influencer in a delay in treatment, and therefore amended during the Implementation Phase in Chapter 4.

Through expanding my search to cover Australian and New Zealand resources, I came across The Cancer Institute NSW (2020) and the Australian and New Zealand Children's Haematology/Oncology Group (ANZCHOG) (2020). Both groups were respondents to the Haeusler et al. (2018) study. These two groups are leading oncology organisations who provide medical research and practice guidelines to Australasia, and additionally have specific research that targets the paediatric population. The Cancer Institute NSW (2020) is Australia's first state-wide government cancer agency and are funded for their research and trials. The ANZCHOG (2020) is a multi-disciplinary professional body for

paediatric oncology and other healthcare professionals working with children with cancer in Australia and New Zealand. They are the national Cancer Cooperative Clinical Trials Group for childhood cancer. These two organisations have endorsed the use of clinical care pathways at Auckland's Starship Hospital (Skeen & Teague, 2020) and the Royal Children's Hospital Melbourne (2009). Both guidelines, although developed by different teams and supportive studies, aim to have antibiotics administered within an hour of arrival or less if septic, opting for CVAD use and rapid intravenous fluid. Their guidelines are supported by evidence from Taplitz et al. (2018), Sung et al. (2011) and Lehrnbecher (2012). These two pathways, alongside the febrile neutropenia pathway by the Children's Hospitals of Philadelphia (2017) became the basis of the development of the pathway for King Faisal Hospital as each pathway provided evidence-based rationale from their independent studies or were supported through published research. Specific details regarding these pathways are discussed in the Implementation Phase in Chapter 4.

Synthesis of Evidence

This chapter has provided an overview of the third phase of Rosswurm and Larrabee's (1999) model for practice change. It has highlighted consensus among leading organisations and hospitals regarding the importance of rapid antibiotic administration. This includes leading governing bodies such as the Infectious Diseases Society of America, The American Society of Oncology, and practicing hospitals such as The Royal Children's hospital Melbourne and Starship Hospital in New Zealand, that are aiming for antibiotics to be administered within 60 minutes of hospital presentation, and 30 minutes if signs of sepsis are present (Bow & Wingard, 2020; Children's Hospital of Philadelphia, 2017; Skeen & Teague, 2020; Taplitz et al., 2018). For the past two decades, rapid antibiotic administration has been a key determinant in the success and outcomes of patients, and with each update it only reinforces the importance more. With new research and studies being released regularly,

researchers are seeing higher levels of sepsis-related organ damage, and mortality with delayed treatment during febrile neutropenia presentations (Kumar et al., 2006; Rhodes et al., 2017; Weiss et al., 2018). The primary goal of hospitals implementing a clinical care pathway for febrile neutropenia, was to improve their time to antibiotics administration and follow best care practice, in such, avoiding the increase in mortality risk, and preventable organ damage. Studies which utilised a clinical care pathway to promote the prevention of delayed treatment, were successful in decreasing the time to antibiotics (Bekmezian, 2015; Browne et al., 2002; Haeusler et al., 2018, Murray et al., 2017; Williams et al., 2014). This practice of implementing a clinical care pathway to improve antibiotic administration times is also supported by UpToDate, an evidence-based practice organisation for health care professionals (Bow & Wingard, 2020). Although many studies focus on the adult population, paediatric hospitals are utilising the same guidelines focussed on efficient antibiotic administration timing and seeing similar improvements in practice. Although more paediatric focussed research should be undertaken, the guideline and target time of 60 minutes time to antibiotic administration is considered safe and effective in children (Sung et al., 2011).

Therefore, with the knowledge of current best practice advice, and current febrile neutropenia pathways being reviewed, the next phase of the project is to design the practice change for King Faisal Hospital. This is the preparation prior to implementation whereby the pathway is developed through understandings of successful pathways in practice and linking this with local guidelines in Saudi Arabia.

CHAPTER FOUR

The fourth phase in Rosswurm and Larrabee's (1999) evidence-based practice model, is designing the practice change. It represents the beginning phase of implementing change through defining outcomes and trialling the project. The practice environment, resources available and results from staff feedback and stakeholder suggestions, are essential factors to consider in this design phase. According to Rosswurm and Larrabee decreasing the complexity of the standard being implemented, increases the likelihood of acceptance. Moreover, positive involvement of the stakeholders and staff during the initial pilot phase will aid with acceptance, through easing into the implementation of the practice change.

Within this phase I utilized the current best practice evidence from leading organizations, as well as already adopted clinical care pathways currently in practice, to develop a pathway suitable to King Faisal Hospital. I incorporated clinical care pathways currently in use to draw inspiration from in regards the layout and flow of my pathway, and as well assess and compare their top priorities in the management of febrile neutropenia. This phase involved meeting with the key stakeholders to discuss local guidelines and compare these with current evidence-based practice. Furthermore, meeting with the key stakeholders to promote their participation in the project, as well as ensuring the pathway design was acceptable by each stakeholder. By the end of this phase, we had a pathway finalised for a pilot run that incorporated the views of the nursing and medical stuff, current advice from specialist governing bodies, and drawing best advice from international and local policies.

Phase Four: Designing Practice Change

In this chapter I will cover how I developed the clinical care pathway for the pilot phase and the planning involved before finalising the practice change. There are 4 key steps acknowledged by Rosswurm and Larrabee (1999) in this phase. The first two steps of defining proposed change and defining outcomes and have been combined in this chapter.

The second step is identifying required resources, and lastly, the planning of the implementation phase. To determine what resources are required, I analysed the results from the nursing survey and comments from key stakeholders to outline common themes among staff and findings. This is an important factor to consider, as Rosswurm and Larrabee advise it will be able to provide me with an awareness of depth of the resources required to allow for successful implementation of the project. For example, through staff discussion there was a clear sense that education and knowledge surrounding febrile neutropenia was a limitation in the department, this was determined in the Nursing Survey in Chapter 2 (See Appendix). The level of confidence in the nurse's knowledge influenced how many education sessions and teachings were required prior to the implementation phase. I also determined three evidenced-based pathways in Chapter 3 and planned to use these three specific febrile neutropenia pathways as evidence-based practice for the basis of developing my pathway. Their similarities, differences, and key aspects were considered and discussed in stakeholder meetings to determine how they would be beneficial for the pathway for King Faisal Hospital. Finally, during this phase a meeting was held with the key stakeholders to plan for the implementation phase. We collaborated on the format, priorities, and feasibility of the clinical care pathway. The planning then begun for the pilot trial month and education and in-services to be help, which are described below. The design phase is the first step in implementing the practice change, as it is vital to plan and strategize the implementation process with the stakeholders to ensure everyone has their roles and has equal understanding of the goals and outcomes for this project (Lancaster et al., 2004).

Define Proposed Change and Outcomes

Clinical care pathways are guidelines utilised in healthcare prompt appropriate management and treatment of specific conditions (Bao et al., 2016). The pathway is appropriate pre-determined category of patients who meet the inclusion criteria to qualify for

treatment. As these pathways are developed within hospitals, utilising local and international guidelines, there is minimal room for adjustment and error (Bao et al., 2016; Evans-Lacko et al., 2010). Key definitions are outlined with each clinical pathway, and important to enforce to ensure clarity and understandings for staff utilising the clinical care pathway. For King Faisal Hospital, the definitions follow best practice guidelines from The American Society of Oncology and the Infectious Diseases Society of America. Neutropenia is defined as an absolute neutrophil count (ANC) of 500 cells/mm3 or less than 1000c/mm3 with an anticipated reduction to less than 500c/mm3 within 48 hours (Taplitz et al., 2018; Hughes et al., 2002), as well, for the clinical care pathways it includes any patient undergoing chemotherapy treatment or recent immunosuppressive therapy where neutropenia is suspected. Furthermore, following international guidelines, the definition of fever for this project was a single recorded temperature of equal or greater than 38.3°C or temperature of >38.0°C maintained over a one-hour period (Bow & Wingard, 2020; Taplitz et al., 2018). The intended outcome of this pathway was to improve the time to antibiotic administration (TAA) from a patient's arrival in the emergency department. Current best practice states first-line administration of antibiotics should be within 60 minutes of arrival, and 30 minutes if signs of sepsis are present (Kumar et al., 2006; Levy et al., 2018; Stephens 2020, Taplitz et al., 2018). This is due to the increasing risk of mortality and irreversible organ damage that occurs with each hour left without appropriate treatment (Stephens, 2020; Weiss et al., 2014). Through a clinical audit of the paediatric department treatment and intervention times at King Faisal Hospital, the average TAA through the months of August – December 2019 (excluding October for religious reasons) was 3 hours 48 minutes. Furthermore, the clinical audit also gave insight into the time frame of physician assessment and antibiotic prescription, with the average time to antibiotic prescription being 2 hours 16 minutes from arrival. At King Faisal Hospital a strict policy that medications cannot be administered without an online

prescription and physician review of a patient exist. Hence, it was important to acknowledge that implementing this clinical care pathway would not solve the delay in TAA instantly, as there were multiple factors to address alongside the implementation of the pathway. These factors that influence time to antibiotic administration needed to be considered as they ultimately influenced the success of the project.

Factors influencing Time to Antibiotic Administration. There were several key factors that were uncovered through the nursing survey and review of current evidence-based research that directly affect the TAA at King Faisal Hospital. For the overall aim of improving TAA, these factors need to be addressed, and are considered individual outcome markers.

The survey discussed in Chapter 2, discovered that the paediatric department at King Faisal Hospital had no nurses trained in the use of a Central Venous Access Device (CVAD), and the first key factor influencing the time to antibiotic administration. The CVAD is a port inserted below the skin in many chemotherapy patients which allow for rapid access of venous blood with minimal room for error compared to peripheral sites and are the preferred method of administration for unwell febrile neutropenic patients (VanHouwelingen et al., 2018). In the initial nursing survey completed for this project it was clear that among the paediatric nursing staff self-knowledge regarding febrile neutropenia and clinical confidence regarding portacaths access was low. Over half of the respondents felt their knowledge regarding febrile neutropenia was *'not enough to even get by'* at best, and a third of staff would either *'actively avoid'* the cases or *'completely rely on another nurse's full support'*. Out of the total survey respondents which was made up of 26 paediatric nurses, there was only one nurse who reported feeling confident to independently care for a febrile neutropenia patient, and zero specifically trained or educated in febrile neutropenia. See Table 1 for a breakdown of nursing responses, and Appendix for full nursing survey results. These

delaying factors are like Haeusler et al. (2018) who completed a study that investigated New Zealand and Australia approaches to the treatment of febrile neutropenia. In their review they reported the key factors influencing the delay in antibiotic administration, these were: lack of Central Venous Access Device (CVAD) capable staff which results in patients having peripheral venous attempts despite a port available, patient and family requests for specifically trained professionals, patients arriving without topical anaesthetic cream applied, and the bypassing of local hospitals.

Table 1:

Key Nursing Survey Results

How comfortable are you with caring for febrile neutropenic patients?

Actively avoids	Not confident alone	Enough to get by	Independent w support nearby	Independent to patient solely
2	7	11	5	1

Where do you feel your knowledge on febrile neutropenia and treatment options sits?

No experience or knowledge prior to KFSH&RC	Very unsure. Relies on others guidance	Enough to get by	Quite confident	Proficient
12	3	9	2	0

Do you feel we adequately treat febrile neutropenia at KFSH&RC?

Not at all – unsafe	Probably not	Do not know	Quite good, room for improvement	Yes, current best practice is upheld
5	4	14	3	0

Defining Outcomes

The goals of this project not only required a change in practice by adapting to a clinical care pathway, but also required the improvement of individual nursing practice and skill through training and educating for the pathway. As discussed in the previous section the two key factors that delayed time to antibiotic administration were the shortage of nurses trained in CVAD, and poor nursing confidence and education regarding febrile neutropenia. Additionally, the time to antibiotic *prescription* was also delayed in the clinical audit, which

may have indicated a lack of awareness and readiness by the prescribing physicians. Even though the overall outcome for successful implementation is a reduction in the time to antibiotic administration, the three factors mentioned above are equally important outcomes to report and assess upon following the implementation.

The outcome measurement for this project will be determined through a follow up clinical audit after 6 and 12 months of implementation, using the same patient criteria as the one conducted in Chapter 2. The goal discussed by the key stakeholders for the overall outcome will show a reduction in antibiotic prescription time indicating a successful implementation phase. The overall outcome will also indicate success in improving the key factors delaying treatment which will show increased confidence, education, and skill of the paediatric nurses. A follow up nursing survey will also be completed following the maintenance of the project after 12 months, which will re-assess the nurse's thoughts and knowledge regarding managing patients with febrile neutropenia and assess their skill and response to the implementation of CVAD training.

Clinical Care Pathways

Key resources utilised in the development of the initial clinical care pathway were three evidenced-based febrile neutropenia pathways already in active use (Children's Hospital of Philadelphia, 2019; Royal Children's Hospital Melbourne, 2020; and Starship Hospital, [Skeen & Teague, 2020]). These guidelines are all published online as education tools and informative guides for patients, families, and health care professionals. These were then compared against current guidelines and evidence-based practice from cancer organisations, and through the synthesis of evidence discussed in Chapter 3 and utilised to develop the pathway for King Faisal Hospital.

Current Pathways in Practice. One of the key resources utilised for the development of the King Faisal clinical care pathway, was from New Zealand's paediatric specialist hospital, Starship Hospital (Skeen & Teague, 2020), which was a pathway developed with supportive evidence from Lehrnbecher et al. (2012). This guideline is updated every two years, most recently being in 2020. This guideline is the recommended guideline for practice in New Zealand, it is globally accessible, and provides rationale to the different treatments between febrile illnesses and febrile neutropenia (Skeen & Teague, 2020). The second clinical care pathway is from the Royal Children's Hospital in Melbourne (RCHM) (2020). This guideline, presented in the form of a flow chart, is clear and concise. It is detailed with antibiotic recommendations, fluid resuscitation and follow up assessment and care. Rosswurm and Larrabee (1999) advise that decreasing the complexity of the practice change will aid in the acceptance of the change by staff and stakeholders, and further support the rationale of implementing a flow cart form clinical care pathway. Additionally, this pathway has been approved by the Victorian Paediatric Clinical Network, and RCHM are members of the Paediatric Integrated Cancer Service and the Victorian Comprehensive Cancer Centre, with invested interest in improving overall cancer outcomes and research in Australia (Australian and New Zealand Children's Haematology/Oncology Group [ANZCHOG], 2020; The Cancer Institute NSW, 2020). The third clinical care pathway was developed by a team at the Children's Hospital of Philadelphia (CHOP) (2019), first in 2008, and then reviewed and adjusted as new and appropriate research was released. They completed their own independent study which aimed to reduce the overall time paediatric oncology patients spent in hospital, thus their clinical care pathway was introduced (Children's Hospital of Philadelphia, 2017). Similar to the pathway by RCHM, CHOP (2019) is formatted in an easy to read, flow chart form. This prompts top priorities from the moment

of arrival and provides recommendations for continuity of care within the hospital, following stabilisation in the emergency department.

The three clinical pathways share many similarities and a few differences. What I was most interested in was their recommendations regarding order of treatment and timing, as all three highlights that antibiotics should be administered within 60 minutes of arrival. Both Starship and RCHM advise antibiotics to be administered within 30 minutes of arrival if signs of sepsis are present and all three hospitals recommend CVAD access as first approach but suggest intravenous line if a port is not available. Additionally, all three give recommendations as to which antibiotic to administer as a first-line option, which are case dependent and differ with blood culture laboratory results and patient's history. It was decided this project would not involve the recommendation of specific antibiotic therapy due to this pathway taking a nursing scope only. Despite specific antibiotic recommendations, RHMC state the first antibiotic should be the most broad-spectrum, which allows practitioners to decide based on availability. Furthermore, all three recommend obtaining a full blood count, urea, and electrolytes, which can be taken when the CVAD is accessed early on. All suggest two sets of blood cultures, and if dual lumens are present, then a culture sample from each lumen. CHOP (2019) makes no mention of a chest x-ray, and both Starship and RCHM make note of chest x-rays to be done only if respiratory symptoms present. These two hospitals also make similar note of a urine culture taken only if clinically indicated. Above all else, all three hospitals clearly enforce that no test or investigation should delay the first dose of antibiotic administration, including laboratory results to determine ANC levels. Finally, these three hospitals are actively promoting current best practice, and are continuously updating their resources to ensure they are relevant with up-to-date research, therefore outlining evidence-based practice for the treatment of febrile neutropenia.

King Faisal Pathway Design. Once I determined the key points from international guidelines, I met with the key stakeholders to discuss the local policies to be revised and included. We met to plan and design our individual pathway based on a combination of the above pathways, current best practice advice, and with the ideas and visions from the key stakeholders.

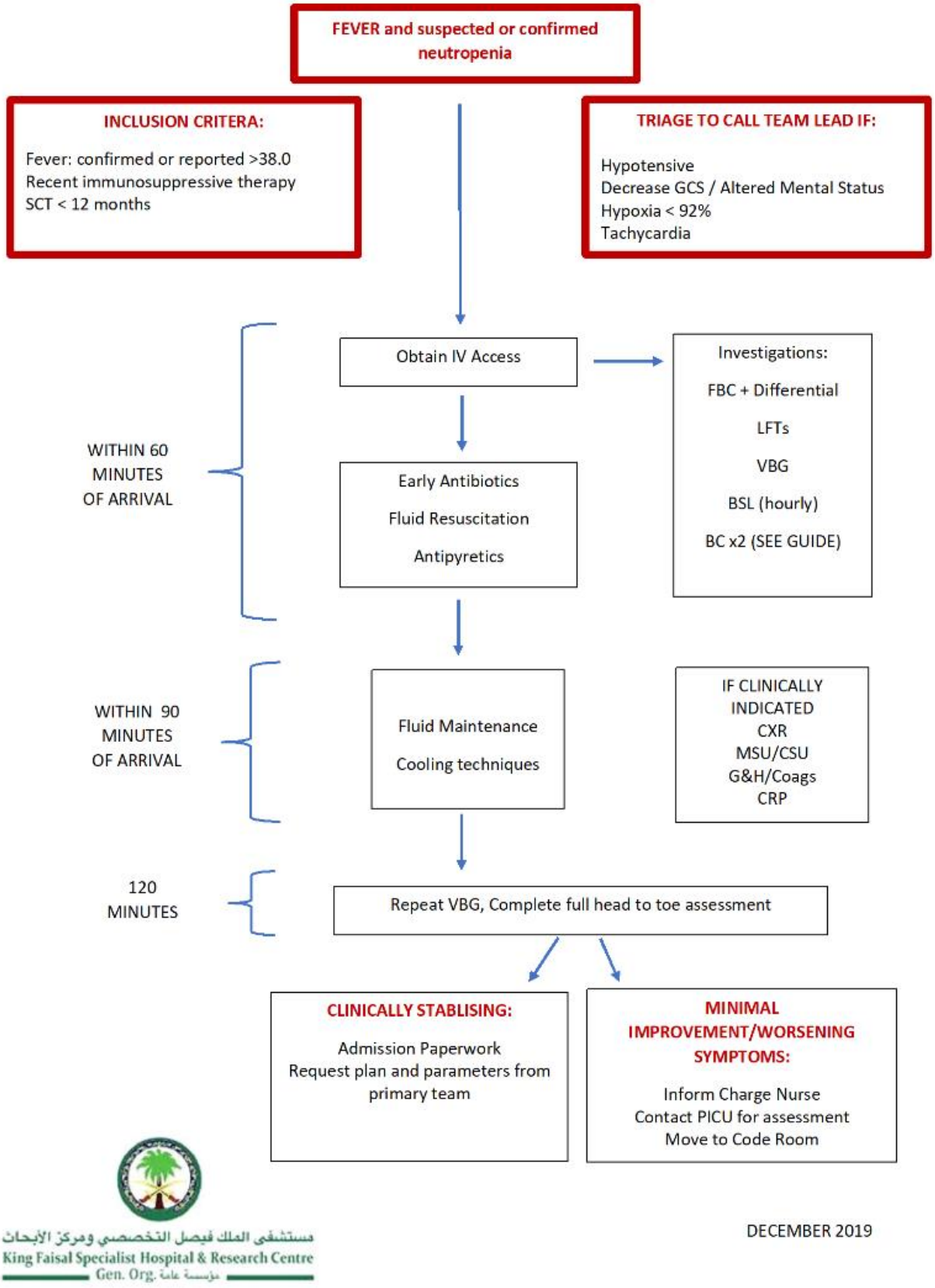
The beginning of the three pathways started with the full assessment completed by both the nurse and doctor. This was deemed a potential issue for this project moving forward, given this is not general practice at King Faisal Hospital, instead doctors provide the initial assessment and nurses wait for instructions following their primary assessment. However, through discussions with the key stakeholders during this phase, we decided to follow the RCHM regarding prioritising patient triage codes. Children with febrile neutropenia and signs of sepsis require antibiotics within 30 minutes, which means they need to be assessed prior to that. Therefore, for our pathway we started by ensuring all possible febrile neutropenia patients were given a Triage Code 2, which prompts doctors to see them within 10 minutes of arrival. If there were severe signs of cardiovascular collapse or respiratory distress these patients were to be given a Triage Code 1 and seen immediately upon arrival. This aids in faster assessment times, and reduces the time to antibiotic prescription, allowing for an improved time to administration. Other key factors that the key stakeholders determined was the inclusion and exclusion criteria of the pathway, which was suited to King Faisal Hospital.

Antipyretics and Cooling techniques were discussed at these meetings. Following global guidelines, acetaminophen was used as a first line antipyretic, and was appropriate to be initiated under verbal order from the physician (Skeen & Teague, 2020; Weinkove et al., 2013). Cooling techniques are seen further down in the pathway as this is not critical in stabilisation. Cooling techniques involved physical cooling such as a damp towel or a fan in patients assessed as hot-to-touch (Weinkove et al., 2013). Furthermore, the key stakeholders

collaborated on the continuity of care section of the pathway, which determines where the patient will be referred too following stabilisation. During this meeting, the proposed pathway was sent to the chief medical officer and charge nurse manager for review, feedback, and approval. The initial clinical care pathway below was approved for use.

Figure 2:

Clinical Care Pathway – Pilot



NURSING NOTES:

BLOOD CULTURES: Two samples, peripherally. If Dual lumen CVAD or Port accessed a sample should be taken from each lumen.

DO NOT WAIT FOR LOCAL ANESTHETIC PRIOR TO IV ACCESS

CXR and MSU are if clinically indicated. If respiratory symptoms are present, encourage the ordering of a CXR. If urinary symptoms are present use appropriate resources to obtain clean catch urine sample. Do not wait for these investigations to be obtained to administer antibiotics.

Verbal orders for IVF and antipyretics are accecptable and should be documented within an appropriate time frame.

Fluid resuscitation: 20ml/kg 0.9% NACL BOLUS, the doctor may request a second bolus. This is accecptable, use nursing knowledge and patient condition to support your judgement.

Acetaminophen: 15mg/kg q4hrly

ALL MEDICATIONS TO BE DOUBLE CHECKED BY A SECOND NURSE

Report any unexcepted lab results instantly to the EMS Paeds consultation on duty. If severe, consider informing the Charge Nurse and moving to the Code Room for further support.

Due to the nature of the patients, variability of conditions, severity and health history doctors will follow their own algorithm for antibiotic prescription. The first dose should be administered within an hour. This dose should be made by the nurses in the department. Do not wait for pharmacy to deliver. If concerns about delay in antibiotic administration inform Paeds TL.

Implementation Plan

The final section in the Design Phase, is planning for the implementation process. This is separated into two sections, *Education Sessions*, and the *Pilot Month*. The implementation plan was discussed and developed during stakeholder meetings that occurred in November 2019. This section draws together the remaining requirements and recourses needed for a successful implementation period. For this we discussed the need for a trial month, to introduce the nurses to the pathway to ensure the nurses had the knowledge and skills to practice safely using the pathway and the beginning of in-service trainings.

Education Sessions

When implementing a change in practice, continuing education, and staff in-service trainings aid in the changes of behaviours and confidence in practitioner's ability to adapt to change (Rosswurm & Larrabee, 1999)**.** Success is determined by the stakeholders and nurses having autonomy and sufficient knowledge to practice safely with the new change in practice. Therefore, a plan to implement and provide trainings and education is vital to the staff accepting the change (Larrabee, 2009).

The key stakeholders were called into a meeting once the pilot trial pathway had been approved by the chief medical officer and clinical charge nurse manager, which we then discussed education and staff training plans. Through the nursing survey already completed, we gained insight into nurse's lack of confidence in their ability to appropriately manage patients with febrile neutropenia. Therefore, we discussed the need for in-services that would provide a relaxed environment where nurses felt safe to ask questions and respond. We delegated the education of febrile neutropenia to the lead paediatric clinical educator and decided the lead physician and me would be present during each of these sessions to show reference to the pathway implementation.

The content of the in-services was discussed during the design planning meeting and were executed throughout December 2019. Content ranged from anatomy and physiology of patients living with cancer and receiving treatment, to current best practice drawing on inspiration from external hospitals and organisations. Most in-services were held during shift change which allowed for more staff to be involved and provided a larger variety of questions and answers. By the end of December 2019, every paediatric nurse had signed attendance for the in-services. The second key education focus was around the training of nurses for CVAD access. Our second paediatric nurse educator took responsibility for the training and signing-off of nurses for this skill. By the end of December, all nurses had completed the study day, and by the end of January, we successfully obtained a 100% sign off rate for all paediatric nurses to safely access a patients CVAD.

Pilot Study

During the planning meeting we discussed the relevance of a Pilot Study to introduce the nursing staff to the new change. Rosswurm and Larrabee (1999) suggest a Pilot study is recommended when implementing change that affects the standard of care in a large hospital, and targets two units prior to widespread implementation. This project was not intended to influence the whole hospital, rather the standard of care specific to the emergency department. However, it was decided during our first stakeholder meeting that December 2019 will follow the principles of a pilot study and become a trial month. This will allow us to provide hands on education and training sessions with the approved pathway. We planned the dates of in-service trainings, and during these in-services staff were encouraged to actively participate, question, and discuss the overall goals and implementation of the project. We planned to introduce the nurses to the pathway in December and remained on the floor during febrile neutropenia cases. At this point we discussed the pathway would not be utilised instead referred to for guidance, until the nurses felt comfortable with the change. Through

this trial period, we were able to gain experience in the flow and feasibility of the pathway during a shift. As the key stakeholders remained present on the floor during the trial month, nurses were able to voice concerns or questions directly to the team responsible for change. A review meeting was held in early January 2020, which discussed nurse and practitioner feedback condensed from the month prior. This was to evaluate and review the pilot month, which largely incorporated the nursing staff responses to the changing practice and gave us a sense of adherence and acceptance to the pathway. Following this, we planned 4-6 weekly meetings for the first few months of implementation in order to be able to collate feedback and adjust the pathway where necessary and discuss any new information or concerns that are unveiled over the implementation period. Each review period is discussed further in the implementation phase.

Through this design phase, we were able to prepare ourselves for the future of implementation, with regular review and stakeholder meetings planned, and inclusive education sessions for the nurses completed. At this point the outcomes and goals were defined, and education sessions completed and satisfactory. We had prepared the nurses, providing clarity and goals for this project, and followed up with training and educator necessary to a successful implementation phase. At the end of December 2019, all nurses and paediatric physicians had been exposed to the trial pathway, with time given to provide feedback, concerns and questions.

This chapter has provided the foundation for the beginning of the implementation phase. At the end of this phase all key stakeholders were aware of the goals and outcomes and had approved the initial pathway to be implemented. Plans for implementation and evaluation had been made, education session and in-services scheduled and completed in December. This allowed nurses to begin to understand the topic, rationale for the use of a pathway, and familiarise themselves with the changing practice. The following chapter

continues on from the trial month of December 2019, focussing on the implementation phase and evaluation of the clinical pathway in practice.

CHAPTER FIVE

Phase Five: Implement and Evaluate Practice Change

Once a practice change has been identified, researched, and developed, the implementation and evaluation are the fifth step in the research model for evidence-based practice (Rosswurm & Larrabee, 1999). In this phase Rosswurm and Larrabee highlight key steps involved in a successful implementation, such as, education of staff through in-services on the change to practice, recognising the change as a new standard of care; and monitoring and evaluating the practice change through outcome measures. Furthermore, this closely relates to the sixth phase in which the project is integrated into practice and maintained as a standard of care and discussed towards the end of the chapter. In Chapter 4, the plan for the initial implementation of this project is outlined and included a discussion about the teaching and pre-implementation period. The plan involved an agreement to monthly reviews and meetings with stakeholders, an assessment of feedback from staff and patients, and an allocated period to discuss issues, concerns and improvements. The intention of this was to ensure that the stakeholders were satisfied that the project was safe to be implemented without close monitoring, and reinforcing this practice change as a new standard of care.

This chapter will provide a detailed description of the December 2019 trial period discussed in chapter 4, as well as individual description and review of each month of implementation. This chapter is separated into these monthly reviews. The monthly evaluations involved the key stakeholders, and senior paediatric nurses. In each monthly review we discussed changes to be made to the pathway, and strategies to implement these. Most often these strategies were regular in-services with the staff, and email communication with updates and changes. As the implementation phase went on, the changes and updates became less frequent due to issues and concerns being acknowledged in the early stages, and nurses becoming more familiar with the pathway. We also discussed feedback that had come

from the nursing and physician team that was obtained through email communication and in-person conversation. Finally, as the need for constant observation decreased, and staff became more autonomous with the pathway, we conducted a review on patient data as a measurement of success, similar to the clinical audit first completed in Chapter 2. This occurred in the month of July 2020.

Furthermore, nearing the end of this chapter I have evaluated the overall implementation phase and a plan for maintenance of the project. Due to time constraints, and my departure from the Middle East, I was not actively involved on the floor and therefore, a plan was made. The project was handed to a paediatric educator and a senior paediatric registered nurse who remained in the department. This chapter incorporates the sixth phase of Rosswurm and Larrabee's (1999) model through maintenance and management for the continuation of the pathway, following cessation of this practice project.

Implementation

Rosswurm and Larrabee (1999) state that implementation of the project will be more successful if the overseeing leadership of the project closely monitors the process and is made available to staff for follow up questions. Therefore, throughout the implementation phase staff were to be given email contacts, and a 24/7 phone contact so that they could reach either myself or the clinical educators for questions and support. All questions were to be documented and then discussed at the monthly meeting. Reinforcement, positive support, and post-pilot surveys are essential to ensure safety of the changing project (Rosswurm & Larrabee, 1999). Furthermore, pilot studies provide the groundwork in research projects, and in this phase determine feasibility of the overall project (Hassan et al., 2006). The decision to adapt, react or reject the proposed project change will come from staff during this feedback stage and is largely dependent on how well supported they are in the changing practice (Lancaster et al., 2004; Rosswurm & Larrabee, 1999). Staff remained well supported during

this phase and this was reflected through appropriate questioning of the project, adherence, and positive feedback of clinical pathway.

December

In December 2019, the key stakeholders implemented a trial and teaching month. We did not plan to utilise the pathway, instead it was used as an educational tool to begin to teach the staff on the importance of appropriate treatment for febrile neutropenia. During this month multiple in-services were held to ensure all paediatric staff received the training required. Furthermore, this month allowed time to upskill the nurses in Central Venous Access Device training and allow them to familiarise themselves with the pathway. Key stakeholders regularly visited the department and remained in constant communication with staff to provide support and education. Following the month of December, the team met to discuss the changes that needed to be made, and the outlook for the month of January. Two key points were bought up as potential factors that delay the time to antibiotic administration, these two were discussed with the stakeholders and exceptions were made to current pathway:

1. Antipyretics. Prior to the implementation of this project, antipyretics could only be given following an online order by the leading physician. It was recognised during the pre-implementation phase that this would potentially delay treatment. The lead physician for the project was interested in trialling verbal orders, commencing with antipyretics. Therefore, this became appropriate to be given under verbal order. This was a new change for the nurses that was well received. Nurses received safety training in verbal orders by the clinical educator, and double-checking medication doses with a second nurse prior to administration became a new standard of care. Verbal orders were a first in the paediatric department and were exclusively for

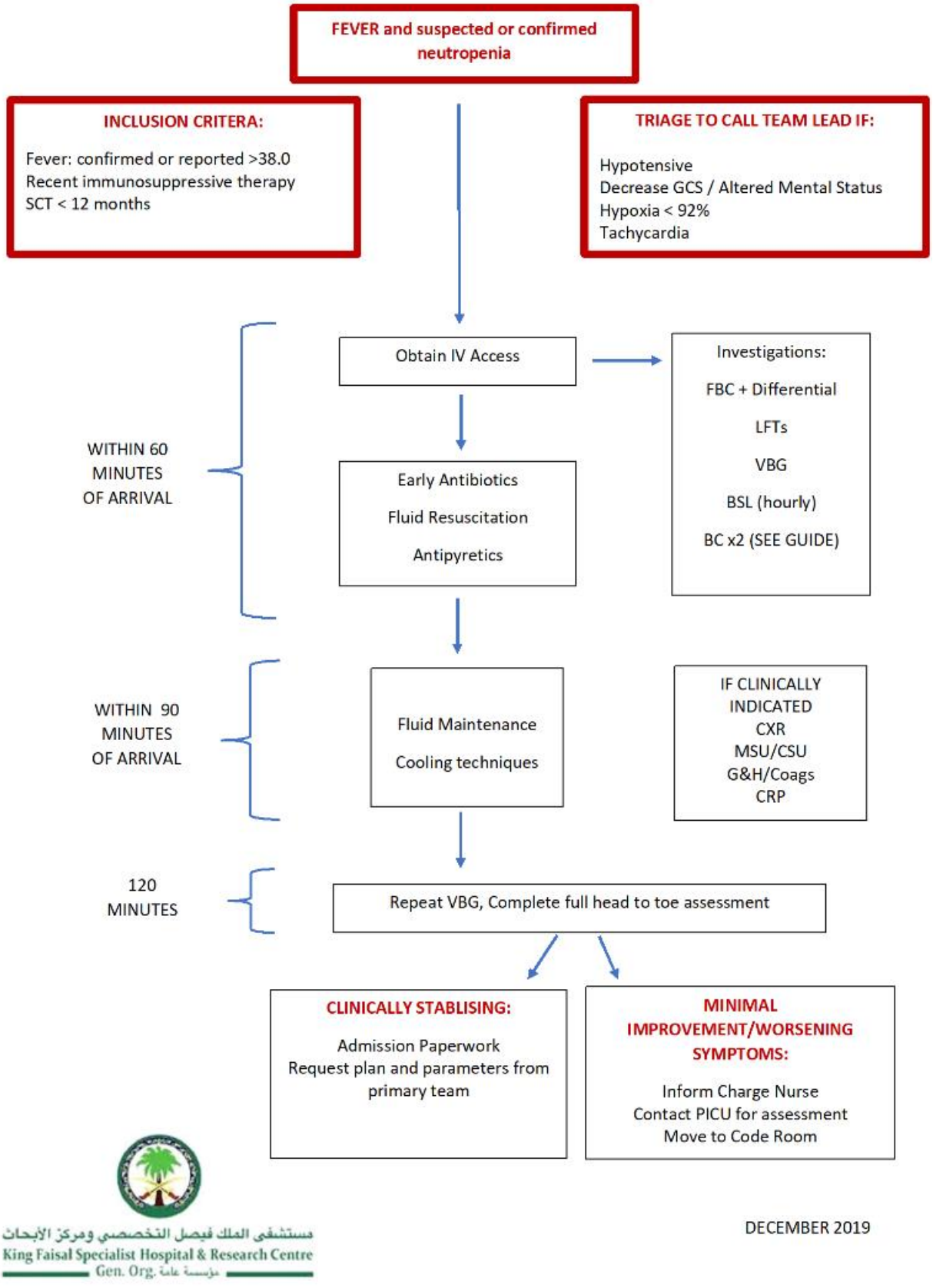
antipyretics for the febrile neutropenia pathway. Therefore, physicians were not to verbally order other pharmacological interventions for any other patients.

2. Triage nurses were to assign a triage category 2 to patients presenting under the inclusion criteria of the pathway. This was to raise awareness to both doctors, nurses, and charge nurses to increase response time. This was met with some initial hesitation and resistance from staff as not all understood the importance of faster assessment times for febrile neutropenia, and they felt they were being asked to change their current standard of practice without reasoning. Clinical educators provided the same education and understanding of febrile neutropenia and associated risks with delayed care to the triage nurses which aided in well-rounded support to this change in practice.

These two points were communicated to the nurses through email, and in-services. The month of December saw the training commence for CVAD. However, nurses were not yet officially signed off until having completed two successful insertions under clinical educator supervision. Therefore, this intervention was not an option for staff at this review, thus was not included in the initial pathway.

Figure 3:

Clinical Care Pathway - December 2019



NURSING NOTES:

BLOOD CULTURES: Two samples, peripherally. If Dual lumen CVAD or Port accessed a sample should be taken from each lumen.

DO NOT WAIT FOR LOCAL ANESTHETIC PRIOR TO IV ACCESS

CXR and MSU are if clinically indicated. If respiratory symptoms are present, encourage the ordering of a CXR. If urinary symptoms are present use appropriate resources to obtain clean catch urine sample. Do not wait for these investigations to be obtained to administer antibiotics.

Verbal orders for IVF and antipyretics are accecptable and should be documented within an appropriate time frame.

Fluid resuscitation: 20ml/kg 0.9% NACL BOLUS, the doctor may request a second bolus. This is accecptable, use nursing knowledge and patient condition to support your judgement.

Acetaminophen: 15mg/kg q4hrly

ALL MEDICATIONS TO BE DOUBLE CHECKED BY A SECOND NURSE

Report any unexcepted lab results instantly to the EMS Paeds consultation on duty. If severe, consider informing the Charge Nurse and moving to the Code Room for further support.

Due to the nature of the patients, variability of conditions, severity and health history doctors will follow their own algorithm for antibiotic prescription. The first dose should be administered within an hour. This dose should be made by the nurses in the department. Do not wait for pharmacy to deliver. If concerns about delay in antibiotic administration inform Paeds TL.

January

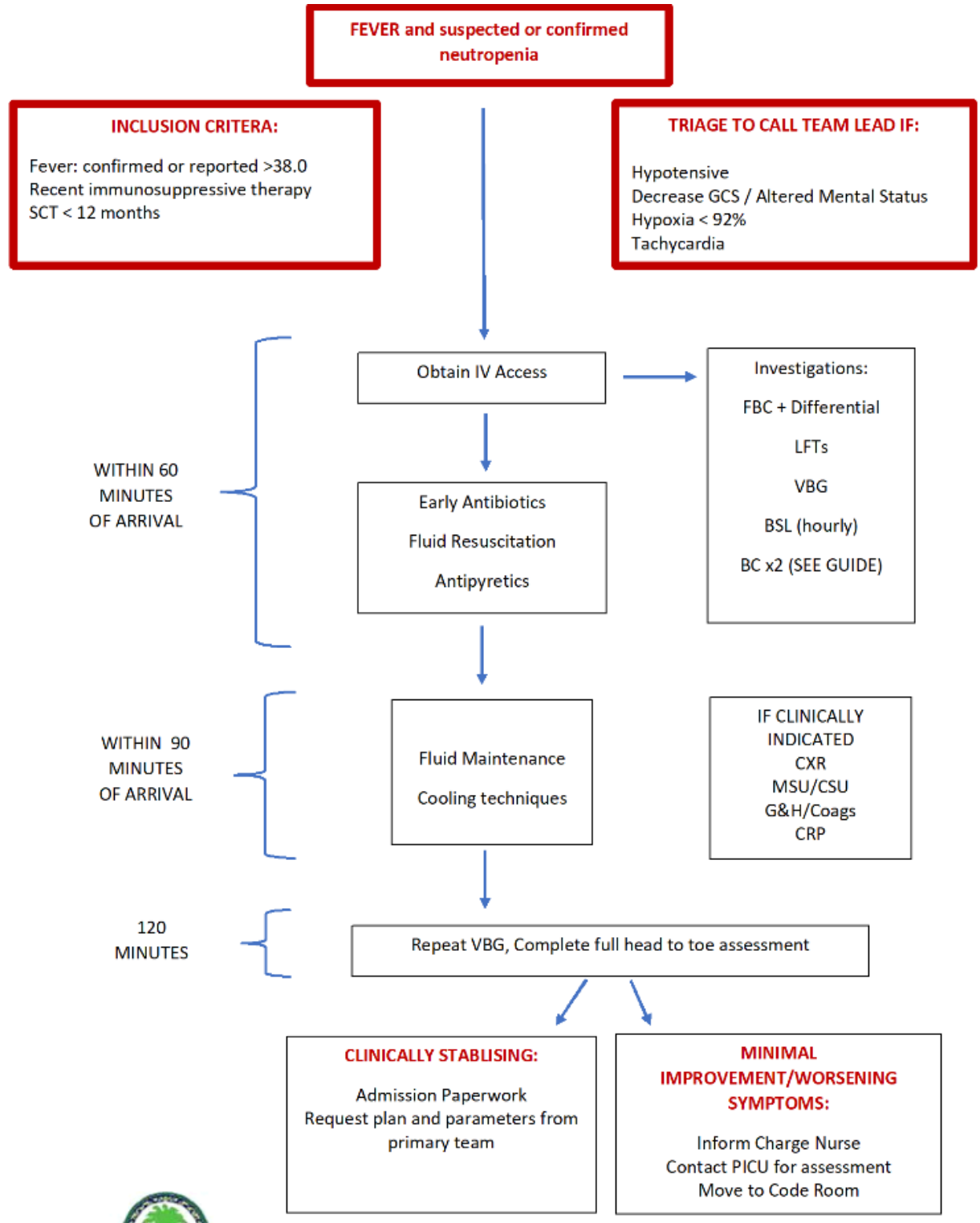
January 2020 was the first official month of implementation, where the pathway was in practice and actively guiding care. The two educators remained on the floor for staff and pathway appropriate patients and oversaw each case for the first month. Staff were encouraged to voice their concerns as they arose and additionally through email communication. The January implementation came from the December review which occurred within the first week of January. Following this these two key factors were discussed:

1. Introduction of paper medication chart. This provided nurses with a paper copy of medication administration history which was approved by the clinical educator. This allowed staff to document verbal orders, and log medications and intravenous fluid doses. However, staff were also required to electronically log this information in the patient chart following stabilisation.
2. Delay in intravenous line insertion/laboratory access. This was a factor already bought to the attention of the educator and this was during the process of training nurses in the central venous access device check off. By the end of the month of January 2020 all nurses had been signed off, however this was not yet added to the pathway until nurses had obtained this scope, which is seen in the February review.

Changes were made and implemented. Nurses were provided with further in services and updated through email, and the pathway was reinstated for February 2020.

Figure 4:

Clinical Care Pathway – January 2020



TIME	MEDICATION	DOSE ROUTE	INITIALS	COMMENTS

NURSING NOTES:

BLOOD CULTURES: Two samples, peripherally. If Dual lumen CVAD or Port accessed a sample should be taken from each lumen.

DO NOT WAIT FOR LOCAL ANESTHETIC PRIOR TO IV ACCESS

CXR and MSU are if clinically indicated. If respiratory symptoms are present, encourage the ordering of a CXR. If urinary symptoms are present use appropriate resources to obtain clean catch urine sample. Do not wait for these investigations to be obtained to administer antibiotics.

Verbal orders for IVF and antipyretics are accecptable and should be documented within an appropriate time frame.

Fluid resuscitation: 20ml/kg 0.9% NACL BOLUS, the doctor may request a second bolus. This is accecptable, use nursing knowledge and patient condition to support your judgement.

Acetaminophen: 15mg/kg q4hrly

ALL MEDICATIONS TO BE DOUBLE CHECKED BY A SECOND NURSE

Report any unexcepted lab results instantly to the EMS Paeds consultation on duty. If severe, consider informing the Charge Nurse and moving to the Code Room for further support.

Due to the nature of the patients, variability of conditions, severity and health history doctors will follow their own algorithm for antibiotic prescription. The first dose should be administered within an hour. This dose should be made by the nurses in the department. Do not wait for pharmacy to deliver. If concerns about delay in antibiotic administration inform Paeds TL.

February

In the first week of February 2020, we completed our monthly review and evaluation. Collating feedback from the staff from the previous month of January, and changes that had been made behind the scenes. For example, CVAD access was now appropriate to add to the pathway as nurses had complete the training and a formal sign off process. Minor issues arose in January which came down to intravenous access, and personality clashes with doctors refusing to provide verbal medication orders. The lead consultant, a key stakeholder reassured nursing staff to direct all physician concerns to her and she was to appropriately manage those setbacks. Cultural differences were not unexpected in this case, and we had expected some push back in this regard. Cultural differences were often seen in the form of male/female hierarchy, not uncommon in the Middle East and heightened in healthcare as nursing was predominantly a female workforce and the physicians being male. However, with our lead physician being a female, we found communication barriers easier to reflect upon and broach the subject when required.

In this review we applauded triage staff who took on initiative to also call ahead to the paediatric team lead to inform of incoming category two patients. Through discussion with the key stakeholders and evaluation of January, the following changes were made to the pathway:

1. CVAD access added.
2. Triage nurses to apply emla[1] if no CVAD.
3. Respiratory MPCR[2] swab added if symptomatic.

[1] Emla is a topical anaesthetic agent applied to the skin to reduce pain for intravenous punctures (VanHouwelingen, 2020).
[2] The Respiratory multiplex polymerase chain reaction (Respiratory MPCR) swabs are nasopharyngeal/oropharyngeal swabs taken for children presenting with respiratory symptoms to detect viruses in respiratory secretions (Ostrow et al., 2017).

It was excluded from the original pathway to avoid unnecessary swabbing in asymptomatic children. Reducing unnecessary testing decreases patient discomfort, promoted symptomatic diagnostic decision making, and allows for more effective resource allocation of tests (Ostrow et al., 2017). However, it was added as a prompt to remind physicians to swab, should the patient be symptomatic.

4. "Hypoxia[3]" term removed and changed to increased oxygen requirement.

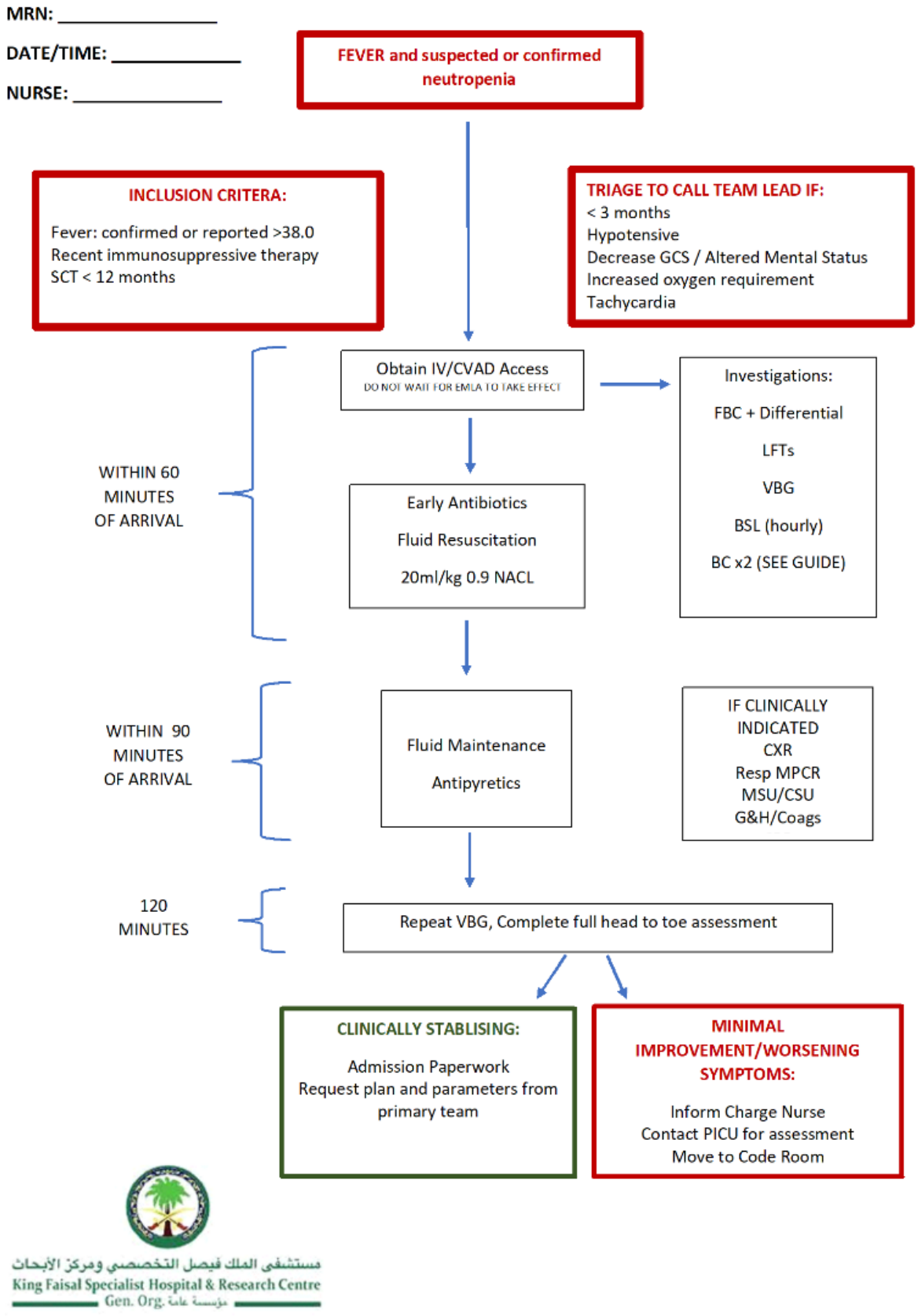
   This term was changed due to the chronic history of patients presenting with long-standing oxygen requirements outside of hospital, or pre-existing health conditions which caused hypoxia and therefore was creating false red flags on the pathway.

Furthermore, the stakeholders and educators were less present during this month. This was to give nurses time on their own to familiarise themselves with the new pathway, and to begin to troubleshoot autonomously. They were frequently encouraged to reach out to key stakeholder staff for issues or complications, or to ensure feedback was being provided as it was being discovered.

[3] Hypoxia occurs when oxygenation is hindered or reduced, often due to damage to the respiratory system resulting in sub-optimal oxygen levels in surrounding organs and cells (Chen et al. 2020).

Figure 5:

Clinical Care Pathway – February 2020



TIME	MEDICATION	DOSE	ROUTE	INITIALS	COMMENTS

NURSING NOTES:

DO NOT WAIT FOR LOCAL ANESTHETIC PRIOR TO IV ACCESS

DO NOT WAIT FOR BLOOD RESULTS PRIOR TO STARTING ANTIBIOTICS

Blood Cultures: Two samples, peripherally. If Dual lumen CVAD or Port accessed a sample should be taken from each lumen, and one peripheral sample.

CXR and MSU are if clinically indicated. If respiratory symptoms are present, encourage the ordering of a CXR. If urinary symptoms are present use appropriate resources to obtain clean catch urine sample. Do not wait for these investigations to be obtained to administer antibiotics.

Verbal orders for IVF and antipyretics are acceptable and should be documented within an appropriate time frame.

Fluid resuscitation: 20ml/kg 0.9% NACL BOLUS, the doctor may request a second bolus. This is acceptable, use nursing knowledge and patient condition to support your judgement.

Acetaminophen: 15mg/kg q4hrly

ALL MEDICATIONS TO BE DOUBLE CHECKED BY A SECOND NURSE

Report any unexcepted lab results instantly to the EMS Paeds consultation on duty. If severe, consider informing the Charge Nurse and moving to the Code Room for further support.

Due to the nature of the patients, variability of conditions, severity and health history doctors will follow their own algorithm for antibiotic prescription. The first dose should be administered within an hour. This dose should be made by the nurses in the department. Do not wait for pharmacy to deliver. If concerns about delay in antibiotic administration inform Paeds TL.

March

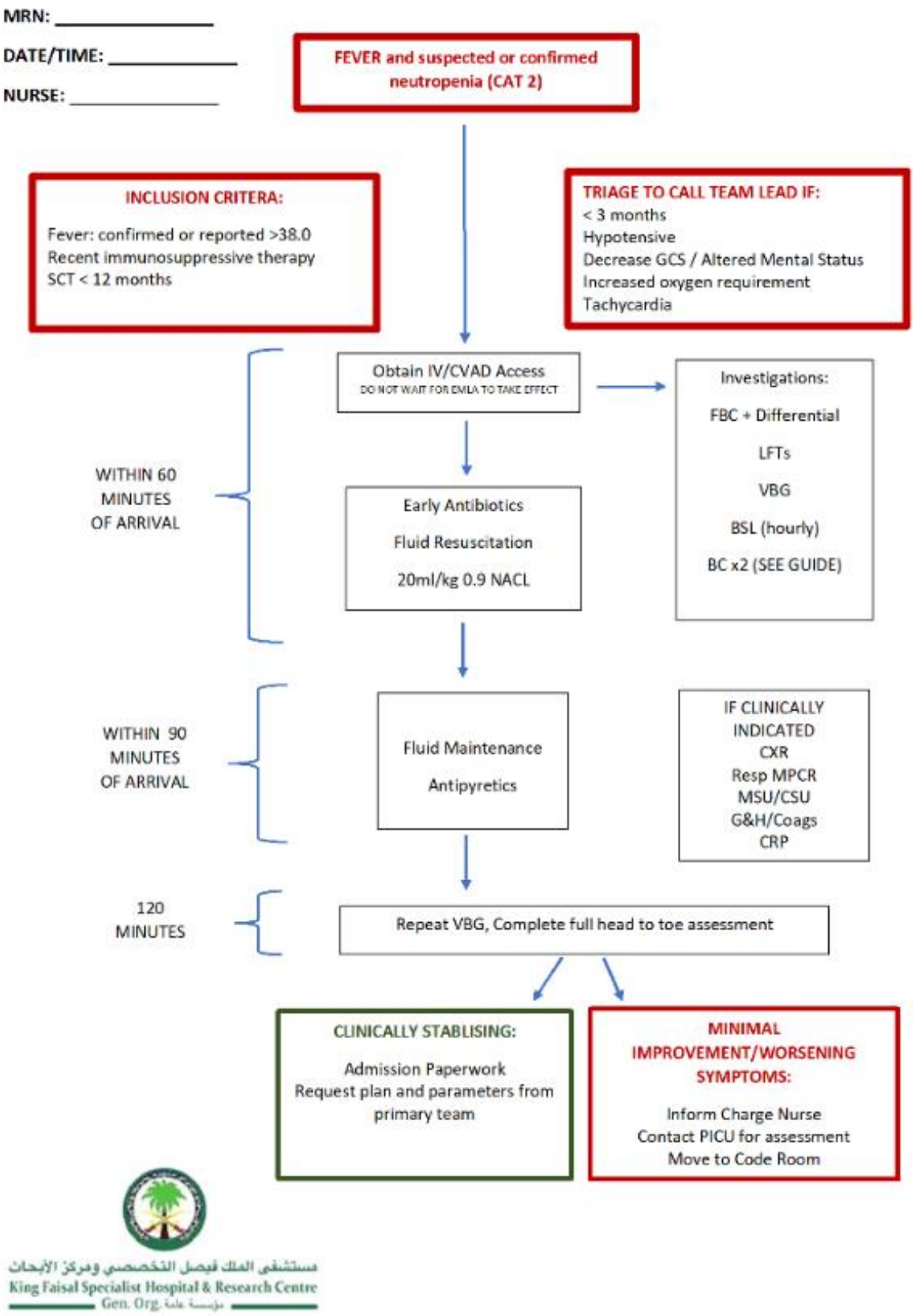
The review held in March was the final of the monthly reviews before it spaced out to quarterly. Unfortunately, due to reasons outside of my control, this also saw the end of my time in Saudi Arabia. However, plans were made to continue with the project, with myself operating virtually. The evaluation fortunately occurred prior to my departure. From the anecdotal feedback obtained from staff, we were having positive reviews since the CVAD access addition to the previous pathway. Nurses were obtaining blood samples faster, there was less unnecessary and failed attempts at intravenous access, and nurses felt they were able to get intravenous fluids and antibiotics more efficiently. However, departmental pressures were continuing to be a barrier bought up by the staff nurses, and nurses were struggling to prioritise febrile neutropenic patients whilst maintaining their regular workload. These departmental pressures were unpredictable and uncontrollable due to the introduction of COVID-19 forcing a restructuring of the department. Therefore, the decision to implement pathway 'champions' was approved by the stakeholder team.

White (2011) describes nursing champions as individuals being passionate about improving the quality of care in a certain field and teaching other nurses in their selected field to promote evidence-base standards of care. They are often peer-selected or self-volunteer for a leadership role within a department. Miech et al. (2018) conducted a review on published champion-related articles, recording more articles published between 2015-2016, than in the first 30 years prior (since 1980-2009). Showing increase in popularity in healthcare, they concluded that studies have consistently found that champions undoubtedly have positive influences on the implementation of practice change. The discussion was held with the nursing staff to identify one to two nurses per team per shift who would be the "champion" for the febrile neutropenia pathway. The role of this nurse was to oversee all febrile neutropenic patients who presented, and specifically allocate them to targeted rooms in the

paediatric department. Should there be two or more febrile neutropenic patients or depending on patient stability/instability, the second nurse predetermined would also take a patient load. When the discussion was had with the nurses to gain interest, there were between three and six staff members, per team, per shift who expressed interest in the ‘champion’ role. The decision was made to train and educate all nurses who showed interest. There were no significant changes on the physical pathway in comparison to the February version.

Figure 6:

Clinical Care Pathway – March 2020



TIME	MEDICATION	DOSE	ROUTE	INITIALS	COMMENTS

NURSING NOTES:

DO NOT WAIT FOR LOCAL ANESTHETIC PRIOR TO IV ACCESS

DO NOT WAIT FOR BLOOD RESULTS PRIOR TO STARTING ANTIBIOTICS

Blood Cultures: Two samples, peripherally. If Dual lumen CVAD or Port accessed a sample should be taken from each lumen, and one peripheral sample.

CXR and MSU are if clinically indicated. If respiratory symptoms are present, encourage the ordering of a CXR. If urinary symptoms are present use appropriate resources to obtain clean catch urine sample. Do not wait for these investigations to be obtained to administer antibiotics.

Verbal orders for IVF and antipyretics are acceptable and should be documented within an appropriate time frame.

Fluid resuscitation: 20ml/kg 0.9% NACL BOLUS, the doctor may request a second bolus. This is acceptable, use nursing knowledge and patient condition to support your judgement.

Acetaminophen: 15mg/kg q4hrly

ALL MEDICATIONS TO BE DOUBLE CHECKED BY A SECOND NURSE

Report any unexcepted lab results instantly to the EMS Paeds consultation on duty. If severe, consider informing the Charge Nurse and moving to the Code Room for further support.

Due to the nature of the patients, variability of conditions, severity and health history doctors will follow their own algorithm for antibiotic prescription. The first dose should be administered within an hour. This dose should be made by the nurses in the department. Do not wait for pharmacy to deliver. If concerns about delay in antibiotic administration inform Paeds TL.

May

The evaluation for the implementation month of May 2020 was conducted over video conference call due to circumstances out of stakeholders control. There had been no significant issues reported since the implementation and therefore no changes to the active pathway was made. However, nurses communicated to the educators they felt a disruption in patient flow and care with febrile neutropenic patients being triaged to the next available room, and in some cases being moved to the other end of the paediatric department. As specific equipment such as CVAD tools, intravenous priming sets, and laboratory tubes were all located at the nursing station, nurses felt the constant moving through the department was causing confusion and disruption to patient care. Their suggestion was assigning two specific rooms dedicated to febrile neutropenia pathway patients, and a champion nurse to oversee those rooms, as well as a febrile neutropenic trolley which contained all necessary equipment located outside the designated rooms. The initiative was bought up by the nurses in email communication and discussed over the virtual video meeting which was then approved by all key stakeholders to be trialled and tested. This initiative ensured nurses had adequate equipment readily accessible, the rooms were constantly prepared for a febrile neutropenic patient and was easily converted to care for the general presentations of paediatrics. Literature shows the more active and involved nurses are in a practice change can greatly improve the quality and success of an outcome (Institute of Medicine, 2011; Shariff, 2014). Furthermore, when nurses participated in policy development, they made valuable contributions to areas of healthcare potentially overlooked by those without face-to-face patient contact (Institute of Medicine, 2011; Shariff, 2014).

July

In the final review of the implementation phase the key stakeholders met once again over video conference call. The clinical educators reported that strong adherence to the

pathway was being maintained despite the decreased presence of the key stakeholders/project managers. They believed the initiative of Champions aided in the continuous education and promotion of the pathway. Nurses had reported feeling an improvement in practice and increased satisfaction and confidence in caring for febrile neutropenia patients.

Clinical Audit

To determine if the anecdotal reports from the nursing staff about the success of the pathway were true, the clinical educator completed a clinical audit like the one completed in Chapter 2. The clinical audit assessed the months of April, May, and June. These months were selected as each had followed adjustments and included strict monitoring of implementation. These months represented a time frame in which the pathway had been in practice for 4 months and therefore the nurses had had time to adjust, upskill and become autonomous in the new standard of practice. Furthermore, nurses had obtained CVAD skill, and education around the treatment of febrile neutropenia.

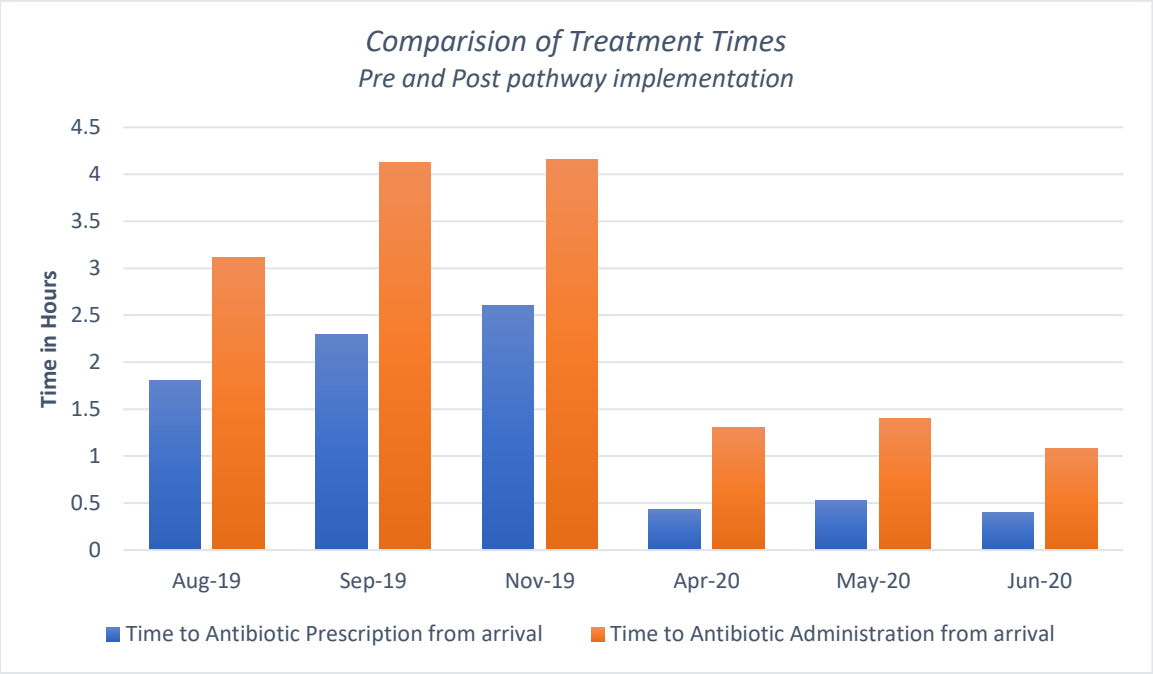
Through this audit review, there were a total of 104 patients who were managed on the pathway. The breakdown of each month was 25 patients in April, 43 patients in May, and 36 patients in June. In April, the average time to antibiotic administration (TAA) was 78 minutes, in May the TAA was 84 minutes, and in June the TAA had come down to an average of 65 minutes. This was an impressive difference that was first noted in the clinical audits from August 2018, September 2018, and November 2018. The overall average TAA for King Faisal Hospital in those months pre pathway implementation were 3 hours and 48 minutes. Please see Table 1 below for pre-and-post implementation comparison. The average TAA post pathway implementation was now 1 hour 15 minutes. The average time to antibiotic prescription was also audited, and found fewer fluctuating times compared to the TAA, with the shortest TAP in June being 24 minutes, and the longest TAP in May with 32 minutes. The average TAP prior to pathway implementation was 2 hours 16 minutes, and the

post-implementation average was now 27 minutes. This has shown a positive reduction in both the time to administration and prescription.

Although not quite within the 60-minute target, the adherence to the pathway had reduced the average time by 67.1%. This was a completely new pathway and idea for the paediatric department of Saudi Arabia, to have a 67% improvement in the TTA within 6 months of implementation is a positive achievement. With a strong maintenance plan, meeting the target TAA of 60 minutes is achievable, and could be accomplished by the end of 2020.

Table 2:

Comparison of Treatment Times following Implementation.



Evaluation

The overall goals and expected outcomes for this practice project was to improve the time to antibiotic administration in febrile neutropenic patients, through the implementation of a clinical care pathway. By the end of June, it had become evident through a clinical audit that this had been achieved, as the time had significantly improved, though not quite reaching best care standards. However, with more exposure to the pathway in practice and completion of the clinical audit 12 months after initial implementation, we will expect to see further improvements, bringing the TAA closer to the target times and ultimately surpassing this.

There were some potentially influential changes that were made during this implementation phase that improved practice more than expected. The first being the introduction of the CVAD trained nurses. This saw nurses obtaining intravenous access and laboratory samples more efficiently than previous peripheral vein attempts. Secondly, the decision to implement Champion nurses. With more nurses interested in being trained in becoming a febrile neutropenic pathway champion, all received additional education, support, and improved personal confidence in practice. This helped with a smoother transition when the key stakeholders reduced the amount of time on the floor, and the Champions remained present, providing continuous support in changing practice. The presence of the champions on the floor meant staff nurses could direct their questions to them and troubleshoot outcomes together.

Maintenance

The project has now reached the maintenance stage, the final stage in Rosswurm and Larrabee's (1999) model for evidence-based practice. This phase is actively ongoing and was initially met some unexpected challenges with regards to the protection of the project. As Saudi Arabia was met with a global pandemic, structuring and resources in the hospital were greatly diminished. Fortunately, the project was implemented in a period when clinical

educators and key stakeholders were able to remain present to support the nurses in the changing practice and allow them to develop autonomy prior to a global lockdown. The maintenance plan was discussed virtually and prior to key stakeholder's departing Saudi Arabia. Significant responsibility for the protection and promotion of the project was given to the delegated Champions and the project was overseen by a senior paediatric registered nurse. Although this practice project is now completed, the pathway will remain in practice and continue with regular clinical audits and updates as new literature is released.

CHAPTER SIX

Discussion

This project was equally as challenging as it was rewarding. I was in a position of healthcare where I had the opportunity to bring a new and exciting change to practice and be instrumental in an initiative never seen before in Saudi Arabia. The topic of febrile neutropenia was relatively new to myself, having never worked in oncology, which tested my own knowledge and ability to research. Adding the element of being in Saudi Arabia created challenges of its own. There is a major communication and language barrier as Arabia is a language with over 300 variations of Arabic, and English is second to these. However, I have always had an interest in linguistics and so this was an exciting challenge for me and one that became easier as my time went by.

The second major challenge being in Saudi Arabia was the culture shift. It is a very hierarchical workplace which has stemmed from the traditional and oppressive views, that women are viewed as inferior to men. This is highlighted in healthcare, where the doctors are predominantly male, and the nurses are mostly female, and therefore the common issues that stem from this patriarchal culture and society as a regular part of the experience. In saying this, I was incredibly fortunate to be working alongside a fantastic group of nurses and physicians from across Finland, Ireland, Jordan, Lebanon, and Germany, in which we were able to come together as equals to provide healthcare and positive health outcomes for the children of Saudi Arabia. I was worried this patriarchy would pose as a limitation to this project, however it only showed up to be a hinderance for a moment during the implementation phase and was readily resolved through physician communication and support.

Another incredibly unexpected factor that impacted on the project was the arrival of COVID-19 to Saudi Arabia. The combination of this and civil and political unrest developing in the area resulted in my rapid and unplanned departure from the Middle East. This challenge was one no one could expect or plan for, however, with the project well on track and halfway through the implementation phase the decision to continue was relatively seamless. With myself operating virtually from the department, I was still able to actively engage in reviews and discussions. I thank the paediatric department for being so strong willed, and enthusiastic to take part in this project, that even whilst working through a pandemic, managed to prioritise this projects importance.

Results and Implications

My project provided the implementation of a clinical care pathway for King Faisal Hospital in Riyadh and was the first of its kind for Saudi Arabia. Implementing a practice change as a young, female health practitioner in a dissimilar culture to my own, was equally as challenging as it was rewarding. I am incredibly proud and honoured to have had this opportunity to aid in the improvement of health outcomes of the paediatric population in Saudi Arabia and seen success through this practice change. The results of this implementation project not only reduced the time to antibiotic administration but improved the standard of care being delivered in the paediatric emergency department. The time of antibiotic administration improved by 67.1% within 8 months, which is a positive achievement. The department is well on track to be achieving best practice, which aims to have antibiotics administered within an hour of arrival to emergency departments (Klastersky et al., 2016; Lehrnbecher et al., 2012; Rhodes et al., 2017; Stephens, 2020; Sung et al., 2011; Taplitz et al., 2018; Weiss et al., 2018). With King Faisal Hospital having an average TAA of 3 hours and 48 minutes in 2019, their paediatric oncology population were at great risk of rapid deterioration and irreversible organ damage (Stephens, 2020; Weiss et al., 2014). By

improving this time, the department can be confident in their ability to provide safe and effective treatment, while actively avoiding adverse effects of delayed treatment.

Implementing a nurse-led clinical care pathway also initiated other opportunities for the department. Nurses have grown in their knowledge and ability to appropriately treat and care for febrile neutropenic patients. They have also upskilled in central venous device access, which is a skill utilised in healthcare globally, and preferred method of intravenous access for the immunocompromised (VanHouwelingen et al., 2018). Furthermore, they were empowered to speak up about their practice and have confidence in their scope as they are knowingly following evidenced-based care. Likewise, the opportunity to become 'nurse champions' in this pathway provided skills and leadership opportunities that aided individual professional development plans. The application of 'nurse champions' during the implementation phase undoubtedly influenced the success of the project as floor nurses took ownership of the pathway and project and volunteered their time to actively promote the pathway and support the team. Furthermore, many paediatric nurses expressed interest in becoming a nurse champion for this pathway when the role was introduced. This was a positive indication that the nurses were actively engaged in the project, accepting of the change, and empowered to educated themselves more. The education and teaching of the nurses in this project played a vital role in the success of implementation. At the beginning of the project, nurses had poor confidence and knowledge regarding febrile neutropenia, but by providing regular in-services, trainings, and support prior to implementation, they were able to hit the ground running with the pathway and appeared to immerse themselves in this project with little to no concerns.

The choice of a clinical care pathway to aid in the improvement of time to antibiotic administration, was well supported by evidence and literature (Bekmezian, 2015; Browne et al., 2002; Haeusler et al., 2018; Murray et al., 2017; Williams et al., 2014). Although there is

still a lack of paediatric specific febrile neutropenia studies and guidelines, the three hospital guidelines utilised for this project follow current best practice guidelines, and have been advocated through articles and studies as a way forward for the improvement of febrile neutropenia care (Haeusler et al., 2018). By using a combination of literature and finding mutual agreement across the treatment protocols for sepsis and febrile neutropenia, as well as investigating treatment for both adults and paediatrics, we were able to develop a plan that met evidence-based standards and had a positive impact at King Faisal Hospital. Seeing similar results in streamlined care and reduced treatment times reinforced that our project had been appropriately implemented and was following in the footsteps of previous hospitals who had successfully implemented clinical care pathway projects. Our defined outcomes and goals were all met through the planning and implementation phases of the project. Nurses appeared confident with their education and training, and enthusiastic to successfully bring the pathway into practice.

Comments on the Model

The decision to utilise Rosswurm and Larrabee's (1999) model for evidence-based practice change improved the flow and outcome of this project. The model was systematic and detailed in a step-by-step plan that ensured all aspects of changing practice were investigated, and that projects were feasible and well supported by literature. Additionally, this model may prove beneficial to the future of nursing development at King Faisal Hospital. By following each phase of this framework, nurses in healthcare can be empowered to question the quality of care, research evidenced-base practice, and create implementation plans to improve the standard of care being delivered. It may also influence further clinical care pathways to be implemented at King Faisal Hospital.

This model is comprised of six separate phases, however there was some difficultly in establishing separation in phases one and two, largely due to the similarities in assessing a

need for change, which in this case through the utilisation of a clinical audit, identified the potential issues and interventions simultaneously. In a way this felt repetitive to investigate, however also felt reassuring in the establishment of the issues identified. I found it supportive to know that upon reflection Larrabee (2009) had recognized this similarity and altered the model to combine sections of phase two into phase one and dispersed other elements of phase two into phase three.

Phase three of Rosswurm and Larrabee's (1999) model ultimately comprises as a current literature review. This was a useful tool which was able to support the rationale for changing practice, understand current literature and article recommendations, and was beneficial in the education of key stakeholders and staff. Finally, I felt the fourth and the fifth phases flowed systematically, and appropriately for this project. The development and design of the pathway which utilised the evidence-based practice determined in the third phase, provided a foundation of understanding of definitions and outcomes prior to implementation. There were limitations with the maintenance phase, as this is ongoing and will be for the future of the pathway, to ensure it remains as current evidence-based practice. However, with my departure from the Middle East and the project being handed over to the staff meant my presence for Phase Six was low. Nonetheless, though meticulous planning and discussions, the handover of the project to a key stakeholder and senior nurse was seamless and staff appeared comfortable with the transition.

Future Recommendations

For the future of this pathway, I recommend a further clinical audit and nursing review 12 months following implementation. There are models available to ensure clinical guidelines are updated as appropriate. It is suggested that clinical guidelines are reviewed every 2 – 3 years or following the trend of approved articles and organisations (Vernooij et al., 2014). In the case for Saudi Arabia, and the topic of Febrile Neutropenia, updated

guidelines and evidence-based advice from governing bodies appeared to be released between 3 -5 years.

This project has seen great adherence of the nurses, who were open and flexible to change. I believe a lot of this adherence came from the initial inclusion of the nurses in the beginning to gauge their interest and support, as well as a pre-determined foundation of trust within the paediatric team. For healthcare professionals implementing practice change projects, I would highly recommend Rosswurm and Larrabee's (1999) evidence-base practice change model. It was clear and concise, and practitioners are guided through the whole process of researching, developing, and integrating an evidence-based change. Furthermore, I would recommend the application of 'nurse champions' for any nurse-led practice change. This was considered early in our planning phase and utilised a few months into implementation. This aided in ensuring constant support as the stakeholders phased out and promoted individual nursing development. Nurses have now seen a positive practice change, that was developed through an initial experience on the floor with supportive literature. I am pleased to hand the project over to the nurse champions, and paediatric nurse educators who remain at King Faisal Hospital.

REFERENCES

Al-Gazali, L., & Hamamy, H. (2014). Consanguinity and Dysmorphology in Arabs. *Human Heredity, 77*(63). https://doi.org/10.1159/000360421

Alharbi, O., Al-Shaia, W., Al-Hamam, A., Al-Marzoug, H., Ahmed, A., & Bagha, M. (2015). Attitude of Saudi Arabian adults towards consanguineous marriage. *Qatar Medical Journal, 2.* https://doi.org/10.5339/qmj.2015.12

Auckland University of Technology. (2019). *Ethics Approval.* https://www.aut.ac.nz/research/researchethics/ethics-approval

Australian and New Zealand Children's Haematology/Oncology Group [ANZCHOG]. (2020). *Who we are.* https://anzchog.org/

Bao, H., Yang, F., Su, S., Wang, X., Zhang, M., Xiao, Y., Jiang, J., Wang, J., & Liu, M. (2016). Evaluating the effect of clinical care pathways on quality of cancer care: analysis of breast, colon and rectal cancer pathways. *Journal of Cancer Research and Clinical Oncology, 142*. https://doi.org/10.1007/s00432-015-2106-z

Bekmezian, A. (2015). Clinical pathway improves pediatrics asthma management in the emergency department and reduces admissions. *Journal of Asthma, 52*(8). https://doi.org/10.3109/02770903.2015.1019086

Bow, E., & Wingard, J. (2020). Overview of neutropenic fever syndromes, In C. A. Kauffman (Ed.), *UpToDate:* https://www.uptodate.com/contents/overview-of-neutropenic-fever-syndromes

Browne, G., Giles, H., Mccaskill, M., Fasher, B., & Lam, T. (2002). The benefits of using clinical pathways for managing acute paediatric illness in an emergency department.

Journal of Quality in Clinical Practice. https://doi.org/10.1046/j.1440-1762.2001.00405.x

Cancer Institute NSW. (2020). What we do. https://www.cancer.nsw.gov.au/

Chen, P., Chiu, T. W., Hsu, P. L., Lin, C. S., Peng, C. I., Wang, Y. C., & Tsai, J. S. (2020). Pathophysiological implications of hypoxia in human diseases. *Journal of Biomedical Science, 27*(63). https://doi.org/10.1186/s12929-020-00658

Chiang, A. C., Ellis, P., & Zon, R. (2017). Perspective on the use of Clinical Pathways in Oncology Care. *American Society of Clinical Oncology Educational Book,* 37. pp. 155-159. https://doi.org/10.1200/EDBK_175533

Children's Hospital of Philadelphia [CHOP]. (2017). *Reducing Time to Antibiotics for Children with Sepsis.* https://www.chop.edu/news/reducing-time-antibiotics-children-sepsis

Children's Hospital of Philadelphia. (2019). *Clinical Pathway for Oncology Patient Presenting with Fever.* https://www.chop.edu/clinical-pathway/oncology-patient-with-fever-clinical-pathway

Chin, R., Browne, G., Lam, T., McCaskill, M., Fasher, B., & Hort, J. (2002). Effectiveness of a croup clinical pathway in the management of children with croup presenting to an emergency department. *Journal of Paediatrics and Child Health, 38*(4), pp. 382-387. https://doi.org/10.1046/j.1440-1754.2002.00011

Clarke, A., Shearer, W., McMillan, A., & Ireland, P. (2010). Investigating apparent variation in quality of care: the critical role of clinician engagement. *Medical Journal of Australia, 193*. https://doi.org/10.5694/j.1326-5377.2010.tb04025.x

Dalkey, N., & Helmer, O. (1963). An experimental application of the DELPHI method to the use of experts. *Management Science, 9*(3). https://doi.org/10.1287/mnsc.9.3.458

Davis, K., & Wilson, S. (2020). Febrile neutropenia in paediatric oncology. *Paediatrics and Child Health, 30*(3). https://doi.org/10.1016/j.paed.2019.12.002

Dellinger, R. P., Levy, M., Carlet, M. J., Bion, J., Parker, M. M., Jaeschke, R., Reinhart, K., Angus, C. D., Brun-Buisson, C., Beale, R., Calandra, T., Dhainaut, J., Gerlach, H., Harvey, M., Marini, J. J., Marshall, J., Ranieri, M., Ramsay, G., Sevranksy, J., … & Vincent, J. (2008). Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock. *Intensive Care Medicine, 34*. https://doi.org/10.1007.s00134-007-0934-2

Demetrios, N. K., Borko, J., & Olga, F. (2014). Timing of initial antibiotic treatment for febrile neutropenia in the emergency department: the need for evidence-based guidelines. *Journal of the National Comprehensive Cancer Network, 12*(11), pp. 1569-1573. https://doi.org/10.6004/jnccn.2014.0157

Esposito, P., & Dal Canton, A. (2014). Clinical audit, a valuable tool to improve quality of care: General methodology and applications in nephrology. *World Journal of Nephrology, 3*(4). https://doi.org/10.5527/wjn.v3.i4.249

Eubank, B., Mohtadi, N., Lafave, M., Wiley, P., Bois, A., Boorman, R., & Sheps, D. (2016). Using the modified Delphi method to establish clinical consensus for the diagnosis and the treatment of patients with rotator cuff pathology. *BMC Medical Research Methodology, 16*. https://doi.org/10.1186/s12874-016.0165-8

Evans-Lacko, S., Jarrett, M., McCrone, P., & Thronicroft, G. (2010). Facilitators and barriers to implementing clinical care pathways. *Biomedical Health Centre Research, 10*(128), https://doi.org/10.1186/1472-6963-10-182

Fielding, J. A. (2019). Rethinking CRAAP: Getting students thinking like fact-checkers in evaluating web sources. *Association of College and Research Libraries, 80*(11). https://doi.org/10.5860/crln.80.11.620

Flower, C., Bow, E., Flynn, P., Goldberg, J., Marr, K., Musser, L., Oliver, T., Somerfield, M., White, B., & Ammann, R. (2013). *Management of fever and neutropenia in children with cancer or undergoing hematopoietic stem cell transplantation guideline endorsement.* https://www.asco.org/sites/new-www.asco.org/files/content-files/practice-and-guidelines/documents/ped-fn-endorsement.pdf

Greenhalgh, T., Robert, G., & Bate, P. (2004). *How to Spread Good Ideas A systematic review of the literature on diffusion, dissemination and sustainability of innovations in health service delivery and organisation.* http://www.netscc.ac.uk/hsdr/files/project/SDO_FR_08-1201-038_V01.pdf

Haeusler, G., Slavin, M., Bryant, P., Babl, F., Mechinaud, F., & Thursky, K. (2018). Management of fever and neutropenia in children with cancer: A survey of Australian and New Zealand practice. *Journal of Paediatrics and Child Health, 54*(2018). https://doi.org/10.1111/jpc.13899

Hassan, Z. A., Schattner, P., & Mazza, D. (2006). Doing a pilot study: why is it essential. *Malaysian Family Physician, 1.* 70-73. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4453116/

Hughes, W., Armstrong, D., Bodey, G., Bow, E., Brown, A., Calandra, T., Feld, R., Pizzo, A., Rolston, K., Shenep, J., & Young, L. (2002). 2002 Guidelines for the use of antimicrobial agents in Neutropenic patients with cancer. *Clinical Infectious Diseases: an official publication of the Infectious Diseases Society of America 34*(6), pp. 730-751. https://doi.org/10.1086/339215

Institute of Medicine (US). (2011). *The future of Nursing: Leading Change, Advancing Health.* National Academies Press. https://doi.org/10.17226/12956

Jastaniah, W., Aljaferi, A., Ayas, M., Alharbi, M., Alkhayat, N., Al-Anzi, F., Yassin, F., Alkasim, F., Alharbi, Q., Abdullah, S., Abrar, M., & Alsutan, A. (2018). Prevalence of hereditary cancer susceptibility syndromes in children with cancer in a highly consanguineous population. *Cancer Epidemiology, 55.* https://doi.org/10.1016/j.canep.2018.05.006

Klastersky, J., de Naurois, J., Rolston, K., Rapoport, B., Maschmeyer, G., Aapro, M., & Herrstedt, J. (2016). Management of febrile neutropaenia: ESMO Clinical Practice Guidelines. *Annals of Oncology, 27.* https://doi.org/10.1093/annonc/mdw325

Kumar, A., Roberts, D., Wood, K., Light, B., Parrillo, J., Sharma, S., Suppes, R., Feinstein, D., Zanotti, S., Taiberg, L., Gurka, D., Kumar, A., & Cheang, M. (2006). Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Critical Care Medicine, 34*(6), pp. 1589-1596. https://doi.org/10.1097/01.CCM.0000217961.75225.E9

Lancaster, G. A., Dodd, S., & Williamson, P. R. (2004). Design and analysis of pilot studies: recommendations for good practice. *Journal of Evaluation in Clinical Practice, 10*(2). https://doi.org/10.1111/j.2002.384.doc.x

Larrabee, J. (2009). *Nurse to nurse. Evidence based practice.* https://doi.org/10.1036/0071493727

Lehrnbecher, T., Phillips, R., Alexander, S., Alvaro, F., Carlesse, F., Hakim, B., Santolaya, M., Castagnola, E., Davis, B., Dupuis, L., Gibson, F., Groll, A., Gaur, A., Gupta, A., Kebudi, R., Petrilli, S., Steinbach, W., Villarroel, M., Zaoutis, T., & Sung, L. (2012). Guideline for the management of fever and neutropenia in children with cancer and/or

undergoing hematopoietic stem-cell transplantation. *Journal of Clinical Oncology, 30.* https://doi.org/10.1200/JCO.2012.42.7161

Levy, M., Evans, L., & Rhodes, A. (2018). The Surviving Sepsis Campaign bundle: 2018 Update. *Intensive Care Medicine, 44*(6). https://doi.org/10/1007/s00134-018-5085-0

Lucas, A., Olin, J., & Coleman, M. (2018). Management and Preventive Measures for Febrile Neutropenia. *Pharmacy and Therapeutics, 43*(4), pp. 228–232. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5871243/

Miech, E. J., Rattray, N. A., Flanagan, M. E., Damschroder, L., Schmid, A. A., & Damush, T. M. (2018). Inside help: An integrative review of champions in healthcare-related implementation. *SAGE Open Medicine, 17*(6). https://doi.org/10.1177/2050312118773261

Murray, A., Alpern, E., Lavelle, J., & Mollen, C. (2017). Clinical pathway effectiveness: Febrile young infant clinical pathway in a paediatric emergency department. *Paediatric Emergency Care, 33*(9), pp. 33-37. https://doi.org/10.1097/PEC.0000000000000960

Norris, J., White, D., Nowell, L., Mrklas, K., & Stelfox, H. (2017). How do stakeholders from multiple hierarchial levels of a large provincial health system define engagement? A qualitative study. *Implementation Science, 12*(98). https://doi.org/10.1186/s13012-017-0625-5

Ostrow, O., Savlov, D., Petrich, A., Richardson, S. E., & Friedman, J. N. (2017). Reducing unnecessary nasopharyngeal virus testing at a tertiary care paediatric centre – a choosing wisely initiative. *Paediatrics and Children Health, 22*(1). https://doi.org/10.1093/pch.pxx086.042

Paolino, J., Mariani, J., Lucas, A., Rupon, J., Weinstein, H., Abrams, A., & Friendmann, A. (2019). Outcomes of a clinical pathway for primary outpatient management of paediatric patients with low-risk febrile neutropenia. *Pediatric Blood & Cancer, 66*(7). https://doi.org/10.1002.pbc.27679

Pearson, A. (2014). Evidence-based Nursing: Synthesizing the best available evidence to translate into action in policy and practice. *Nursing Clinics of North America, 49*(4). https://doi.org/10/1016/j.cnur.2014.09.001

Rhodes, A., Evans, E. L., Alhazzani, W., Levy, M. M., Antoneli, M., Ferrer, R., Kumar, A., Sevranky, E. J., Sprung, L. C., Nunnally, E. M., Rochwerg, B., Rubenfeld, D. G., Angus, C. D., Annane, D., Beale, J. R., Bellinghan, J. G., Bernard, R. G., Chiche, J., Coopersmith, C., … & Dellinger, R. P. (2017). Surviving sepsis campaign: International guidelines for management of sepsis and septic shock: 2016. *Critical Care Medicine, 45*(3), pp. 486-552. https://doi.org/10.1097/CCM.0000000000002255

Rosswurm, M., & Larrabee, J. (1999). A model for change to evidence-based practice. *Journal of Nursing Scholarship 31*(4). https://doi.org/10.1111/j.1547-5069.1999.tb00510.x

Royal Children's Hospital Melbourne. (2009). *Fever and suspected or confirmed neutropenia.* https://www.rch.org.au/clinicalguide/guideline_index/Fever_and_suspected_or_confirmed_neutropenia/

Royal Children's Hospital Melbourne. (2020). *Fever and suspected or confirmed neutropenia.* https://www.rch.org.au/clinicalguide/guideline_index/Fever_and_suspected_or_confirmed_neutropenia/

Shankar, A. N., Shankar, V. N. & Praveen, V. (2011). The Basics in Research Methodology: The clinical audit. *Journal of Clinical and Diagnostic Research, 5*(3). https://www.jcdr.net/articles/pdf/1350/2084~final.pdf

Shariff, N. (2014). Factors that act as facilitators and barriers to nurse leaders' participation in health policy development. *Biomed Central Nursing, 13*(20). https://doi.org/10.1186/1472-6955-13-20

Skeen, J., & Teague, L. (2020). *Antibiotic protocol for the management of febrile neutropenia.* https://www.starship.org.nz/guidelines/antibiotic-protocol-for-the-management-of-febrile-neutropenia/

Smith, R. (1992). Audit and research. *British Medical Journal, 305*(905-905). https://doi.org/10.1136/bmj.305.6859.905

Stephens., S. (2020). Neutropenic Fever in the Intensive Care Unit. In: Nates J., Price K. (eds) *Oncologic Critical Care*. https://doi.org/10.1007/978-3-319-74588-6_118

Sung, L., Phillips, R., & Lehrnbecher, T. (2011). Time for paediatric febrile neutropenia guidelines – children are not little adults. *European Journal of Cancer, 47*(6). pp. 811-813. https://doi.org/10.1016/j.ejca.2011.01.021

Taplitz, R., Kennedy, B. E., Bow, J. E., Crew, J., Gleason, C., Hawley, K. D., Langston, A. A., Nastoupil, J. L., Rajotte, M., Rolston, K., Strasfeld, L., & Flowers, R. C. (2018). Outpatient management of fever and neutropenia in adults treated for malignancy: American society of Clinical Oncology and Infectious Diseases society of America clinical practice guideline update. *Journal of Clinical Oncology, 36*(14). https://doi.org/10.1200/JCO.2017.77.6211

VanHouwelingen, L., Vera, L., Lu, M., Wynn, L., Wu, J., Prajapati, H., Gold, R., Murphy, A., Fernandez-Pineada, I., Gosain, A., Pui, C., & Davidoff, A. (2018). Neutropenia at the time of subcutaneous port insertion may not be a risk factor for early infectious complications in pediatric oncology patients. *Journal of Pediatric Surgery: Oncology*, *54*(1). https://doi.org/10.1016/j.jpedsurg.2018.10.024

Van Weel, C., Alnasir, F., Farahat, T., Usta, J., Osman, M., Abdulmalik, M., Nashat, N., Alsharief, M. W., Sansousi, S., Saleh, H., Tarawneh, M., Goodyear-Smith, F., Howe, A., & Kassai, R. (2017). Primary healthcare policy implementation in the Eastern Mediterranean region: Experiences of six countries. *European Journal of General Practice, 24*(1). https://doi.org/10.1080.13814788.2017.1397624

Vernooij, R., Sanabria, A. S., Sola, I., & Alonso, P. (2014). Guidance for updating clinical practice guidelines: A systematic review of methodological handbooks. *Implementation Science, 9*(1). https://doi.org/10.1186/1748-5908-9-3

Vicente, M., Al-Nahedh, M., Parsad, S., Knoebel, R. W., Pisano, J., & Pettit, N. N. (2017). Impact of a clinical pathway on appropriate empiric vancomycin use in cancer patients with febrile neutropenia. *Journal of Oncology Pharmacy Practice*, *23*(8). https://doi.org/10.1177/1078155216668672

Weinkove, R., Clay, J., & Wood, C. (2013). Temperature management in haematology patients with febrile neutropenia: a practice survey. *New Zealand Medical Journal, 126*(1373). https://assets-global.website-files.com/5e332a62c703f653182faf47/5e332a62c703f6b64a2fdb14_content%20(1).pdf

Weiss, S., Fitzgerald, J., Balamuth, F., Alpern, E., Lavelle, J., Chilutti, M., Grundmeier, R., Nadkarni, V., & Thomas, N. (2014). Delayed antimicrobial therapy increases

mortality and organ dysfunction duration in paediatric sepsis. *Critical care medicine 42*(11). Pp. 2409-2417. https://doi.org/10.1097/CCM.0000000000000509

Weycker, D., Barron, R., Kartashov, A., Legg, J., & Lyman, G. (2013). Incidence, treatment, and consequences of chemotherapy-induced febrile neutropenia in the inpatient and outpatient settings. *Journal of Oncology Pharmacy Practice, 20*(3). https://doi.org/10.1177/1078155213492450

White, C. (2011). Nurse Champions: A Key Role in bridging the gap between research and practice. *Journal of Emergency Nursing, 37*. https://doi.org/10.1016/j.jen.2011.04.009

APPENDIX: Nursing Survey Results Summary

KFSH&RC Febrile Neutropenic Staffing Survey

DECEMBER 2019

How comfortable are you with caring for febrile neutropenic patients?

Actively avoids	Not confident alone	Enough to get by	Independent w support nearby	Independent to patient solely
2	7	11	5	1

Where do you feel your knowledge on febrile neutropenia and treatment options sits?

No experience or knowledge prior to KFSH&RC	Very unsure. Relies on others guidance	Enough to get by	Quite confident	Proficient
12	3	9	2	0

Do you feel we adequately treat febrile neutropenia at KFSH&RC?

Not at all – unsafe	Probably not	Do not know	Quite good, room for improvement	Yes, current best practice is upheld
5	4	14	3	0

The following are YES/NO responses:

Are you aware of current, up-to-date best practice guidelines when it comes to treating febrile neutropenia?

NO: 24 YES: 2

Do you actively prioritize febrile neutropenic patients on their arrival?

NO: 19 YES: 7

Are you able to access Port-a-Caths?

NO: 26 YES: 0

Are you open to adopting a new clinical guideline for treating febrile neutropenia?

NO: 0 YES: 26

Do you have any concerns or barriers nurses may face regarding introducing a new clinical guideline (please explain below)

Common themes:

Doctors not willing to support change.

Busy shifts and lots of patients mean the FN patients get delayed care.

'I don't really know much about FN.'

Lack of support from ACCN

Do you have additional ideas to add when streamlining care for febrile neutropenic patients?

Champion nurses for FN?

Consultant support to fast-track doctors.

Teachings are probably needed for staff.