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Acuity-Based Models of Care: Improving Wait Times and Efficiency in an Outpatient Infusion Center

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Abstract

Background: Timeliness is a crucial aspect of high-quality care, yet remains a common issue faced by many outpatient infusion settings leading to patient dissatisfaction and potential negative outcomes.

Local Problem: At a 28-chair community infusion center, results from patient satisfaction surveys as well as chart audits highlighted suboptimal wait times and efficiency. 32% of patients were dissatisfied with wait times ranging from 23 to 40 minutes based on the therapy received.

Methods: A quality improvement project was conducted aiming to decrease the average wait time of patients receiving short therapies while increasing patient satisfaction. After a thorough review of the literature, an acuity-based model of care was implemented incorporating three new interventions into practice: the development of a new oncology-specific acuity tool used for pre-planned nursing assignments, the start-up of a fast-track area of care, and nursing education.

Results: Chart audit data was analyzed pre and post-implementation showing a 19.4% decrease in wait times for short therapy patients from an average of 23.2 minutes to 18.7 minutes ($p = 0.354$). NRC satisfaction surveys were also analyzed noting a 5.9% increase in patient satisfaction related to timeliness of care.

Conclusions: Implementing an acuity-based model of care may optimize unit efficiency and timeliness, improve patient and nurse satisfaction, create safer and more equitable nursing assignments, reduce resource waste, and generate potential increased revenue.

Keywords: Timeliness, wait times, acuity-based models of care, acuity, acuity tool, infusion, immunotherapy, chemotherapy.

Introduction

Problem Description

Timeliness is one of the six aims for improving the quality of healthcare noted by the Institute of Medicine (Edwards et al., 2017). However, long wait times remain a common problem faced by infusion care settings across the nation leading to suboptimal care (Hashemi-Sadraei et al., 2021). Not only have increased wait times proven to directly impact outcomes, but research has shown that delays in care are a notable source of dissatisfaction and emotional distress for patients (Bateni, 2023).

At a 28-chair community infusion center, results from patient satisfaction surveys highlighted that the second highest area of patient dissatisfaction is related to wait times, with 32% of patients being dissatisfied (NRC, n.d.). This past September, members of leadership as well as point-of-care nurses identified that medication preparation was creating delays in patient care. Staff members along with the help of an operational excellence lead completed a project that significantly optimized pharmacy mixing hood usage aiding in decreased wait times for medication availability. However, wait times continued to remain high suggesting delays related to Infusion Room efficiency. A chart audit completed on March 1st of 2024 highlighted that the average wait time from when a patient's visit is scheduled (or when the patient arrives if late) to when the patient receives their first medication is 23 minutes for patients receiving short non-chemo treatments and 40 minutes for those receiving longer immunotherapy or chemotherapy treatments. After completing a thorough investigation of factors attributing to wait times on the unit, three main problem areas were identified: clinic communication, order discrepancies, and unit workflows.

Due to the timeframe and scope of this quality improvement project, care workflows were identified as the most promising area for change on this unit. The current workflow in the Infusion Room consists of direct patient care provided primarily by 8 nurses. The unit is sectioned into four "pods" with two nurses staffing each. Every pod consists of six patient chairs where nurses self-assign themselves to care based on their availability. The unit also staffs two to three "float" nurses each day who serve to support the pod nurses as needed. In analyzing this workflow, two main areas for optimization were identified. Firstly, float nurses were often underutilized. Though helpful at times throughout the day, the majority of float nurses' shifts are spent searching for opportunities to help staff rather than effectively supporting their team. Secondly, due to varying therapy lengths, patient acuity, and appointment times, it is not uncommon for delays to occur. When a new patient arrives for treatment, depending on whether their pre-determined nurse is assisting another patient at the time or not, the new arrival may either cause disruption to the care of a patient actively receiving treatment or need to wait until their nurse becomes available. This issue is further amplified by the current self-assigning model for nursing assignments. Nurses in a pod most commonly alternate assigning themselves to patients based on arrival time. However, this does not take into account the acuity of patients or treatment regimens creating inequitable assignments and further opportunities for delays.

This workflow is discordant with the unit's aim to provide safe, timely, and patient-centered care. While some delays related to the complex nature of the disease processes treated are unavoidable, optimizing workflows on the unit can impact both wait times and the overall satisfaction of patients. Acuity-based models of care have not only proven to decrease wait times but also create equitable assignments allowing for safer care, higher patient satisfaction, as well as nurse satisfaction (Vortherms et al., 2015). This quality improvement project aimed to determine

how acuity-based models of care impact wait times for patients receiving anti-cancer or benign hematologic therapies in an outpatient infusion setting.

Available Knowledge

A literature review was conducted to identify current knowledge regarding the overall impact of wait times as well as acuity-based models of care in the outpatient infusion setting. Using the research platform EBSCOhost, a search for evidence was conducted using the databases Cumulated Index to Nursing and Allied Health Literature (CINAHL) Complete, MEDLINE, and Cochrane Central Register of Controlled Trials. The search engine Google Scholar was also used to find additional research evidence. The following key terms were used in this search: "outpatient infusion", "wait times", and "acuity." Subsequently, MeSH terms utilized in relation to outpatient infusion included infusion clinic, oncology, infusion, chemotherapy, and immunotherapy. This search yielded a total of 210 articles after duplicates were removed and publishing years were limited from 2014 to 2024. Utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 71 full-text articles were further screened after the limiters of English language and peer-reviewed were applied and irrelevant studies were removed. Exclusion criteria consisted of methodology with low levels of evidence, interventions outside of this project's scope of practice, studies with no outcome measures of interest, and studies examining the pediatric population. Inclusion criteria consisted of studies examining the adult population, oncology or infusion patients, and outpatient oncology or infusion settings. Of the 75 full-text articles, 6 articles were selected for full analysis. A full diagram of the PRISMA process may be found in Appendix A.

Critical Appraisal of the Evidence

Overall Impact of Wait Times. Two research groups investigated how wait times impacted overall health and well-being for patients as well as how wait times were perceived by

patients. Graboyes et al. (2019) performed a systematic review including 18 studies to determine the impact of wait times on survival in head and neck cancer patients. These studies primarily consisted of retrospective case and cohort studies between the years of 2007 and 2018. Graboyes et al. found a correlation between prolonged diagnosis to treatment initiation times and decreased survival suggesting that timely care is associated with increased survival of head and neck cancer patients (2019). This was supported by Joanna Briggs Institute (JBI) level three evidence; however, one must consider that these studies were limited to a specific population seen in infusion centers and may not apply to all patients receiving care at an infusion center (2013). Further, the study's authors noted a high level of heterogeneity in defining what truly constitutes a "delay" in treatment which could have impacted findings and prevented a full meta-analysis from being performed.

Mathews et al. (2015) carried out 60 patient interviews at a regional cancer center in Newfoundland and Labrador. The main goal of these interviews was to determine how wait times impact patients' overall satisfaction with care in the oncological setting. Qualitative interviews were conducted using semi-structured questions addressing wait times and perceptions of care. A thematic analysis was then conducted by the research team which noted that while the majority of patients noted timeliness of care to be a factor of dissatisfaction, patient perceptions of wait times were multi-faceted and further impacted by caregiver's interpersonal skills and overall coordination of care. The findings of this study suggest that valid measures must be created to truly determine wait-related satisfaction and overall impact on care, but that there is a strong association between wait times and patient satisfaction. However, one must consider that this study had low levels of evidence (JBI level 4) as the methods of interviewing provide room for error related to subjectiveness and patient recall. More research would be needed to support these findings.

Acuity-Based Models, Wait Times, and Satisfaction. Naiker et al. (2018) conducted a systematic review to identify strategies to decrease wait times in outpatient settings. Using multiple high-quality databases, a total of 151 records were identified and 38 studies were subsequently analyzed in full. The majority of studies were cohort or case studies. Though these studies were generalized to the outpatient setting rather than outpatient infusion, three overarching themes were identified to improve wait times: resource alignment, operational efficiency, and process improvement. Of the three themes noted, process improvement which encompassed capacity planning, resource allocation, reduction of variation, appointment scheduling, clinical staff improvement processes, and elimination of waste, had the greatest positive results for decreasing wait times (Naiker et al., 2018). While measured outcomes do not directly align with those implemented in this project, implementing an acuity-based model of care would fall under process improvement suggesting positive potential impacts based on the JBI level three evidence provided in this review. However, the variety of settings reviewed along with differing outcome measures between studies may be hard to apply to individual settings.

Edwards et al. (2017) implemented an acuity-based scheduling model at an outpatient cancer center as an evidence-based quality improvement project using a rapid cycle test of change approach. The acuity-based model involved the creation and assignment of levels of acuity as they related to treatment durations. On top of the implementation of this acuity assignment system, they further implemented a 17-chair “short infusion treatment” area in hopes of expediting shorter treatments. While no true calculation of wait times was performed, Edwards et al. collected pre and post-intervention data on capacity, infusion hours, utilization rate, patient visits, chair turns, and average infusion length (2017). These data points were utilized to determine “efficiency wait times.” Aggregate comparisons pre and post-intervention showed improvement across all outcome measures suggesting overall improvement in efficiency. Edwards et al. (2017) further investigated

patient satisfaction related to wait times using Press Ganey Satisfaction Surveys. After the implementation of the acuity-based model, Press Ganey satisfaction with wait time scores increased by 2.1 points. While these findings may help support the implementation of an acuity-based model of care, their significance is limited by the quality improvement projects' JBI level five evidence.

Schrameck et al. (2022) discussed the implementation of a new oncology-based acuity tool across 6 outpatient clinics in a quality improvement initiative. A point-based, multi-level acuity tool similar to those discussed in prior studies was found to miss highly complex patients with its usage. Based on feedback received from nurses utilizing the tool, a new model that took into consideration multiple psychosocial and physical needs such as interpreter services was established. Schrameck et al. (2022) utilized staff surveys to determine the impact of the new model. Eighty-five pre and post-surveys were completed and showed positive results suggesting better balanced and equitable nursing assignments and increased nurse satisfaction. While these results were promising, this JBI level five evidence project was presented as a poster presentation at an Oncology Nursing Society Congress so full data of methods were not available.

Similarly to many of the prior studies mentioned, Vortherms et al. (2015) implemented an evidence-based quality improvement project aiming to maximize patient satisfaction, employee engagement, and equity in workload amongst nurses. Utilizing evidence from 46 articles of moderate to strong strength, they created a five-point acuity scale. Vortherms et al. (2015) conducted a six-month-long pilot study to test and validate the acuity tool that was created utilizing a pre-assigned pilot group of patients and a control group. The average acuity of patients in both groups was comparable, but the control group did not utilize acuity-based scheduling. Nurses on the unit cycled through caring for both groups in week-long periods. The pilot study helped identify optimal maximum acuity levels per nurse as well as a consensus of efficacy from

nurses. After the completion of the pilot study, a six-week implementation period was conducted. Vortherms et al. (2015) measured outcomes involving patient activity and staffing levels as well as hospital time off, overtime, and sick time used by nurses. A 57% reduction in hospital time off was noted along with a 76% reduction in overtime hours, and a 22% decrease in sick time. These data points are directly related to both nursing satisfaction as well as the efficacy of the model. The authors further noted that a balanced workload was achieved, the work environment was improved, and the patient care experience was enhanced. While these findings are strong, the study falls under JBI level 4 evidence and did not provide thorough details of data collection, nor did they clearly state sample sizes.

Evidence Synthesis

Based on the compilation of evidence found in this review, acuity-based models of care prove to be a positive intervention in improving outpatient infusion unit efficiency. These models may further increase patient satisfaction. However, one must take into consideration the minimal high-quality, research-based evidence available on this subject. The majority of studies analyzed in this literature review were either qualitative research or evidence-based quality improvement projects. The findings of these studies were clinically significant, however, the lack of quantitative data is a barrier to determining the statistical significance of findings. Further, while many studies alluded to improved efficiency with the use of acuity-based models of care, none directly measured wait times as an outcome.

While statistical significance may not be supported by evidence, all studies supported the clinical significance of acuity-based models of care. The evidence provided by Graboyes et al. (2019), and Mathews et al. (2015) helped establish the baseline importance of timeliness in both oncological and infusion care. Graboyes et al. (2019) found that there is a correlation between delays in treatment and survival in head and neck cancers. Matthews et al. (2019) suggest that

further research must be conducted in order to create a more consistent definition of patient satisfaction in relation to wait times, but acknowledge that satisfaction with wait times is multi-faceted. They further support the idea that wait times overall can have a strong emotional and psychological impact on patients awaiting treatment. These studies help support the need for improved models of care to decrease wait times.

Naiker et al. (2018) identified that process improvement is one of the most effective ways to optimize timeliness in outpatient settings. Evidence from all three studies investigating the implementation of acuity-based models as a means of process improvement (Edwards et al., 2017, Schrameck et al., 2022, and Vortherms et al., 2015) suggested positive outcomes. Three common themes of outcomes were noted amongst these studies: patient and nursing satisfaction, equitable workloads to support safer care, and improved unit efficiency. Over the past years, patients in the outpatient infusion setting have not only multiplied in numbers but become more complex. In order to continue providing high-quality and safe care to patients, models must be adapted to best support both patients and staff; Evidence of these common outcomes suggests that acuity-based models may do just that.

Implications for this Quality Improvement Project

This literature highlights the importance of timeliness and efficiency in outpatient infusion settings. Not only is timeliness one of the six aims for improving the quality of healthcare, but directly impacts both patient satisfaction and outcomes. Evidence from studies analyzed in this review suggested that acuity-based models of care may optimize both timeliness and efficiency with a secondary outcome of increased satisfaction. These findings also suggested a likely positive impact of the proposed interventions and desired outcomes of this quality improvement project. The literature further identified a gap in available knowledge regarding acuity-based models of care in infusion settings as well as their direct impact on wait times.

Rationale

The Model for Improvement framework was utilized for this quality improvement project. This model consists of two phases: the first focuses on creating specific aims and measures followed by selecting an intervention while the second phase tests the intervention utilizing a Plan-Do-Study-Act (PDSA) cycle (IHI, n.d.). The first phase of this framework was completed over three months after completing a 5 P assessment of the unit. A specific aim and intervention were chosen to address wait times with chart audit data being the primary source of measurement. During the Plan phase of the PDSA cycle, three months of data was collected through chart audits calculating the average patient wait time defined as the number of minutes spent between when the patient's visit was scheduled (or when the patient checked in if late) until the first medication was given. Three months worth of patient satisfaction survey results were also gathered from NRC Health surveys. Control charts were created based on this data and analyzed. The Do phase of this project began in June following review for IRB exempt status and spanned four weeks. This phase consisted of the implementation of a new oncology-specific acuity tool, pre-planned nursing assignments, as well as a "Fast Track" section and workflow for patients scheduled to receive short therapies less than 30 minutes. The Study phase involved the same processes utilized in the Plan phase for chart auditing and survey analysis to determine any significant differences in wait times and satisfaction. During the final Act phase, findings were disseminated to key stakeholders (nursing director, nurse manager, and staff nurses) and the change was adopted by the unit.

Project Aims

The global aim of this quality improvement project was to decrease wait times for those receiving care at the infusion facility. The process started with a patient's arrival to the unit and ends with the administration of their first medication. By working on this we expected to improve overall patient satisfaction with care. This was important to work on now because not only is

timely care crucial to patient outcomes in oncological treatment, but wait times were further noted to be a detractor in patient satisfaction survey results of this unit.

The specific aim of this quality improvement project was to decrease the average wait time of patients receiving short therapies by 20% by the end of July 2024. Patient satisfaction will further be addressed as a secondary outcome aiming to increase patient satisfaction by 10% by the end of July 2024.

Methods

Context

Prior to the implementation of this project there were many areas of waste that if optimized would create opportunities for increased revenue. Four infusion chairs were blocked off as "overflow" chairs. These chairs were only utilized if a patient needed to be added to the schedule last minute and no other chairs were available. Further, two additional chairs were not utilized by the unit on a daily basis because they are smaller than others. Part of this quality improvement project involved the reallocation of chairs for the use of a "fast track" area which is utilized by patients receiving short treatments. By utilizing these chairs that typically are not used to full capacity, not only did we expect the timeliness of patient care to improve due to the availability of increased chair space, but it was possible that revenue would increase also. A survey conducted in 2019 by the American Society of Clinical Oncology estimated that each hematology/oncology infusion chair generates about $274,740 per year in revenue (Bourbeau et al., 2020).

Another area of waste discovered in the assessment of this unit was that nurses who were scheduled in the "float" position were severely underutilized. Nurses in this assignment did not take on a patient load but rather "floated" around the unit assisting their colleagues when needed. While this position may have been useful some days, overall, both staff and leadership note that the majority of time spent in this position is time spent looking for things to help with rather than

truly helping. Typically, two float nurses were scheduled each day on the unit. The implementation of the fast track reallocated one of these float nurses to be the fast track nurses in aims to improve the efficiency of the unit and optimize the use of staffing resources. Once established, fewer nurses were needed to provide efficient and safe care to patients. Even one less nurse staffed per day could save nearly $86,000 annually as this is the average cost of one FTE (A. Fysh, personal communication, March 18, 2024).

The only costs associated with the implementation of this quality improvement project were those of printing a poster and handouts for education. This costed no more than $50. The potential revenue generated by one infusion chair ($274,740) along with the savings of one less FTE ($86,000) outweighed the costs of implementation.

Interventions

An acuity-based model of care was implemented and trialed during this quality improvement project. This entailed four interworking interventions: the development of a new oncology-specific acuity tool used for pre-planned nursing assignments, the start-up of a fast-track area, nursing education to support resource nurses in scheduling patients according to acuity, as well as general nursing education to familiarize the entire nursing team with the new process. The primary team members involved in this project were this author as the project lead, unit leadership, nursing staff, and the operational excellence data analyst.

The Acuity Tool and Nursing Assignments

An oncology-specific acuity tool was created utilizing supporting evidence from reviews of the literature, analysis of tools used by similar infusion centers, and feedback and opinions from "expert" nurses and members of leadership on the unit. The acuity tool was scaled on a level from one to five with five being the highest acuity. Specific treatments and drug regimens were assigned a corresponding acuity level based on the following factors: risk for reaction, pre-

medications required, symptom management during treatment, nursing tasks during treatment such as continuous vitals, and required double-checks. Factors such as psychosocial issues, mobility issues, precautions, and new drug regimen starts also warranted an additional acuity point. After agreement between the project lead and nursing team for a finalized tool, a physical copy of the acuity tool was created to be kept at the resource desk as well as made available on the unit's electronic share drive. This tool assisted unit leadership and resource nurses in creating pre-assigned nurse assignments that were even and equitable across all staff members aiming to have all nurses under 15 acuity points per day. A copy of the Oncology Acuity Tool is included in Appendix B.

The Fast Track

In order to create a "Fast Track", infusion chairs were reassigned to pods. Two chairs closest to the entry of the unit were utilized as the fast-track chairs with one of those two being an overflow chair. To ensure each pod still had a designated overflow chair despite the implementation of the fast-track, two chairs that previously were not being utilized were incorporated into pods. No structural changes needed to occur and therefore no review by a fire marshal or facilities to determine compliance was required. Education was provided to staff to ensure the teams understood which infusion chairs would be part of which pod assignments. Treatment time slots were scheduled in 30-minute intervals from the start to the closing of the business day for the primary fast-track chair with the exception of a "lunchtime" block between 1200 and 1300. Treatments that were eligible to be scheduled in the fast-track chairs were identified in the acuity tool. One nurse was in charge of providing care to patients in the fast-track area with the goal of a 1:1 patient-to-nurse ratio. A description of this process change was presented to the nursing director and nurse manager of this unit who had decisional authority for change, and the process was approved for implementation.

Resource Nurse Education

Since nurses in the resource role are in charge of creating patient assignments for the unit and will be the primary users of the acuity tool, an individualized education session was provided to this group of nurses. A meeting was scheduled including the project lead, leadership members, and the resource nurses and a PowerPoint™ presentation was utilized to familiarize the nurses with the acuity tool. The project lead further facilitated a discussion to answer questions and concerns that arose. The nurses were then given a short ten-question "quiz" asking them to utilize the acuity tool to assign acuities to different example patients. This intervention not only served as education but also as a form of data collection to determine the efficacy of the tool.

General Nurse Education

In order to familiarize the entire nursing team with new changes brought about by the implementation of the acuity-based model of care, education was provided during a scheduled staff meeting. This meeting included a brief overview of the acuity tool that resource nurses will be utilizing, information about how the fast-track would be scheduled and staffed, and how infusion chairs were reassigned to pods. A question-and-answer session followed to ensure nurses understood the new model.

Study of the Interventions

The specific aims of this quality improvement project were to decrease wait times and improve patient satisfaction. Therefore, to assess the impact of interventions, wait times and patient satisfaction were studied utilizing measures described in the following section. Baseline data regarding wait times was collected via chart audits for February through April. Similarly, data was collected for one month post-intervention utilizing chart audits. To assess patient satisfaction, NRC Health™ survey results were analyzed pre and post-interventions. Though it does not relate

to a specific aim, the reliability of the acuity tool was also studied since it was a newly developed tool rather than one that had undergone prior psychometric testing.

Measures

Acuity Tool Reliability

In order to determine the reliability of the acuity tool, testing was completed during the resource education session. Nurses were asked to assign acuities to five sample patients. They completed this test twice. During the second test, questions were presented in a different order. Answers were then compared between nurses to test for reproducibility and answers between individuals' two tests compared for repeatability using a Gage Repeatability and Reproducibility (R&R) test to gauge the overall reliability of the tool. The Acuity Tool reliability prompts may be found in Appendix C.

Wait Times

For this project, wait times were defined as the amount of time between when a patient checks in until the time that the first medication/treatment is provided. To support the reliability of these measures, the definition of what is considered the start of the wait time was further broken down depending on when a patient arrived, when the appointment was scheduled, and when a patient was roomed. If a patient arrived on time or before the start of the scheduled appointment time and waited in the waiting room, the wait time start was defined as the time when the appointment was scheduled to start. If a patient arrived early and the nursing team brought them back to a room before the scheduled appointment start time, the defined wait time start became when the patient was roomed. If a patient arrived late to their scheduled appointment, the start time was defined as the time the patient checks in. For all cases, the wait time end was defined as the start time of a procedure or the first medication given. These times were obtained from chart audits utilizing Epic™ reports during the defined periods above and then analyzed.

Patient Satisfaction

Patient satisfaction was measured utilizing NRC Health™ surveys. NRC Health™ is a well-established and tested survey system utilized by the hospital. Surveys are sent to patients within 24 hours of their appointment and provide real time feedback to the facility in order to capture the patient's experience before, during, and after treatment (NRC Health, n.d.). The survey utilizes Likert scale questions as well as short answer questions. While the survey asks questions regarding many different areas of care, there are categories and questions specifically related to satisfaction with timeliness of care. Results for these questions were analyzed pre and post-project implementation. Means were then compared having a similar number of surveys completed in the time frame with an acceptable difference margin of 20%.

Analysis

Multiple methods and tests were utilized to analyze data. First, continuous quantitative data for wait times were charted to determine if the distribution of findings is normal. There was not a normal distribution of findings and to accommodate for this, daily means were utilized to create a normal distribution of data. An interval plot with a 95% confidence interval as well as t-tests were then utilized to determine if a significant change was noticed post-implementation of the acuity-based model of care. For patient satisfaction, continuous data was collected from Likert scale questions and further analyzed descriptively noting mean, standard deviation, and range to conduct a comparison of means between pre and post-implementation surveys. Patterns and themes were also searched for in the short-answer question comments for qualitative data.

Ethical Considerations

This quality improvement project aimed to optimize a nursing process related to scheduling and organization rather than direct patient care. Therefore, there were no potential anticipated opportunities for harm to patients. However, it was acknowledged that patients may

benefit from the optimized timeliness this project seeks to create. Ethical considerations for this project primarily centered around the nursing staff and their fear of the audit process. In order to mitigate ethical issues, chart audits did not include nurse identification and staff was educated that audits were only used to identify wait times. It was also recognized this this project lead had developed professional relationships with patients on the unit which may have created response bias during data collection of patient satisfaction surveys. To further ensure this project would pose no ethical issues, it was reviewed by a University of New Hampshire Nursing Program review committee as well as the Mass General Hospital Institutional Review Board (IRB). The Mass General IRB determined the project met the criteria for a QI project which was exempt from full IRB review.

Results

Initial Steps

Two formal education sessions were completed as detailed in the interventions section. During these meetings, staff noted that they did not feel ready to implement the change leading to the implementation period being delayed by one week. For the week that followed, the project lead held continuing informal one-on-one education sessions throughout the day with staff members outlining what new changes would look like in action. Once staff expressed that they felt more comfortable with the change, the oncology tool, nursing assignments, and fast-track area went live for an implementation phase between June 17th and July 12th. A few changes were made throughout this implementation phase. After the completion of the first week, the physical assignment sheet that was created by the project lead was modified slightly taking into consideration staff preferences of its layout. Further, as the fast-track area was utilized, certain procedures and treatments were identified to be more appropriate for nurse assignments to better optimize fast-track usage. The acuity tool was modified slightly to reflect these changes.

Process Measures

Acuity Tool Reliability

After the completion of education sessions, fifteen staff members completed reliability testing for the acuity tool. Of those fifteen nurses, seven of them were resource nurses. Data analysis showed that overall, the oncology acuity tool was reliable. The only significant area of deviation was related to highly complex patients; Question five on the reliability test referred to a patient who had a history of reactions, was mobility dependent, had a trach that required suctioning, and was non-English speaking requiring a translator. Testing showed that as more factors warranted additional acuity points, nurses were more likely to miss a point or two. However, nurses' answers for more straightforward patients were both repeatable and reproducible suggesting that the tool is reliable (see Figure 1).

Figure 1

Repeatability and Reproducibility Testing Results

Source	VarComp	% Contribution (of VarComp)	StdDev	Study Var. (6 x SD)	%Study Var. (%SV)
Total Gage R&R	0.0803	1.185	0.2834	1.7002	10.8859
Repeatability	0.0133	0.1968	0.1155	0.6928	4.4359
Reproducibility	0.067	0.9883	0.2588	1.5527	9.9411
Nurse	0.0061	0.0905	0.0783	0.0007	3.0083
Nurse x Question	0.0608	0.8978	0.2466	0.007	9.475
Question to Question	6.6958	98.815	2.5876	15.5258	99.4057
Total Variation	6.7761	100	2.6031	15.6186	100

Wait Times

Wait time results were analyzed in two separate periods: the first two weeks of implementation as well as the full four weeks of implementation. This decision was made as many

confounding variables occurred during the second two weeks of implementation that likely affected results. During the third week of implementation, patient scheduling was not normal due to a holiday week. The following week of implementation was severely understaffed due to multiple resignations and callouts on the unit. However, these data points were still included and utilized as conditions are not always consistent on the unit and this provided insightful information on how the acuity-based model functioned during these times.

Due to the complexity of care and variations in medication preparation times, results attained from chart audits produced a non-normal distribution of data. To better analyze data sets, rational sub-groupings of daily means were used to create a normal distribution of data. During the first two weeks of implementation, wait times for fast-track eligible patients were reduced from a baseline mean wait time of 23.2 minutes to 18.7 minutes post-intervention (see Figure 2). No significant change in wait times was identified for non-fast-track eligible patients during this period. Utilizing a 2-Sample t Test these results were determined to be statistically insignificant (p = 0.354).

Figure 2

Interval Plot of Daily Mean Wait Times and 2 Sample t-Test (Implementation Weeks 1-2)

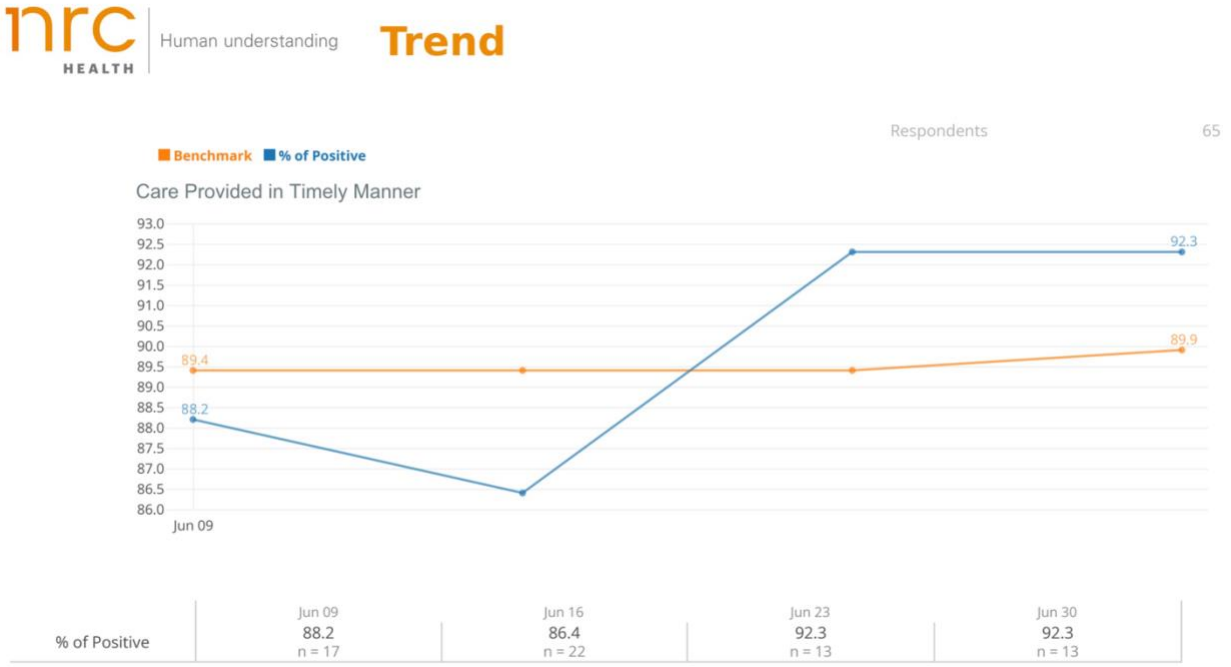
When the third and fourth weeks of data points were incorporated into the analysis, results varied from those found during the first two weeks of implementation. Mean wait times for fast-track eligible patients only decreased by about two minutes. However, there was a notable decrease for non-fast-track eligible patients from a baseline of 40.2 to 36.2 minutes. Despite this change, both results were still determined to be statistically insignificant ($p = 0.22$). The 2-Sample t Test further highlighted that there was a low power (beta = 0.137) due to the small sample size of data.

Patient Satisfaction

NRC survey data showed an overall increase in patient satisfaction related to timeliness of care. Immediately prior to this project's implementation, only 86.4 percent of patients were satisfied with timeliness. This increased to an average of 92.3 percent during the implementation period (see Figure 3). While these survey questions did not directly ask about satisfaction regarding fast-track implementation, no other processes were changed during the implementation of this project. However, one must acknowledge that other factors could have impacted these results.

Figure 3

Patient Satisfaction Run Chart



Contextual Elements

During the planning and implementation of this quality improvement project, staffing on the unit was undergoing high turnover while also experiencing a transition in leadership. Changes associated with this created high levels of stress and worry for staff on the unit causing an environment that was not optimal for change. During the initial planning and implementation of this project, there were low levels of buy-in due to change in general; While nurses on the unit thought that this quality improvement project was a great idea and foresaw benefits it would bring to the unit, they noted that they were very unhappy with other factors such as consistent communications from leadership and were resistant to any change brought forth at the time. Staff willingness to partake in this change likely affected results. However, not all nurses were resistant to change, and those who were highly supportive of the project were positive factors for the project's success. Further, the delay caused by both IRB review and staff resistance caused the

implementation phase to be shortened decreasing the data that was able to be retrieved related to interventions limiting the sample size.

Associations

After data analysis was completed, there were many notable associations among interventions, outcomes, and contextual elements. The most prominent relationship was found to be between the experience of the nurse working in the fast-track area of care with the efficacy of the intervention. Nurses working in the fast-track who had five years of oncology experience or greater generally yielded shorter wait times than those with less than five years of experience. Similar effects were noted when looking at nurses' work styles and personalities. Those who came from a nursing background rooted in fast-paced care such as the emergency department tended to create shorter wait times for patients as did those who were quick on their feet, strong at multitasking, and worked well independently.

Equity of nursing assignments was also dependent on who created them. The creation of assignments was primarily completed by either the nurse manager or the chart prep nurse. These nurses utilized slightly different methods for assigning patients and therefore yield differences in results. One created assignments that were even across the board but at times created challenges for add-on patients in relation to chair availability while the other nurse created assignments that optimized chair availability but were less balanced among nurses.

Add-on patient volumes as well as overall patient volumes and acuity also impacted intervention results. On days where patient volumes or total acuity was higher than normal, wait times and satisfaction were not as optimal as slower days. On busy days many confounding variables can impact wait time such as delays with medication mixing in the pharmacy, delays with communication of providers, etc. Since wait times were the primary measure of this project, confounding variables can easily affect results.

Unintended Consequences

Nursing satisfaction was not a measure this project focused on, however, nurses expressed increased satisfaction related to their nursing assignments for the day. They specifically commented on how the pre-made assignments decreased time in the morning previously needed to distribute and look up patients, allowed for more equitable assignments, created a more manageable workload throughout the shift, allowed for proper lunch breaks, and made it possible for nurses to leave closer to their shift end time. Leadership further noted that with the optimized efficacy brought on by this project's interventions, they will likely be able to decrease the number of staff scheduled each day both decreasing staffing costs and allowing for more staff vacation time to be utilized.

This project also highlighted a need for changes in patient scheduling. Patients are currently booked by a scheduling team unrelated to nursing. During this project, patient appointment times were found to not always be correct, timings of appointments were heaviest between ten and two, and open slots in the mornings and evenings were not being utilized. This created extra work for the nursing team to correct and manage when creating daily assignments. These findings suggest that optimizing scheduling procedures could further benefit the unit's efficacy.

Discussion

Summary

The specific aim of this quality improvement project was to decrease the average wait time for patients receiving short therapies by 20% subsequently increasing patient satisfaction. In order to meet this goal a new acuity-based model of care was implemented. This model of care included the development of an oncology-specific acuity tool, pre-planned equitable nursing assignments, and a Fast Track area of care. Before this project, wait times were a major area of patient

dissatisfaction. While the acuity-based model of care did not create a statistically significant effect, clinical significance was noted. Project aims were just nearly met during the first two weeks of implementation having decreased by 19.4% for patients who were eligible to use the Fast Track area of care. However, the average decrease over the full four weeks of implementation was only 7.6 percent. When considering these results, one must acknowledge the short implementation period that limited a data collection as well as the confounding variables that impacted the last two weeks of implementation.

Fast Track eligible patients noted excitement and satisfaction with the addition of the Fast Track as it created fewer delays in their care and these findings were supported by satisfaction scores. Further, interventions implemented during this project increased the satisfaction of nurses on the unit. This was an unintended, but highly anticipated outcome. Prior nursing workflows were suboptimal leading to high anxiety, burnout, and dissatisfaction. As a result of the new acuity model established, nurses noted a more equitable and manageable workload which will likely lead to safer practices and a higher quality of patient care. This project also helped highlight a need for change in the current patient scheduling practices as well as leadership communication on the unit. In the future, these changes would further optimize this model of care.

Interpretation

The interventions implemented during this project were associated with a decrease in wait times as well as an increase in patient satisfaction for those receiving short therapies. By utilizing separate treatment chairs than those receiving longer therapies, there were fewer delays for those scheduled for short therapies allowing for more timely care. These findings were comparable to those published by Edwards et al. (2017) who noted an increase in efficiency of wait times and patient satisfaction after the implementation of an acuity-based model of care. Further, unintended outcomes of increased nurse satisfaction regarding equitable assignments and manageable

workloads were similar to those found by both Schrameck et al. (2022) and Vortherms et al. (2015).

This quality improvement project positively impacted both patients treated at this center as well as the microsystem itself. Results yielded by the creation of the fast track allowed for a higher quality of care for patients. While health outcomes were not a measure studied during this project, timely care is recognized to be a crucial factor in improving the quality of care for patients (IOM, 2001). In combination with the Fast Track, the acuity-based model of care further decreased waste and improved efficiency in the nursing workflow both optimizing system processes and supporting core team members of this microsystem. The project also helped identify areas of care that could be strengthened to further optimize system processes allowing leadership on this unit to best focus continuing efforts for improvement.

While anticipated outcomes of this project related to wait times for short therapy patients and nurses came to fruition during the first two weeks of implementation, overall wait times for the entire implementation period fell short of project goals. As discussed, there were many confounding variables impacting results during this period, but these variables will undoubtedly arise again in the future. It is also important to acknowledge that delays can still occur due to other factors of treatment such as pharmacy delays, incomplete physician orders, medication mixing, etc. Further study of outcomes related to this intervention will be crucial to determine its effectiveness over time.

Not only did project results suggest a potential decrease in wait times associated with the implementation of the acuity-based model, but it also suggested that the change would be cost-effective. No significant costs were associated with the implementation of the acuity-based model of care, and while it is too soon to determine the true impact this change may have on revenue, this model allowed for an increase in patient volume. An additional two treatment chairs were utilized

in this model change which could increase revenue by $549,480 per year (Bourbeau et al., 2020). The model also optimized the utilization of nursing staff which, in time, could allow for decreased FTE expenditure. While adopting this change may come with the trade-off of increased unit education needs and possible resistance to change by staff, the increased quality of care this model allows for combined with its cost-effectiveness should make its implementation justifiable.

Limitations

While this quality improvement project produced positive results for the microsystem it was implemented in, there is still a very limited amount of research to support its generalizability. Further, these interventions may not be as effective for smaller cancer centers that have fewer resources or serve fewer patients. The interventions of this project benefited a center that saw upwards of 70 patients per day with average staffing numbers of twelve nurses and three nursing assistants. Smaller centers may not have the available staff to allocate to a fast-track area nor have a need for a fast-track area for limited patient volumes. The oncology-specific acuity tool could benefit a generalized population. However, treatment regimens and additive factors may need to be individualized to the patient population of the center utilizing it to be effective. The tool will further need to be adapted over time as new treatments become available to continue to support a generalized population of patients.

Minor flaws in the methodology of this project caused by confounding variables could further limit this project's generalizability. Due to a high level of nursing turnover at the time of this project's implementation, there were days when either the manager or the project lead needed to create the nursing assignments for the coming days. This role was supposed to be that of the resource or chart prep nurse as this was the long-term goal for these roles. Both the project lead and unit manager likely had more flexibility and time to put into the creation of these assignments than nurses working on the floor would have. This may have limited findings regarding the

usability and time-effectiveness of these interventions. However, similar processes were used by those in charge of creating nursing assignments and produced comparable results regardless of the person in the role when the tool was used as intended.

It must also be taken into consideration that chart audits were the primary source of data collection for this project. While charting and documentation are intended to be completed in real time, it is understood that this is not always the case and has the potential to impact the results of this project. However, in-person observation of nurses on this unit suggested that the majority of charting is completed in real-time with minimal deviation to this process. Electronic medical record charting also does not always capture confounding delays. For example, if a patient had difficult IV access which caused a delay in receiving medication, the captured wait time may encompass that time spent attaining access even though it was not directly related to the interventions of this project. To account for this potential skew of results, data analysis included a redistribution by daily means to minimize the impact of outliers.

Conclusion

Usefulness of the Work

This quality improvement project helped improve both timeliness and satisfaction of care provided on the unit it was implemented. Project interventions created a decrease in wait times as well as an increase in both patient and nurse satisfaction. While statistical significance was not determined, clinical significance was noted; Processes of care were optimized while decreasing the waste of resources and creating a potential for increased revenue. It further helped identify areas and processes that would benefit from improvement helping leaders focus and direct their next efforts.

Sustainability

The sustainability of this work will be dependent on those continuing its implementation. As the process continues to be utilized on the unit, there will need to be very clear roles and expectations established as to who is in charge of creating the nursing assignments due to the current high rate of nursing turnover. Processes will need to be put into place to account for staff callouts, resignations, or vacation time for those in charge of creating nursing assignments. While the acuity tool was created utilizing categories of generalization that allowed for some flexibility to account for new and emerging treatment regimens, the tool may need to be continuously adapted as oncological care advances or patient populations change.

Potential for Spread to Other Contexts

While this project was created for use in an oncological/infusion setting, the idea of acuity-based models of care is universal and may benefit many different areas of care. Acuity-based models of care are already utilized in many emergency care settings helping to both identify the care needs of patients and allow for safe and appropriate nursing assignments. Similar acuity tools may be created based on common unit procedures or patient diagnoses to establish levels of acuity. Utilizing this practice may help foster a higher quality of safe patient care, equitable nursing assignments, and overall unit satisfaction.

Implications for Practice and Further Study in the Field

A review of the literature highlighted that acuity-based models of care in the field of oncology are not well established. Minimal research exists examining the impacts these models may have on patient outcomes, timeliness of care, and satisfaction. However, the positive trend of results of this quality improvement project suggests its continued implementation may benefit both patients and nurses of the microsystem. Continuing process changes and PDSA cycles may help optimize interventions set in place during this project. Further quality improvement projects

or research may help establish the impact of acuity-based models of care in the oncological setting.

Suggested Next Steps

In order to optimize outcomes related to the implementation of this quality improvement project, integrated processes and areas of care must be addressed. As noted previously, this project highlighted that the system utilized to schedule patients in this microsystem created barriers for this model to function as it was intended. Patient appointments are frequently scheduled inappropriately, appointment start times are not well balanced throughout the day, and errors in crucial appointment information are not uncommon. Even when nursing assignments were equitable and balanced using the acuity tool, influxes of patient arrivals primarily between the times of ten and two created barriers to timely treatment. Further, areas of improvement were noted related to provider communication. It is not uncommon for patients to arrive to the unit lacking appropriate physician orders which delays treatments and subsequent chair times. Addressing these factors creating delays will not only improve patient care but further optimize project interventions.

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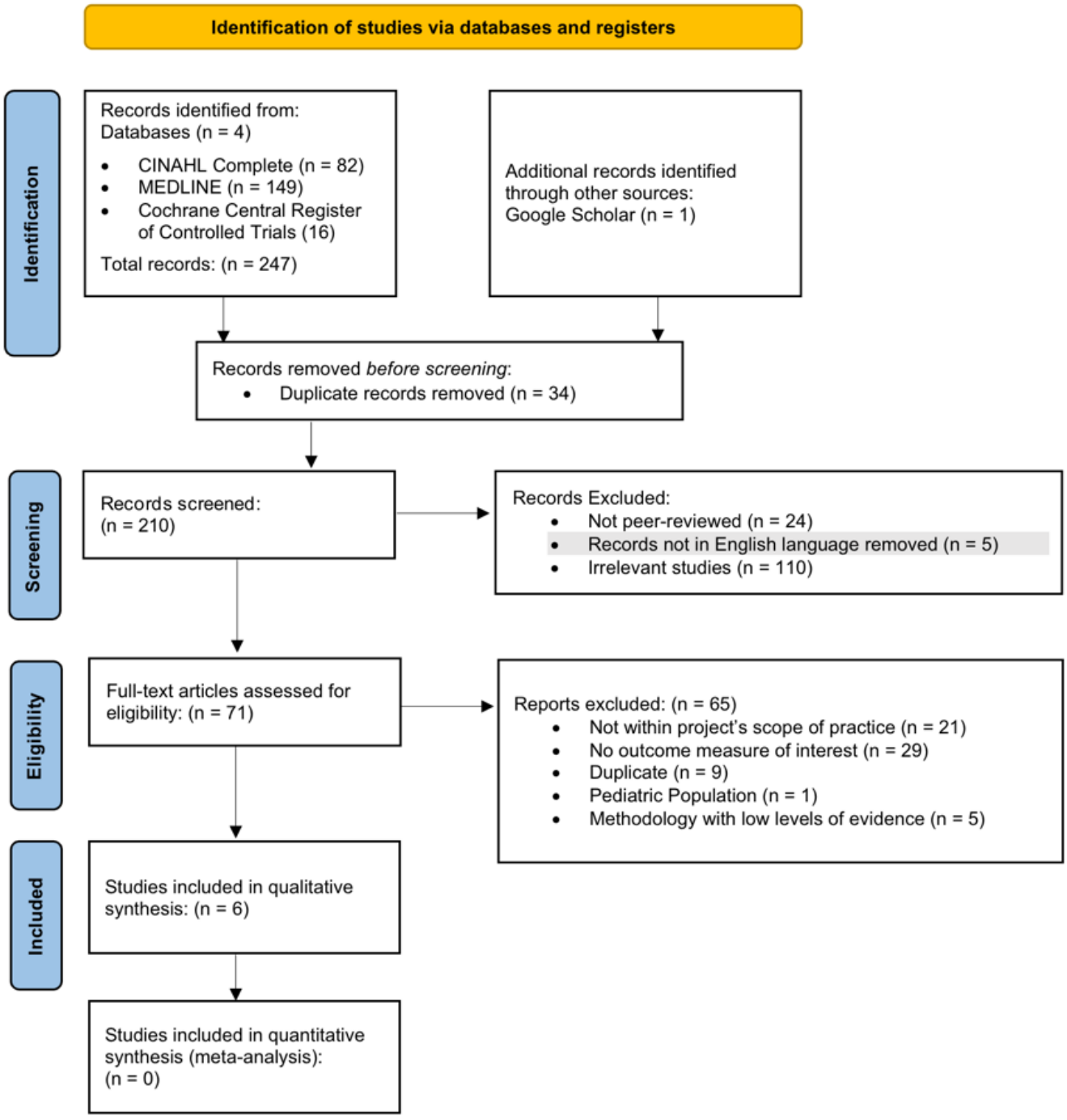
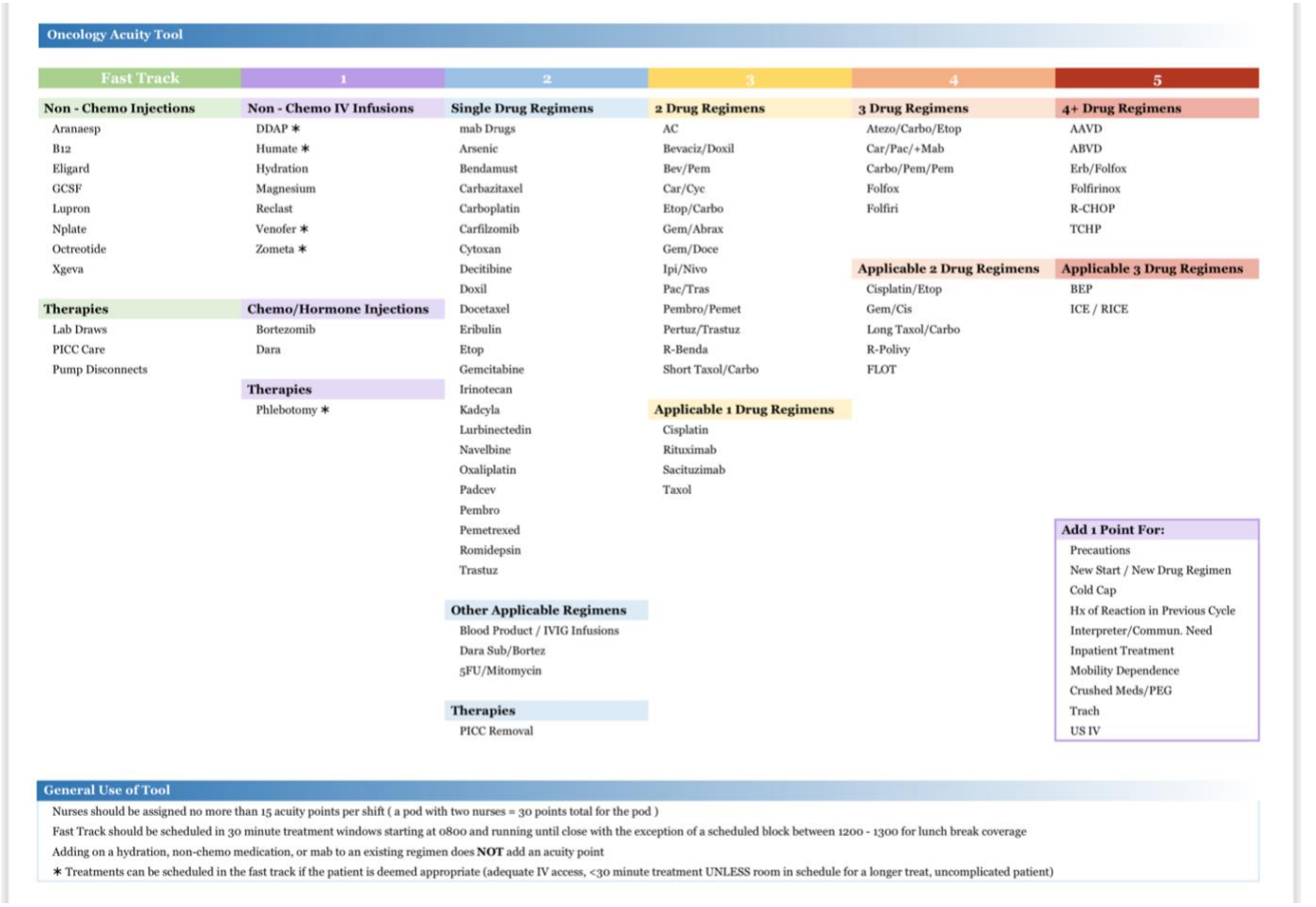
Appendix A

Literature Review PRISMA Matrix



Appendix B

Oncology Acuity Tool



Oncology Acuity Tool

Fast Track	1	2	3	4	5
Non - Chemo Injections	**Non - Chemo IV Infusions**	**Single Drug Regimens**	**2 Drug Regimens**	**3 Drug Regimens**	**4+ Drug Regimens**
Aranaesp	DDAP ✶	mab Drugs	AC	Atezo/Carbo/Etop	AAVD
B12	Humate ✶	Arsenic	Bevaciz/Doxil	Car/Pac/+Mab	ABVD
Eligard	Hydration	Bendamust	Bev/Pem	Carbo/Pem/Pem	Erb/Folfox
GCSF	Magnesium	Carbazitaxel	Car/Cyc	Folfox	Folfirinox
Lupron	Reclast	Carboplatin	Etop/Carbo	Folfiri	R-CHOP
Nplate	Venofer ✶	Carfilzomib	Gem/Abrax		TCHP
Octreotide	Zometa ✶	Cytoxan	Gem/Doce		
Xgeva		Decitibine	Ipi/Nivo	**Applicable 2 Drug Regimens**	**Applicable 3 Drug Regimens**
		Doxil	Pac/Tras	Cisplatin/Etop	BEP
Therapies	**Chemo/Hormone Injections**	Docetaxel	Pembro/Pemet	Gem/Cis	ICE / RICE
Lab Draws	Bortezomib	Eribulin	Pertuz/Trastuz	Long Taxol/Carbo	
PICC Care	Dara	Etop	R-Benda	R-Polivy	
Pump Disconnects		Gemcitabine	Short Taxol/Carbo	FLOT	
	Therapies	Irinotecan			
	Phlebotomy ✶	Kadcyla	**Applicable 1 Drug Regimens**		
		Lurbinectedin	Cisplatin		
		Navelbine	Rituximab		
		Oxaliplatin	Sacituzimab		
		Padcev	Taxol		
		Pembro			
		Pemetrexed			**Add 1 Point For:**
		Romidepsin			Precautions
		Trastuz			New Start / New Drug Regimen
					Cold Cap
		Other Applicable Regimens			Hx of Reaction in Previous Cycle
		Blood Product / IVIG Infusions			Interpreter/Commun. Need
		Dara Sub/Bortez			Inpatient Treatment
		5FU/Mitomycin			Mobility Dependence
					Crushed Meds/PEG
		Therapies			Trach
		PICC Removal			US IV

General Use of Tool

Nurses should be assigned no more than 15 acuity points per shift (a pod with two nurses = 30 points total for the pod)

Fast Track should be scheduled in 30 minute treatment windows starting at 0800 and running until close with the exception of a scheduled block between 1200 - 1300 for lunch break coverage

Adding on a hydration, non-chemo medication, or mab to an existing regimen does **NOT** add an acuity point

✶ Treatments can be scheduled in the fast track if the patient is deemed appropriate (adequate IV access, <30 minute treatment UNLESS room in schedule for a longer treat, uncomplicated patient)

Appendix C

Acuity Tool Reliability Quiz

Name:

Years of Oncology Experience:

Resource Nurse: Y / N

1.) 34-year-old female with a hx of HER 2 + breast cancer receiving maintenance Trastuzumab. What acuity would you give this patient? _____

2.) 55-year-old male with a hx of melanoma receiving cycle 2 ipi/nivo treatment, history of reaction in cycle one. The patient does not have central access and has needed US placement in the past. What acuity would you give this patient? _____

3.) 40-year-old male with a hx of colorectal cancer receiving maintenance folfox. For this visit, the APC is requesting to add on 1 L of hydration. According to the acuity tool, does this addition change the acuity? _____

4.) 60-year-old female with a hx of multiple myeloma receiving cycle one day one of Daratumumab. What acuity would you give this patient? _____

5.) 70-year-old male with a hx of lung cancer receiving cycle 4 of 3-hour taxol/carbo, history of reaction in previous cycles. Presents from a skilled nursing facility and is mobility dependent with a trach that requires frequent suctioning. The patient is non-English speaking. Labs noted low iron requiring an add on for Venofer this visit. What acuity would you give this patient? _____