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Abstract

Background: Frailty is a syndrome characterized by an increased burden of symptoms and higher susceptibility to adverse health, including higher functional decline rates, pressure ulcers, falls, delirium, extended hospital stay, and discharge to assisted living facilities. Screening patients for frailty before undergoing a surgical procedure is recommended to minimize postoperative complications. In the preoperative phase at a midwestern academic hospital, surgical patients are not screened for frailty using a validated screening tool.

Purpose: This project sought to calculate the Clinical Frailty Scale (CFS) score using a novel algorithm. After validating the novel algorithm, this research project predicted that clinicians would appropriately refer to the novel algorithm to identify frail patients. Other long-term goals included enhancing patient outcomes and influencing organization policies utilizing a frailty screening tool.

Theoretical/Conceptual Framework: The Johns Hopkins Nursing Evidence-Based Practice model was utilized to implement the frailty screening tool and evaluate its impact on frailty identification. The model uses a three-step process involving practice questions, evidence, and translation.

Method: This project utilized existing patient data from the patient's Electronic Medical Record (EMR) and identified physical frailty using a novel algorithm developed by the research team. The CFS, a validated screening tool, was used to validate the novel algorithm's ability to predict frailty.

Results: The correlation coefficient (r) between the novel algorithm and the CFS score from researcher #1 was 0.66835. The r value between the novel algorithm and the CFS score from

researcher #2 was 0.637808. The r value of the CFS scores between researcher #1 and researcher # 2 was 0.8122. These findings suggest that the novel algorithm is a reliable tool for assessing frailty, and that there is agreement between the two researchers in their assessment of CFS.

Conclusion: In this project, the moderate positive relationship between the novel algorithm score and the CFS score suggest that the novel algorithm may be a useful tool for assessing the same construct as the CFS tool. However, further research is needed to determine the extent to which the novel algorithm and the CFS tool scores measure the same construct and whether one is more valid, reliable, or efficient than the other. Overall, the findings from this project suggests that the novel algorithm may have clinical significance as a potential alternative or complementary tool to the CFS tool for assessing the same construct.

Screening Patients for Frailty in the Preoperative Phase

With advances in medicine and equipment, more people, including frail patients, are classified as appropriate to safely undergo surgical procedures. An effective frailty screening tool is beneficial to identify frail patients, so providers can optimize patients' clinical state before they undergo a surgical procedure (Poh & Teo, 2020). In this project, the researchers worked with stakeholders to develop a novel screening tool and the aim was to make it easier to identify frail patients at a midwestern academic medical center.

Background

One in six people over the age of 60 years are frail (Nidadavolu et al., 2020). Frailty is an essential concept in the care of surgical patients, although controversy remains regarding its defining features and clinical utilization. Frailty is a common clinical syndrome in older adults that carries an increased risk for poor health outcomes including falls, incident disability, hospitalization, and mortality (Xue, 2011). An international physician consensus group defined physical frailty as "a medical syndrome with multiple causes and contributors that is characterized by diminished strength, endurance, and reduced physiological function that increases an individual's vulnerability for developing increased dependency and/or death" (Morley et al., 2013, p.4). Frailty decreases the function of multiple organ systems leading to increased vulnerability to minor external stressors, and it is a major concern for surgical patients (Dhesi et al., 2019). It is vital to note that frailty affects the physical aspect of the body and can also significantly affect patients in their functional, emotional, cognitive, and social domains. Sadiq and his colleagues (2018) recommended that a "holistic view of frailty" including functional, emotional, cognitive and social domains be utilized to identify frail patients.

Age is the primary factor that is associated with frailty (Tjeertes et al., 2020). Additional factors include smoking, female gender, Hispanic or African American ethnicity, depression, and lower education level (Bandeen-Roche et al., 2015). Since life expectancy continues to rise, the number of frail patients undergoing surgical treatment may increase. There is growing evidence documenting that preoperative frailty is a valid indicator of postoperative complications; therefore, it is vital to identify by screening this growing population for frailty effectively and efficiently so that individualized care is delivered appropriately (Tjeertes et al., 2020).

Problem Statement

At a large academic medical center, providers use screening tools such as the Metabolic equivalents (MET) (Appendix H) and Barthel Index (BI) (Appendix I) to evaluate patients' functional independence and activity level. The Metabolic equivalents are defined as "the caloric consumption of an active individual compared with the resting basal metabolic rate at rest" (Sanghvi, 2013, p.150). One MET is equivalent to 1 kilocalorie per kilogram per hour and is the caloric consumption of a person while at complete rest. Activities of two to four METs include light walking and doing household chores. Running and climbing is considered a MET score of greater than 10, and a higher MET score indicates a higher functional capacity for patients (Sanghvi, 2013). The BI (BI) is a tool used to measure basic activities of daily living (ADL), and it contains ten items with varying weights measuring basic ADL. The BI score is a cumulative score with a maximum score of 100 corresponding to complete independence and a minimum score of 0 corresponding to total dependence (Yi et al., 2020).

Even if these tools provide information that could be used to help to identify physically frail patients, they are not validated to evaluate patients for frailty. When individuals are not properly screened for frailty using validated tools, misguided clinical practices could lead to

numerous complications that can worsen their outcomes, creating financial and emotional burdens on patients and society.

Purpose, Aims & Objectives

The main purpose of this research project was to use a validated frailty screening tool, the Clinical Frailty Scale (CFS), to score patients and compare the result with the score derived from a novel algorithm created by the project team utilizing the information from the BI, MET score, and number of comorbidities. After validating the novel algorithm created by the team, this project predicted that the novel algorithm could help to identify physical frailty. By adopting this practice, the long-term goal was for providers to deliver more individualized care to frail patients during the perioperative period. Other long-term goals included enhancing patient outcomes, promoting a holistic view of frailty, and influencing organization policies utilizing a validated frailty screening tool.

PICOT Question

In preoperative assessment providers at a midwestern academic hospital (P), can the use of a novel decision algorithm applied to a frailty screening tool (I) compared to using a validated frailty screening tool alone (C), demonstrate the potential for improved clinicians' ability in identifying frail patients (O)?

Significance/ Organizational Gap

Frailty has significant adverse effects on patients and the health care system. As individuals age, their risk of developing surgical complications increases (Nidadavolu et al., 2020). For instance, surgical patients over the age of 80 have a 20% chance of developing a postoperative complication such as cardiac arrest or pneumonia (Nidadavolu et al., 2020). Furthermore, frail patients have a higher risk of readmission and discharge to skilled care

facilities. Notably, the risk of mortality is 4.19 times more likely in frail patients. If frail individuals are not effectively screened, they can have numerous postoperative complications that prolong their hospital length of stay which adds a high healthcare cost (Panayi et al., 2019).

With advancing technologies, one-third of all operating room procedures are done on individuals over 65 years old (Nidadavolu et al., 2020). Jung et al. (2015) demonstrated that frail patients were more likely than non-frail patients to experience postoperative complications such as deep venous thrombosis (DVT), acute renal failure, or the need for blood transfusions (Rothenberg et al., 2019). Frailty also results in a three to eight-fold increase in the risk of postoperative delirium (Jung et al., 2015).

Another study by Birkelbach et al. (2019) demonstrated that individuals identified as frail had twice the incidence of developing postoperative complications compared to non-frail individuals. The mean length of stay in the hospital increased from five days in non-frail individuals to eight days in frail individuals (Birkelbach et al., 2019). Identifying and appropriately using a reliable screening tool would allow frail individuals to consider other mechanisms to treat a disease state or optimize their health leading up to surgery to create a more favorable outcome. For instance, individuals who increased their hemoglobin levels to above 13 g/dl prior to surgery had fewer complications from the surgery (Cui et al., 2017).

This project was implemented at Barnes-Jewish Hospital (BJH) in the preoperative phase on the day of surgery. Currently, a validated frailty screening tool is not used preoperatively to screen patients for frailty. As a result, this provided an opportunity for this research project to implement a new frailty screening method that was validated, effective and user friendly.

Review of Literature

One of the most important aspects of conducting a quality improvement project is identifying reliable evidence based resources and tools (Moran et al., 2020). To answer this clinical question, a literature review of related terms was performed. Reliable databases were assessed during the literature review using databases from the Cumulative Index for Nursing and Allied Health Literature (CINAHL), National Library of Medicine, National Center for Biotechnology Information (NCBI), PubMed, and ProQuest. Published articles within seven years were analyzed to ensure the most relevant information was provided.

A search was formulated using key terms in the search engine of each database. Words and phrases that already existed in the project's PICOT question were used, and other relevant articles were searched using Medical Subject Headings (MeSH). Within CINAHL, search terms utilized included "frailty screening tools", "frailty screening tool and surgery", "frailty and anesthesia care" and "frailty screening tool" and “identification of frail surgical patients." Articles were excluded if they were over seven years of age, with preference given to articles published within the past five years. Other terms utilized within CINAHL were "frailty surgical outcomes" and "frailty effects on surgery". After utilizing the most pertinent articles in CINAHL, articles within PubMed and NCBI were analyzed. MeSH searching terms utilized within these databases included "functional impairment during surgery" and "frailty surgical complications". Boolean operators were used between keywords to narrow or broaden search results. Scholarly journals that were not peer-reviewed were excluded from the list.

Articles were evaluated using the John Hopkins Evidence-Based Practice Model (JHEBP) based on the relevance of information and the quality of the data (Appendix F). Levels of evidence are assigned one to five based (Appendix G) on the methodological quality of their

design, validity, and applicability to patient care. For example, Level 1 evidence provides consistent results with robust sample sizes and recommendations. In contrast, Level III evidence provides inconsistent results that make it challenging to create conclusions (Dang & Dearholt, 2018). Within ProQuest, the search terms “frailty and anesthesia care" and "anesthesia effects on the elderly" were utilized. After analysis, a major theme throughout the articles was that the Clinical Frailty Scale (CFS) was identified as a reliable predictor of postoperative complications. Another theme presented throughout the article was that elderly individuals with comorbidities were classified as frail. A third theme was the degree of frailty was positively correlated with a worse outcome from surgery. The search strategies described above yielded numerous findings and are discussed thematically in the following sections.

Clinical Frailty Scale

The Clinical Frailty Scale (CFS) is a tool utilized to summarize the overall level of frailty and fitness of an elderly adult upon examination (Mendiratta & Latif, 2022). The nine-level scoring tool categorizes individuals into a different sub-specialty of frailty based upon their fitness level. Sze et al. (2019) evaluated six different frailty screening tools, and the CSF showed the strongest correlation for identifying frail individuals. Throughout the articles' evaluation, the CFS consistently ranked among the most reliable and user-friendly tools for providers. In these three cohort studies, groups of patients undergoing surgery were followed and evaluated before and after their procedure. The CFS consistently was the most accurate and time-efficient at predicting which patients would develop postoperative complications. The CFS had a correlation coefficient of 0.86 to 0.89 and a sensitivity of 87% with a specificity of 89% in identifying frail patients. Furthermore, the CFS had the lowest misclassification rate of 12% amongst the six

frailty tools presented within the study, a p-value of less than 0.001, indicating the results of the CFS were highly statistically significant for identifying frailty (Sze et al., 2019).

Aucoin et al. (2020) provided level 1 evidence demonstrating that the CFS was the strongest assessment tool for identifying frailty. Within this systematic review, 35 different screening tools were analyzed. The CFS was the most sensitive in detecting mortality and non-favorable discharge with an odds ratio of 4.89 (95% CI, 1.83 to 13.05). In comparison, the Edmonton Frail Scale and the Frailty Phenotype Screening tool had an odds ratio of 2.93 (95% CI, 4.00 to 9.94) and 3.79 (95% CI, 1.75 to 8.22), respectively. Additionally, the CFS had the highest reported measures of feasibility. In this study, the CFS had an odds ratio of 4.89, indicating strong reliability correlating frailty to postoperative complications. Furthermore, the CFS had the strongest capability in detecting mortality and patients being discharged to a site other than their home. Aucoin et al. (2020) also demonstrated that the CFS was easier to use ($P< 0.0001$), had fewer logistical barriers ($P<0.0001$) and was faster to conduct ($P<0.0001$). Additionally, Gregorevic et al. (2016) demonstrated the usability of the screening tool. Among the 35 different screening tools, the most evaluated tools within the systematic review of the studies were the Fried Phenotype, the CFS, the Frailty Index, the Edmonton Frail Scale, and the Katz Instrumental Activities of Daily Living. Amongst those studies, the CFS had the highest completion rate by providers (95%) compared to others. Moreover, the CFS was the most accurate predictor for 90-day mortality rate (Gregorevic et al. 2016).

Age & Comorbidities Associated with Frailty

Another important theme identified was that increasing age and increasing comorbidities were associated with frailty. Basic & Shanley (2015), demonstrated through a prospective cohort study that an increase in coexisting comorbid states was associated with frailty and thus a worse

outcome following surgery. Sze et al. (2019) and Lee et al. (2021), demonstrated through a randomized trial and a systematic review that aging was associated with an increase in comorbid conditions and worse outcome. Sze et al. (2020) demonstrated that frailty was higher in patients with CHF than in control patients (52% vs. 30%) and associated with worse surgical outcomes. Therefore, managing or optimizing the comorbidities before surgery could potentially reduce the risk of post-operative complications.

Lee et al. (2021) demonstrated that individuals with more comorbidities had a higher likelihood of being screened as frail, with a relative risk ratio of 2.35. Diabetes had a relative risk ratio of 1.35 for screening for frailty. Chronic obstructive pulmonary disease (COPD) and previous stroke had a relative risk ratio of 1.44 and 2.37, respectively. Peripheral vascular disease, chronic kidney disease, and congestive heart failure were all associated with an increased risk of frailty. Furthermore, dementia had the highest relative risk ratio for frailty, with a relative risk ratio of 7.51 (Lee et al., 2021).

Basic & Shanley (2015) demonstrated that aging individuals with more comorbidities were more likely to be screened as frail and have higher postoperative complications. In particular, elderly patients had an increased risk of respiratory infection and acute renal failure postoperatively. Furthermore, elderly individuals had a higher risk for stroke and malnutrition. Other significant findings were that elderly individuals had an increased risk for developing urinary retention and seizure disorder, which increased their likelihood of being classified as frail (Basic & Shanley, 2015).

Severity of Frailty Associated with Worse Surgical Outcomes

Montgomery et al. (2021) demonstrated through a prospective cohort study that patients who had more severe levels of frailty experienced worse surgical outcomes. Lee et al., (2021)

demonstrated through a systematic review and meta-analysis that elderly individuals with increasing severity of frailty had worse post-surgical outcomes. Four other studies utilizing a retrospective cohort review, a prospective cohort study review, and two retrospective cohort studies demonstrated that the severity of frailty is positively correlated with worse outcomes from the surgery. For example, the CFS is graded on a scale with increasing severity from 1 to 9. A CFS score of greater than or equal to 5 is associated with worse outcomes. Montgomery et al. (2021) demonstrated that the mortality rate for patients undergoing cardiac surgery with a CFS score of 5 or greater is 4% compared to 0.4% if the CFS score is 4 or less. Therefore, a frailty score that increases from <4 to 5, in this study, was correlated with a roughly ten times higher mortality rate. Patients classified as severely frail had a 17.6% chance of requiring 48 hours or more of mechanical ventilation following the procedure compared to only 3.3% of patients classified as mildly frail (Montgomery et al. 2021). Lin et al. (2016) demonstrated that patients classified as severely frail had a 21.7% chance of dying within the first thirty days of surgery compared to only 3.6% of patients classified as mildly frail (Lin et al., 2016). All six of the studies utilized screening tools such as the CFS tool and demonstrated that an increase in the severity of scoring on the screening tool was positively correlated with a worse post-surgical outcome.

Lee et al. (2021) demonstrated that after cardiac surgery, the readmission rate to the ICU was 9.8% in severely frail individuals and 3.3% in mildly frail individuals. Lee et al. (2021) demonstrated that patients screened as frail had an increased mortality rate with a relative risk ratio of 2.35. However, even patients screened as pre-frail were associated with an increased operative mortality rate with a relative risk ratio of 2.03 (Lee et al., 2021).

Curtis et al. (2018) demonstrated that the severity of frailty is positively correlated to increased mortality. Within the study, for every 1-unit increase in the patient's CFS score, the odds of dying increased by 23%. Furthermore, for every 1-unit increase in the patient's frailty score, the likelihood of being discharged to a skilled nursing facility (SNF) compared to home increased by 52%. Sadiq et al. (2018) found similar results for their study using a different model. They categorized patients as severely frail, moderately frail, or not frail using item response theory (IRT) to examine the ability of 32 heterogeneous markers capturing limitations in physical, functional, emotional, and social activity. The patients in severely or moderately frail categories had higher odds of experiencing postoperative complications than patients categorized as not frail. Furthermore, the severely frail patients had a 10.7% risk of reporting a poorer quality of life after surgery than 9.2% of moderately frail individuals (Sadiq et al., 2018).

These studies demonstrate that the greater the severity in frailty, the higher likelihood of developing postoperative complications. Sze et al. (2019) demonstrated that the CFS had the highest sensitivity and specificity and was the most user-friendly screening tool for clinicians. One strength of the study was that it included a large sample size of 467 patients. Although many frailty screening tools exist, one of the study's limitations was that only three screening tools were evaluated within this study. Another strength of the Sze et al. (2019) study was that it evaluated level I evidence. The Aucoin et al. (2020) study demonstrated that the CFS tool is effective for screening for frailty. The strength of this study was that the odds ratio was more significant than 1, indicating an increase in the reliability of the study. The study demonstrated the CFS was the most effective and convenient screening tool with the highest provider response rate among these studies.

Sze et al. (2019) and Lee et al. (2021) demonstrated that patients with increased age and comorbidities are more likely to be screened as frail. Therefore, in patients undergoing surgery, improving their chronic conditions prior to the procedure can improve postoperative outcomes.

While frailty increases the risk of complications, the severity of frailty is also correlated with postoperative complications. Curtis et al. (2018) and Sadiq et al. (2018) demonstrated that severely frail individuals had worse postoperative outcomes than mildly frail or pre-frail individuals. However, even mildly or pre-frail individuals had worse outcomes compared to non-frail individuals. This demonstrates that improving a patient's fitness leading up to surgery may improve postoperative outcomes.

Patient Population and System Needs

The patient population for this project consisted of patients who were waiting to undergo surgery in the preoperative area of BJH. Since the CFS is approved for and validated on individuals over the age of 65, patients over this age were screened. The patients were tested and screened using a mobile app that screens patients for frailty. When selecting patients to screen for frailty, patients who were seen in the CPAP clinic within the last two weeks with a MET score and BI were intentionally selected.

Evidence for the DNP Project

A review of current literature highlighted the importance implementing and evaluating a practice model for identifying frailty preoperatively to avoid or anticipate and prepare for adverse outcomes after surgery. Based on the level of evidence, the number of supportive articles, and tool content inclusion, the CFS was identified for implementation (Basic & Shanley, 2015; Curtis et al., 2018; Gregorevic et al., 2019; Sze et al., 2017). Data collection, analysis, and

evaluation focused on validating the novel algorithm against the established CFS screening tool with the objective to determine what patient demographics most correlate with frailty.

Theoretical Framework or Evidence Based Practice Model

The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) model was utilized to guide and implement the frailty screening tool and evaluate its impact on increasing frailty identification. The JHNEBP Model is a problem-solving approach to clinical decision-making to guide individual or group use. It is specifically designed to meet the needs of health care providers who are eager to enhance patient care. The model uses a three-step process called PET: practice question, evidence, and translation. The goal of the model is to ensure that the latest research findings and best practices are incorporated into patient care (Dang & Dearholt, 2018). Based on the JHNEBP model, this project's first step was exploring the problem with other healthcare professionals such as a physical therapist, anesthesia providers, clinical care expertise, biostatisticians, and preoperative assessment providers. Defining the clinical problem, background, its significance to patients and the healthcare system were established. The second step in the model entails internal and external searching for evidence related to frailty screening. In this phase, the project appraised, summarized, and synthesized the level and quality of evidence, and developed a recommendation for practice change. The project evaluated and determined the appropriateness of utilizing the novel algorithm as an improved practice model, report results to stakeholders, identify next steps, and disseminate findings.

Methodology

Project Design

Before the team started applying the CFS screening tool, both team members in the project took a free online module (Appendix B) provided by Dalhousie University on how to use the screening tool properly. The team also practiced using the CFS screening tool on case studies provided by the university. After completing education, both team members screened patients in the preoperative phase on the day of surgery utilizing the CFS tool. Each team member screened the same patient independently at different times using the CFS screening tool through the aid of the mobile application (Appendix C), which Dalhousie University provided, resulting in two CFS scores for each patient. The investigators determined potential candidates for the project on the day of surgery from the daily surgery schedules. The project team accessed the patient's name, age, and date of CPAP visit from the EMR before approaching the patient for consent. The Investigators visited patients whose eligibility had been confirmed in the preoperative area and asked them if they were willing to partake in the study. A consent form was provided to review and address any questions or concerns that they may have. Once informed consent was obtained, both investigators screened the patient for frailty using the CFS tool independently.

During the project's second phase, the project team conducted chart reviews on the same patients seen in the preoperative phase. The team accessed the patients' MET, comorbidities, and BI scores from their medical records to derive a CFS score using the novel algorithm. After data collection, the project compared the results of the frailty score between the CFS screening tool and the novel algorithm. To examine the interrater reliability, the project compared the CFS score between each team member. After results were generated from this research project, in an

effort to validate the novel algorithm, the team disseminated information to the stakeholders, and future recommendations were proposed.

Health Promotion/Disease Prevention

Frailty in the perioperative phase is a major concern for surgical patients. Screening and optimizing patients before surgery is a significant intervention toward health promotion and disease prevention of frail patients. This project was focused on the development of a practice model for screening patients for physical frailty in the preoperative setting, and the long-term goal was to optimize these patients before surgery to prevent the postoperative complications associated with frailty. Optimizing interventions for frail patients include nutritional, education, low-intensity exercise intervention, and individually tailored geriatric care models before surgery. Possible strategies to prevent frailty include lifestyle/behavioral factors, proper nutrition, and cognitive health maintenance (Walston & Buta, 2018). Short and simple instruments are most feasible in clinical practice (Walston & Buta, 2018), and the project team predicted that screening surgical patients using the CFS helped promote health and prevent diseases.

Stakeholders

There is a need for frailty-related education programs for patients/caregivers and stakeholders to develop an integrated approach for screening and managing surgical patients with frailty (Liu et al., 2022). The project team disseminated the results from this project to provide educational presentations to the stakeholders, such as the project chair, committee member, mentor, CPAP clinic director, and Washington University anesthesia department.

Resources and Budget Assessment

One of the main strengths supporting this quality improvement research project was having access to resources from a major teaching hospital. Barnes-Jewish Hospital (BJC) is supportive and proactive in implementing evidence-based practice (EBP) in its institutions. In 2003, Barnes-Jewish Hospital was the first adult hospital in Missouri to achieve the American Nurses Credentialing Center (ANCC) Magnet Recognition. One of the ANCC's requirements to award Magnet Recognition is the application of existing and new evidence-based practices (American Nurses Credentialing Center, 2020). The staff members are accustomed to quality initiatives, and there is a cultural impetus for ongoing improvement in patient care.

The anesthesia department at Washington University is dedicated to ongoing projects to improve patient care. For instance, Washington University is providing groundbreaking data analyzing the effectiveness of intravenous anesthetic medications versus inhaled anesthetic medications in a new THRIVE study. Therefore, Barnes-Jewish Hospital and Washington University's department of Anesthesiology provide an excellent opportunity for creating and validating a novel algorithm. Another strength of this project was that BJC has 1,273 beds, 51,713 admissions, and 22,030 outpatient surgery visits per year. The hospital provides care services to a diverse population, primarily from the greater St. Louis, southern Illinois, and southeast Missouri regions. The hospital also serves a diverse population from around the world in over 100 different languages (Barnes Jewish Hospital, 2020). This allows the project team to implement the frailty screening tool for a large and diverse sample size.

The team believes that this project is cost-effective, and most of the cost for the QI project came from the personnel time. The project chair is an employee of the Washington University Department of Anesthesiology (WUDA). The project also has a faculty member from the Goldfarb School of Nursing and a mentor that also is employed by WUDA. Two statisticians

consulted with the project team on data collection and analysis. The CFS screening tool's online education and mobile app were provided for free. Dalhousie University has provided online training modules on their website, providing the training for anyone interested in the subject. There was a total commute distance of four miles for the team members for each day they assess patients at the hospital, and the average gas price in Missouri is $ 4.71. The project team spent approximately five dollars per day. The software (SPSS) required for data collection and analysis posed a high cost for the project team. The cost of utilizing the SPSS software was $57 for each team member. The team estimates that the total cost for this QI project was between $1,989.5 and $2,715.00 (Appendix J).

Project Site

Barnes-Jewish Hospital (BJH) is a large academic teaching facility in an urban environment dedicated to optimizing surgical care. The project team screened BJH patients in the preoperative phase before they undergo a surgical procedure. The project team only screened patients over the age of 65 because the CFS tool has only been validated on patients over the age of 65. The patients must also have been seen in the Center for Preoperative Assessment and Planning (CPAP) clinic within two weeks before surgery and have their MET and BI score charted on EMR. The CPAP clinic has a clinician team, including ten physician anesthesiologists, thirty nurse practitioners, and thirty registered nurses who specialize in preparing patients for a surgical procedure (Washington University School of Medicine, 2022).

Population

The project team screened patients over the age of 65 because the CFS tool has only been validated on patients over the age of 65. The inclusion criteria for the sample were patients seen in the CPAP within two weeks before the day of surgery. The patients also needed to have the

CPAP note, BI, and MET score in the EMR. Patients under the age of 65 were excluded from this project. Patients who experienced functional or activity level changes between their CPAP visit and the day of surgery were excluded from the sample. Patients seen in the CPAP clinic were evaluated for activity level (METs) and functional independence (Barthel Index). There was a time gap between patients' visits to the CPAP clinic and the day of surgery. If there was any activity level or functional status change in that period, the project team excluded those patients from the sample.

Ethical Considerations

When conducting a project of this magnitude, it was critical to consider several important ethical considerations. One such consideration was ensuring that patients fully understood the project's instructions and implications before agreeing to participate. To address this, patients were provided with clear information including risks and benefits about the project and signed a form indicating their informed consent. Additionally, the project team was respectful of all ethnicities and cultures, and provided professional translation services when necessary to ensure all participants fully understood the project. In summary, the project team took great care to ensure ethical considerations were addressed throughout the project, in order to protect the rights and wellbeing of all participants.

Recruitment/Sampling Strategy

Patients were not directly recruited for the project but were selected after undergoing a chart review and pre-screening process. A convenience sampling of 100 patient participants was employed. Specifically, the research team identified patients who were 65 or older and met the study's inclusion criteria from the EMR. The researchers then approached and interviewed these

patients in the preoperative holding area before their scheduled surgery. This approach was made possible due to the hospital's large patient population, which provided access to a broad range of participants.

Measurement Instruments

Once consent was obtained from the patient, the project team screened the patient for physical frailty using a novel algorithm that utilized data collected in the CPAP clinic as proxy measures. Currently, the BI and MET score are measured when patients are evaluated in person at the CPAP clinic. The novel algorithm utilizes information from these sources after patients were consented, along with the number of comorbidities to assign each patient a score. Patients were also questioned directly using a validated frailty screening tool, Clinical Frailty Screening (Appendix A), provided by Dalhousie University. Dalhousie also provides a mobile application (Appendix C) as a supportive tool to calculate the CFS score efficiently. The mobile app has the same questions as the paper format, and it is used in this project to generate a CFS score for each patient quickly. Each project team member downloaded the mobile app, and it was only used to generate a CFS score efficiently. The mobile application did not require the patient's personal information to generate a score and did not store their answers for each question. The project team put in the answers from the patient's response in the mobile app, and the app generated a CFS score. In other words, the mobile app served as a CFS score "calculator."

A Barthel Index (BI) of 30 or less was a main factor in separating and assigning patients a CFS score. If the patient was terminally ill with a BI of 30 or less, they received a CFS score of 9 but if the BI was greater than 30, they received a CFS score of 8. If the patient required help with basic activities of daily living and had a BI of 30 or less, they received a CFS score of 7 but if the BI was greater than 30, they received a CFS score of 6. If the patient did not require help

with basic activities of daily living, then their CFS score was determined by their MET score. The MET score determines the amount of activity and exercise the patient is capable of. A patient with a MET score of 1 received a CFS score of 6 while a MET score of 2 to 3 assigned patients a CFS score of 5.

If the patient did not require help with basic activities or instrumental activities of daily living, they were further subdivided based on their comorbidities. Patients with ten or more comorbidities received a CFS score of 4. Patients with less than ten comorbidities were assigned a score based on their MET score. A MET score of 4 with symptomatic comorbidities received a CFS score of 3. A MET score of 4 with asymptomatic comorbidities received a CFS score of 2 and a MET score of 10 received a CFS score of 1.

In contrast to the novel algorithm created by the researchers, the traditional and validated CFS screening tool (Appendix A) was performed in the preoperative phase on the day of surgery. First, the patients were asked if there were any changes in their activity level or functional status after their CPAP visit. If their answer was “yes”, it was also likely that their BI and MET score had changed, so these patients were not further evaluated for frailty. If patients answered “no” to the first question, the project team screened them for frailty using the CFS screening tool. To screen for frailty, the first question is to determine if they are terminally ill with a life expectancy of less than six months to live. The next question examines whether the individual is completely dependent and approaching the end of their life. Moreover, by utilizing the established mobile app, the researchers determined whether the patient was completely dependent on personal care. As the patient is continually evaluated based on their independence level, they were assigned a CFS score. After the CFS score was determined by using the mobile app and the novel algorithm, the scores were compared to help validate the novel algorithm.

Data Collection Procedure

To collect the data, the project team evaluated patients in the preoperative phase through direct patient interviewing and from chart reviews once consent from the patient was secured. Given the time allotted for the project and the number of patients screened, the estimated goal for the number of participants was 100. During the initial period, the patients were screened by the researchers via direct patient interviews. The patients were screened using the validated CFS screening tool via the mobile app and the novel algorithm created by the students. Patients were evaluated in the preoperative area on the day of surgery before providers evaluated their patients and during downtimes. When patients were evaluated, their demographics such as age, sex, educational background, and ethnicity were collected. During the evaluation, the score obtained from the novel algorithm was compared to the score from the CFS screening tool. The data collected from each method was recorded in a data collection table format (Appendix D) and stored in a secure drive provided by the Washington University School of Medicine for data analysis. In addition, all the paper documents utilized in this project were kept secure behind two locked doors.

Data Analysis

Statistical analysis was performed and evaluated using Microsoft Excel with the assistance of statisticians from Washington University, Dr. Arbi Ben Abdallah, and Goldfarb School of Nursing, Dr. George Vineyard. The independent variables within the study were the demographics of the patient including age, sex, ethnicity, and educational background. The dependent variable was the CFS score obtained from performing the CFS screening tool via the mobile app and conducting the novel algorithm. The results were categorized as the project team

screened patients for CFS. In one table, the absolute value of the CFS score was obtained and recorded, and this continuous level of measurement was analyzed by an intraclass correlation (ICC) measurement. To further analyze the demographics within the study the mean CFS score for each ethnicity and educational level was compared between researcher #1 and researcher #2.

Evaluation and Outcomes

Results/ Discussion of Findings/Outcomes

During the correlation analysis there were several features analyzed. The CFS score obtained by researcher #1 was compared to the CFS score obtained by researcher #2. By doing a correlation analysis between the data sets from each researcher, the data showed (Appendix L) that the researchers were interviewing the patients correctly and obtaining similar scores. The correlation coefficient (r) between the CFS score obtained from researcher #1 and the CFS score obtained from researcher #2 using the mobile app was 0.812. A r value of 0.8 or greater is associated with a very strong association indicating that the two researchers were receiving similar values when interviewing patients using the established CFS screening tool via the mobile app (Akoglu, 2018).

The second correlation analysis included comparing the CFS score obtained from researcher #1 with the CFS score from the novel algorithm. Furthermore, the CFS score obtained from researcher #2 was compared to the CFS score obtained from the novel algorithm. If the CFS scores obtained from the two researchers using the CFS screening tool were strongly associated and the CFS scores have a positive association with the novel algorithm, then in theory the novel algorithm could be used in the future to produce a frailty score for each patient without interviewing the patient. When comparing the CFS score obtained from researcher #1 with the CFS score from the novel algorithm, the correlation coefficient was 0.668 (Appendix J).

When comparing the CFS score obtained from researcher #2 with the CFS score from the novel algorithm, the correlation coefficient was 0.638. A r value of 0.6 to 0.8 indicates a strong association between two values (Akoglu, 2018). Therefore, there is a strong association between the CFS score obtained using the validated CFS screening tool and the CFS score generated from the novel algorithm. Future research could potentially extrapolate this data to verify the use of the novel algorithm in the clinical setting.

The main goal of the statistical analysis was to identify an association between the CFS score generated from the mobile app and the CFS score generated from the novel algorithm. There was a strong association between the two.

Study data were further analyzed to evaluate any association between ethnicity, educational background, and gender to the CFS score. When the data was evaluated, the average CFS score for African American females for researcher #1 was 4.85 (Appendix L). The average CFS score for African American females for researcher #2 was 5.14 and the average from the novel algorithm was 4.43. In contrast, the average CFS score for white females by researcher #1 was 4.09, and the average CFS score for researcher #2 and the novel algorithm for white females was 4.09 and 4 respectively. From that data collection, the data suggests that African American females may be at a higher risk of frailty than white females. However, the sample size was not large enough to draw conclusions based on ethnicity and gender.

When evaluating the different ethnicities and CFS scores for males in the study, similar analysis was conducted. The average CFS score for Asian males obtained from researcher #1 was 4.5. The average CFS score for Asian males from researcher #2 and the novel algorithm was 4.5 and 5 respectively. In contrast, the average CFS score for white males obtained from researcher #1 was 3.51 and the average CFS score for white males obtained from researcher #2

and the novel algorithm was 3.69 and 3.92 respectively. Therefore, the average CFS score for Asian males was consistently higher than the average CFS score for white males. A further analysis between the level of education and the CFS score was conducted but there was no clear correlation or tend between the level of education of the patient and the severity of the frailty score in this data (Appendix L).

Strengths and limitations of Findings

One of the strengths of performing a correlation study is that it shows if two variables are related (Akoglu, 2018). The correlation study showed a strong association between the CFS score obtained from the mobile app and the CFS score from the novel algorithm. Another strength of the study is that correlation findings can serve as a starting point for future research. The data generated from this study can be used in the future to determine if the physical frailty score is correlated with the surgical and post-surgical outcome of patients. Another benefit of a correlation study is that it is easy to classify the results in a tangible manner. The correlation coefficient (r) is a statistical measure of the strength of the linear relationship. The closer the r value is to 1, the stronger the relationship and the closer the r value to negative 1, the stronger the negative correlation (Akoglu, 2018).

One of the limitations of the findings is that correlation does not prove causation. When two variables are correlated that does not indicate that one variable causes another variable (Akoglu, 2018). Furthermore, one of the limitations of the finding is that due to scheduling and delays in the preoperative setting, only 100 patients were included in the study. After reviewing the findings, the majority of patients were Caucasian making it difficult to generalize these results to all ethnicity types. The majority of patients either had four years of college or high school education. Very few of the patients interviewed Another potential limitation of the study

was that all the patients were interviewed at the same hospital. Patients who go to a large academic hospital for surgery tend to have a higher acuity of illness and this may have caused the frailty score of the patients in the study to be increased. Another potential limitation of doing a correlation study is that it does not determine what is causing the differences within the study. For example, from our data collection, African Americans had a higher average frailty score than white Americans, but the data does not indicate what cause or factors lead African Americans to have a higher frailty score. Another potential limitation to the study is the impact of the researcher or observe while the patient is filling out the survey. For instance, when a patient is answering questions in the hospital in front of family and the surveyor, the patient might slightly alter their answers to prevent appearing weak or dependent on others. The patient may be embarrassed that they are not able to bathe themselves and therefore they answer questions to make it seem as though they are more independent and less frail than they actually are.

Evaluation of the Process & Outside Influences

The study was supported by Barnes Jewish Hospital, Goldfarb School of Nursing and the Department of Anesthesiology at Washington University in St. Louis. One of the main difficulties of the study was finding an area to interview preoperative patients without interfering with the flow of the hospital setting. Research can often be seen by staff as a distraction from performing their job or an extra chore to complete. Every effort was made to be as succinct and professional with the patients and staff. However, many patients were unable to answer questions for the survey due to other tasks that had to be completed during the preoperative setting to prepare the patient for surgery. While this did not lead to missing data for the patients that were interviewed, it decreased the potential sample size of the study. These outside influences limited the number of patients interviewed for the study and prolonged the results of the study.

System and Practice Impact

Implications for Organizational and Systems Change

The implications of this project are multifactorial. The correlational data obtained from this study can be used in future studies to identify if the CFS scores obtained from the patients correlates with the outcomes and complications from the surgery. Furthermore, the data within the study demonstrated that there is a positive association between the CFS score obtained from the established CFS scale in the mobile app to the CFS score in the novel algorithm. Therefore, with further validation, the novel algorithm could become an automated, established part of the preoperative EMR that aids clinicians in identifying physical frailty and how they manage patient care. In the meantime, clinicians can use the findings of this practice model evaluation to understand how the METs and BI can inform their assessment of physical frailty in the preoperative phase.

Recommendations for Nursing Practice/Sustainability

The recommendation for nursing and advanced nursing practice is that the evidence obtained from this project can be used in the clinical setting. For example, if a patient presents with more than ten comorbidities, they have a higher likelihood of being frail. Being able to identify frailty in the preoperative setting is important to influence and dictate the best possible care for patients. Since the novel algorithm shows a positive correlation to the established mobile app CFS score, the project has the potential to create sustainability in the future. The benefit of using the novel algorithm to score and track frailty is that it does not require staff members to physically interview the patient, saving valuable time in busy preoperative clinic. The algorithm can generate a CFS score based on existing data that already exists in the EMS. Therefore, in the

future, quantifying a frailty score for each patient would be sustainable because it does not require additional staff or time to complete once the algorithm is developed and instituted.

Summary and Conclusion

Project Summary & Plans for Dissemination

Accurately identifying and quantifying the severity of frailty in preoperative patients is important because increasing frailty scores have been associated with worse post-surgical outcomes in other studies. Preoperative providers and staff are already busy with many tasks required to prepare the patient for surgery. While instituting a mandatory interview of each patient with the mobile app may not be feasible in the clinical setting, a novel algorithm can serve as a surrogate for interviewing the patient. The novel algorithm takes existing information from the EMR and computes it into a frailty score for each patient. The data depicted in this study show a strong correlation between the frailty score generated from the novel algorithm to the frailty score from the established mobile app. As a result, future studies could work on automatically generating a frailty score in every preoperative patient using the novel algorithm and determining how that correlate to the post-surgical outcomes. The plan for future dissemination is to present the findings at research day to share the results with the academic community. Once the poster and presentation were shared, the plan is to present the results with the staff at the CPAP clinic. Furthermore, results and plans for future implementation of the algorithm in the clinical setting were discussed with the CPAP director.

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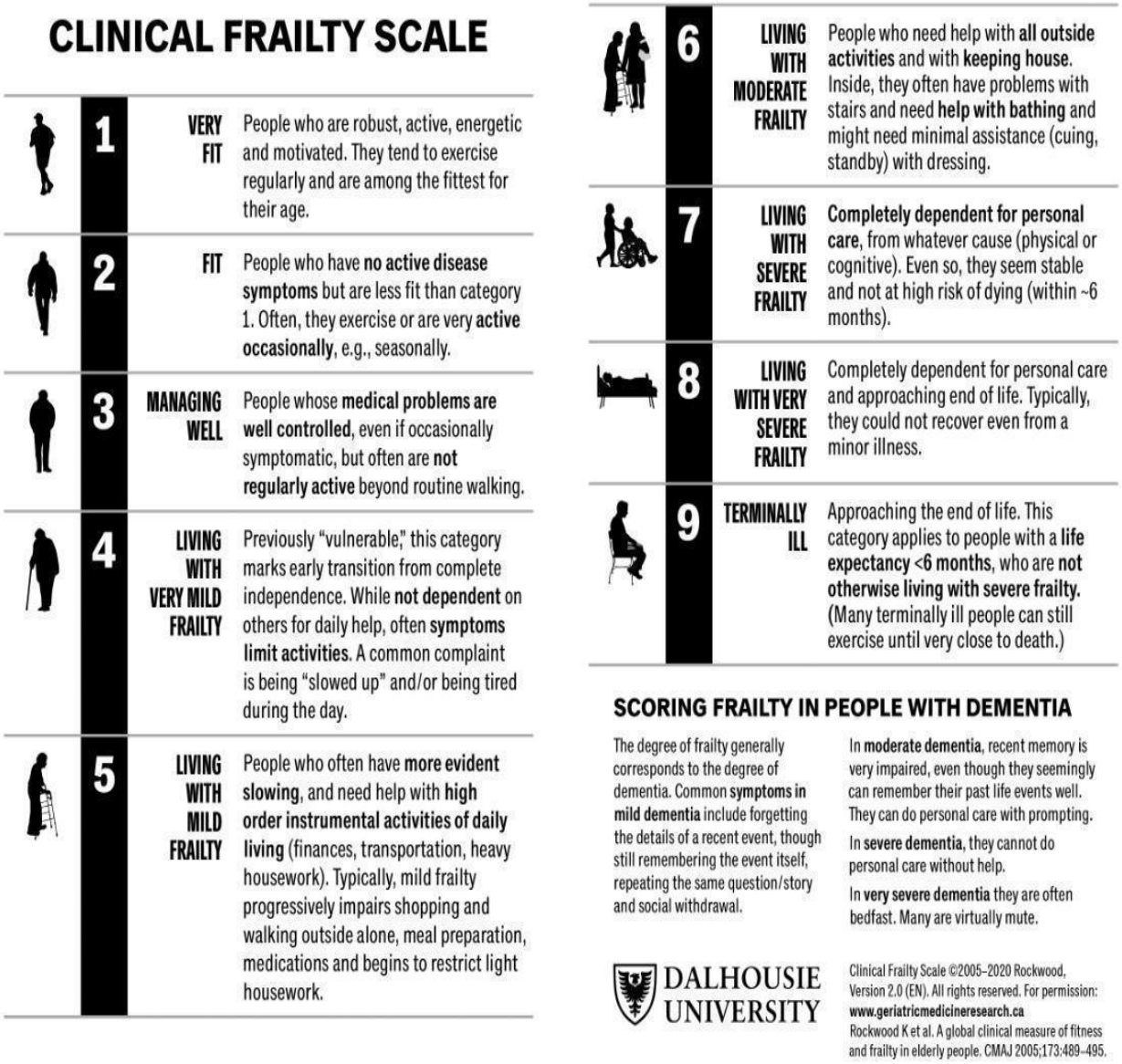
Appendix A

The Clinical Frailty Scale Screening Tool



CLINICAL FRAILTY SCALE

1	VERY FIT	People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age.
2	FIT	People who have **no active disease symptoms** but are less fit than category 1. Often, they exercise or are very **active occasionally**, e.g., seasonally.
3	MANAGING WELL	People whose **medical problems are well controlled**, even if occasionally symptomatic, but often are **not regularly active** beyond routine walking.
4	LIVING WITH VERY MILD FRAILTY	Previously "vulnerable," this category marks early transition from complete independence. While **not dependent** on others for daily help, often **symptoms limit activities**. A common complaint is being "slowed up" and/or being tired during the day.
5	LIVING WITH MILD FRAILTY	People who often have **more evident slowing**, and need help with **high order instrumental activities of daily living** (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications and begins to restrict light housework.
6	LIVING WITH MODERATE FRAILTY	People who need help with **all outside activities** and with **keeping house**. Inside, they often have problems with stairs and need **help with bathing** and might need minimal assistance (cuing, standby) with dressing.
7	LIVING WITH SEVERE FRAILTY	**Completely dependent for personal care**, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~6 months).
8	LIVING WITH VERY SEVERE FRAILTY	Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness.
9	TERMINALLY ILL	Approaching the end of life. This category applies to people with a **life expectancy <6 months**, who are **not otherwise living with severe frailty.** (Many terminally ill people can still exercise until very close to death.)

SCORING FRAILTY IN PEOPLE WITH DEMENTIA

The degree of frailty generally corresponds to the degree of dementia. Common **symptoms in mild dementia** include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In **moderate dementia**, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In **severe dementia**, they cannot do personal care without help.

In **very severe dementia** they are often bedfast. Many are virtually mute.

DALHOUSIE UNIVERSITY

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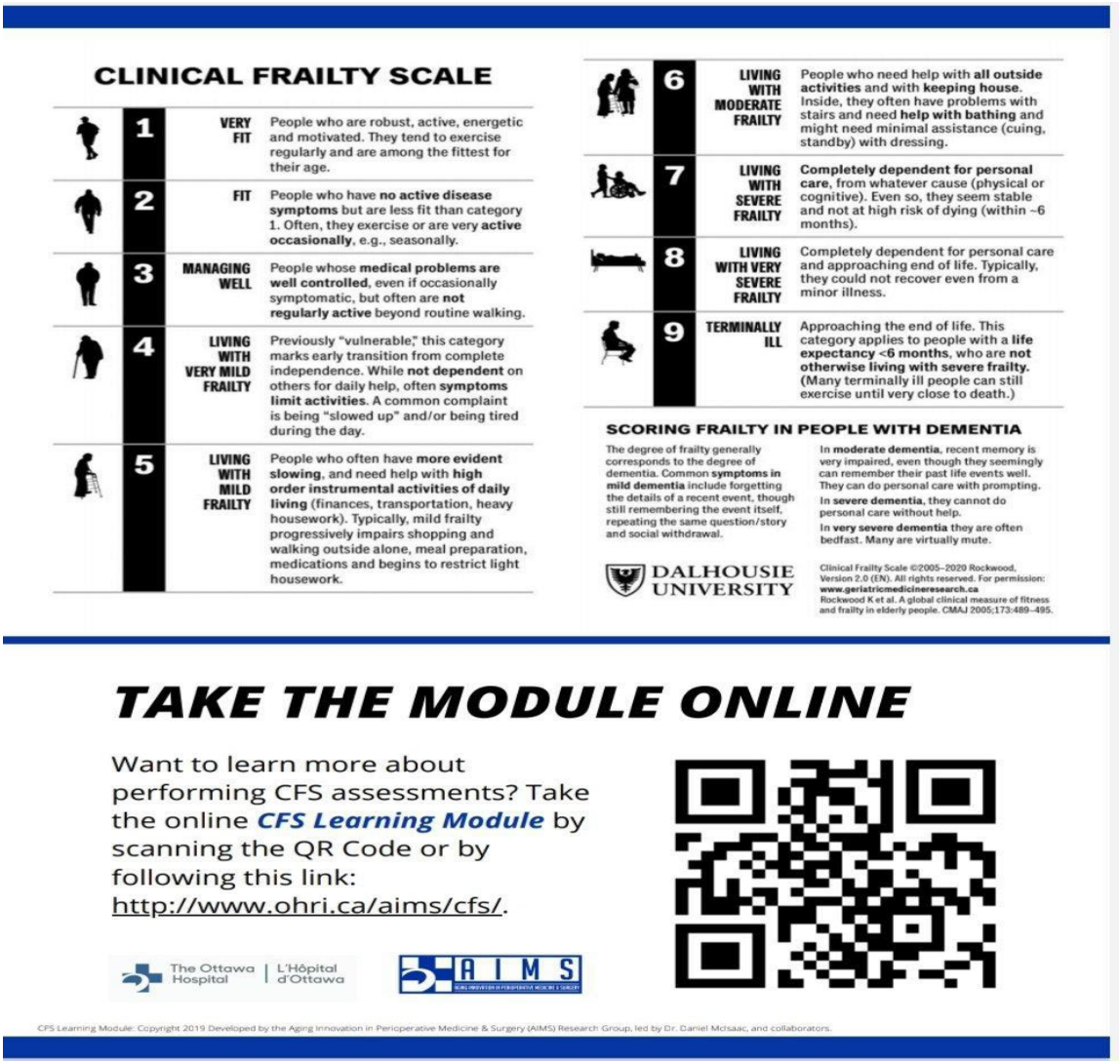
Appendix B

Clinical Frailty Scale Training Modules

https://rise.articulate.com/share/deb4rT02lvONbq4AfcMNRUudcd6QMts3#/

(Dalhousie University, 2020)



Appendix C

Clinical Frailty Scale Mobile App

iPhone Users: Click here
Android Users: Click here

(Dalhousie University, 2020)

Appendix D

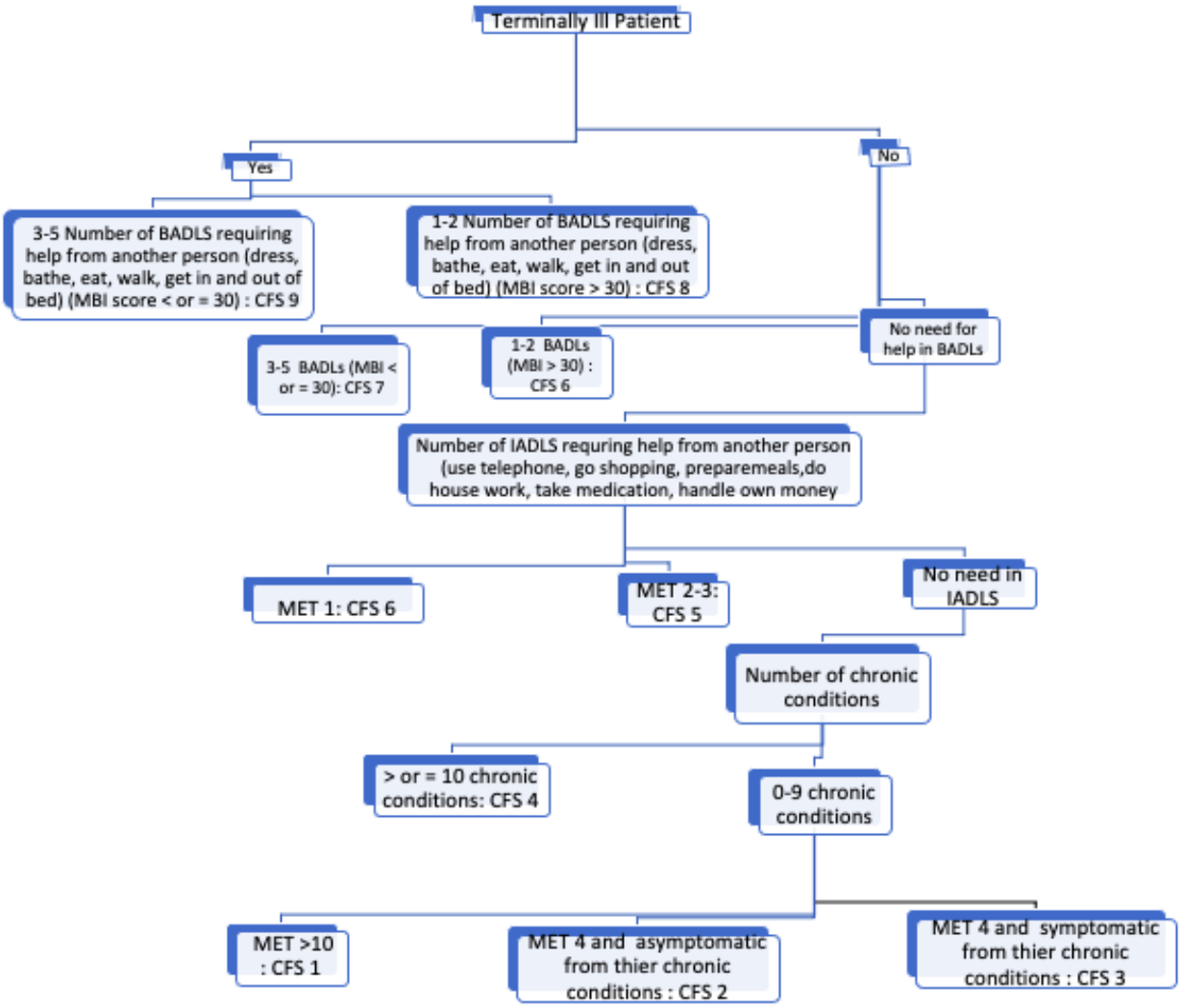
Data Collection Table

Patient Initial	Age	Sex	MRN	Ethnicity	Educational Background	CFS Score researcher #1	CFS Score researcher #2	CFS Score Novel Algorithm

Appendix E

A Novel Algorithm

MET: Metabolic Equivalent
CFS: Clinical Frailty Scale
MBI: modified Barthel Index score
BADLS: Basic Activities of Daily Living
IADLS: Instrumental Activities of Daily Living



Appendix F

JHNEBP Evidence Rating Scales

Strength of the Evidence	
Level I	Experimental study/randomized controlled trial (RCT) or meta analysis of RCT
Level II	Quasi-experimental study
Level III	Non-experimental study, qualitative study, or meta-synthesis.
Level IV	Opinion of nationally recognized experts based on research evidence or expert consensus panel (systematic review, clinical practice guidelines)
Level V	Opinion of individual expert based on non-research evidence. (Includes case studies; literature review; organizational experience e.g., quality improvement and financial data; clinical expertise, or personal experience)

Quality of the Evidence			
A	High	Research	consistent results with sufficient sample size, adequate control, and definitive conclusions; consistent recommendations based on extensive literature review that includes thoughtful reference to scientific evidence.
		Summative reviews	well-defined, reproducible search strategies; consistent results with sufficient numbers of well defined studies; criteria-based evaluation of overall scientific strength and quality of included studies; definitive conclusions.
		Organizational	well-defined methods using a rigorous approach; consistent results with sufficient sample size; use of reliable **and** valid measures
		Expert Opinion	expertise is clearly evident
B	Good	Research	reasonably consistent results, sufficient sample size, some control, with fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence
		Summative reviews	reasonably thorough and appropriate search; reasonably consistent results with sufficient numbers of well defined studies; evaluation of strengths and limitations of included studies; fairly definitive conclusions.
		Organizational	Well-defined methods; reasonably consistent results with sufficient numbers; use of **reliable and valid** measures; reasonably consistent recommendations
		Expert Opinion	expertise appears to be credible.
C	Low quality or major flaws	Research	little evidence with inconsistent results, insufficient sample size, conclusions cannot be drawn
		Summative reviews	undefined, poorly defined, or limited search strategies; insufficient evidence with inconsistent results; conclusions cannot be drawn
		Organizational	Undefined, **or** poorly defined methods; insufficient sample size; inconsistent results; undefined, poorly defined or measures that lack adequate reliability or validity
		Expert Opinion	expertise is not discernable or is dubious.

**A study rated an A would be of high quality, whereas, a study rated a C would have major flaws that raise serious questions about the believability of the findings and should be automatically eliminated from consideration.*

Newhouse R, Dearholt S, Poe S, Pugh LC, White K. The Johns Hopkins Nursing Evidence-based Practice Rating Scale. 2005. Baltimore, MD, The Johns Hopkins Hospital; Johns Hopkins University School of Nursing.

Appendix G

Literature Review

1	Article reference in APA format Type of Evidence: Level and quality of evidence:	Abstract	Study Variables (Demographics; IV, DV, or research concept)	Sampling Method, Sample Size, Setting	Main Findings relevant to Problem or PICOT Question	Strengths	Limitations	Implications/ Recommendations relevant to Problem or PICOT Question
1 Sze et al	Sze, S., Pellicori. P., Zhang, J., Weston, J., & Clark A.L. (2019). Identification of frailty in chronic heart failure. *The American College of Cardiology Foundation,* 7(4), 291-302. https://doi.org/10.1016/j.jchf.2018.11.017 Type: Randomized trial Level I, Quality B	OBJECTIVES: This study sought to report the prevalence of frailty, classification performance, and agreement among 3 frailty assessment tools and 3 screening tools in chronic heart failure (CHF) patients. BACKGROUND: Frailty is common in patients with CHF. There are many available frailty tools, but no standard method for evaluating frailty. METHODS: We used the following frailty screening tools: the clinical frailty scale (CFS); the Derby frailty index; and the acute frailty network frailty criteria. We used the following frailty assessment tools: the Fried criteria; the Edmonton frailty score; and the Deficit Index. RESULTS: A total of 467 consecutive ambulatory CHF patients (67% male; median age: 76 years; interquartile range [IQR]: 69 to 82 years; median N-terminal pro–B-type natriuretic peptide: 1,156 ng/l [IQR: 469 to 2,463 ng/l]) and 87 control patients (79% male; median age: 73 years; IQR: 69 to 77 years) were studied. The prevalence of frailty using the different tools was higher in CHF patients than in control patients (30% to 52% vs. 2% to 15%, respectively). Frail patients tended to	Demographics: Age, Sex, Height, BMI Independent variable: -patients with chronic heart failure, -other comorbidities measured using the Carlson comorbidity index/score - medication taken -blood test Dependent: The prevalence of frailty in CHF patients using different screening tools. Measuring Sensitivity, specificity, and misclassification of frailty screening tools.	Sample size: 467 Control subjects: 87 Ambulatory patients with CHF attending a community heart clinic failure clinic were enrolled between September 2016 and March 2017. CHF diagnosis was established with reduced EF <40%. Control subjects > 65 years of age, with no previous or current symptoms or signs of CHF. All participants and control patients were screened	Frailty is common in patients with CHF (54%). CFS is a short and easy to use frailty screening tool that has comparable effectiveness as length frailty assessment in identifying frailty. Overall, CFS has the highest sensitivity and specificity with the lowest misclassification rate: Sensitivity 87%, Specificity 89%, PPV 86 %, NPV 90%, False positive 6%, False Negative 6%, Misclassification 12%. CFS had the highest in detecting Frailty among CHF patients (K=0.65, p< 0.001)	A measure of inter-rater agreement for categorical scales was applied. CFS (0.65), AFN (0.44), DFI (0.34). The authors took proper care of identifying cofounders The sample size was large, n = 467 participants. This large sample size increases the generalizability of the study findings. The same researcher applied the screening tool to all patients which minimizes variation in measurements.	The authors identified the study's limitation to applying the results to other populations with different health care and social system. The authors also acknowledged the existence of many frailties screening tools and only used three of the most used frailty screening tools.	This randomized trial showed that CFS is an efficient and effective frailty screening tool. Our change project is to implement an efficient and user-friendly frailty screening tool to improve clinicians' ability to identify frail patients and attitudes about frailty screening. This article is relevant to our PICOT as we search for the most effective and efficient screening tool to better screen frail patients.

		be older, have worse symptoms, higher N-terminal pro–B-type natriuretic peptide levels, and more comorbidities. Of the screening tools, CFS had the strongest correlation and agreement with the assessment tools (correlation coefficient: 0.86 to 0.89, kappa coefficient: 0.65 to 0.72, depending on the frailty assessment tools, all p < 0.001). CFS had the highest sensitivity (87%) and specificity (89%) among screening tools and the lowest misclassification rate (12%) among all 6 frailty tools in identifying frailty according to the standard combined frailty index. CONCLUSIONS: Frailty is common in CHF patients and is associated with increasing age, comorbidities, and severity of heart failure. CFS is a simple screening tool that identifies a similar group using more lengthy assessment tools. (J Am Coll Cardiol HF 2019;7:291–302) © 2019 by the American College of Cardiology Foundation.		and assessed by the same researcher using three frailty screening tools, The Derby Frailty Index (DFI), The Acute Frailty Network Criteria (AFN) and The Clinical Frailty Scale (CFS).	compared to AFN (K=0.44), and DFI (K= 0.34, p < 0.001). K 60-80% is considered good.			
2. **Aucoin et al**	Aucoin, S.D., Hao, M., Sohi, R., Shaw, J., Bentov, I., Walker, D., & McIsaac. (2020). Accuracy and feasibility of clinically applied frailty instruments before surgery. *The American Society of Anesthesiologists, 1*(133), 78-95. https://doi.org/10.1097/ALN.0000000000003257 Type: A systematic	Background: A barrier to routine preoperative frailty assessment is the large number of frailty instruments described. Previous systematic reviews estimate the association of frailty with outcomes, but none have evaluated outcomes at the individual instrument level or specific to clinical assessment of frailty, which must combine accuracy with feasibility to support clinical practice. Methods: The authors conducted a preregistered systematic review (CRD42019107551) of studies prospectively applying a frailty instrument in a clinical setting before surgery.	Independent variable: Routine preoperative frailty assessment applying a frailty assessment. Dependent variables: Mortality, non-favorable discharge, complications, delirium.	The study identified 985 titles and abstracts; reviewed 982. The authors assessed 338 full text articles and included 70 studies. Together, the included studies involved 42,954 participants. All articles were published between 2009 and 2018,	- Based on limited but consistent data, the Clinical Frailty Scale had largest effect size when predicting postoperative mortality with a greater 4.5-fold increase in the odds of death (minimal data) -Evidence supports the feasibility of the Clinical Frailty Scale over other frailty instruments	The authors ensured a broad, peer-reviewed search strategy to medical and allied health databases to include the available literature The reliability of the study findings is increased since the odds ratio was > 1 Statistical heterogeneity (I^2) was reported to evaluate the expression of the inconsistency of studies' results Area Under the Curve (AUC) was reported on some of the studies to	Out of 70 studies, only 10 of them reported relevant function, quality of life or disability outcomes. Such data are key considerations for older people considering surgery	This article is relevant to our PICOT in the process of instituting an efficient and user-friendly frailty screening tool. The article helps to identify an efficient, effective, and user-friendly frailty screening tool.

	review and meta-analysis Level I, Quality B	Medline, Excerpta Medica Database, Cochrane Library, and the Comprehensive Index to Nursing and Allied Health Literature, and Cochrane databases were searched using a peer-reviewed strategy. All stages of the review were completed in duplicate. The primary outcome was mortality and secondary outcomes reflected routinely collected and patient-centered measures; feasibility measures were also collected. Effect estimates were pooled using random-effects models or narratively synthesized. Risk of bias was assessed. results: Seventy studies were included; 45 contributed to meta-analyses. Frailty was defined using 35 different instruments; five were meta-analyzed, with the Fried Phenotype having the largest number of studies. Most strongly associated with mortality and nonfavorable discharge was the Clinical Frailty Scale (odds ratio, 4.89; 95% CI, 1.83 to 13.05 and odds ratio, 6.31; 95% CI, 4.00 to 9.94, respectively); complications was associated with the Edmonton Frail Scale (odds ratio, 2.93; 95% CI, 1.52 to 5.65); and delirium was associ-ated with the Frailty Phenotype (odds ratio, 3.79; 95% CI, 1.75 to 8.22). The Clinical Frailty Scale had the highest reported measures of feasibility. conclusions: Clinicians should consider accuracy and feasibility when choosing a frailty instrument. Strong evidence in both domains support the Clinical Frailty Scale,		regions of origin included North America, Europe, Australia, Asia, and South America.	such as Fried Phenotype -Discussing risk of nonhome discharge is highly relevant before surgery where the strongest evidence supports the Clinical Frailty Scale, as it had the largest association with nonhome discharge and lower heterogeneit y compared to the Fried Phenotype and Frailty Index.	evaluate discrimination		

		while the Fried Phenotype may require a trade-off of accuracy with lower feasibility.						
3. Hui et al	Lin, H., Watts, J.N., Peel, N.M & Hubbard, R.E. (2016). Frailty and post-operative outcomes in older surgical patients: A systematic review. *BMC Geriatrics, 16*(157), 1-12. doi: 10.1186/s12877-016-0329-8 Type: A systemic review Level 1, Quality B	Abstract Background: As the population ages, increasing numbers of older adults are undergoing surgery. Frailty is prevalent in older adults and may be a better predictor of post-operative morbidity and mortality than chronological age. The aim of this review was to examine the impact of frailty on adverse outcomes in the 'older old' and 'oldest old' surgical patients. Methods: A systematic review was undertaken. Electronic databases from 2010 to 2015 were searched to identify articles which evaluated the relationship between frailty and post-operative outcomes in surgical populations with a mean age of 75 and older. Articles were excluded if they were in non-English languages or if frailty was measured using a single marker only. Demographic data, type of surgery performed, frailty measure and impact of frailty on adverse outcomes were extracted from the selected studies. Quality of the studies and risk of bias was assessed by the Epidemiological Appraisal Instrument. Results: Twenty-three studies were selected for the review and they were assessed as medium to high quality. The mean age ranged from 75 to 87 years, and included patients undergoing cardiac, oncological, general, vascular and hip	Demographics: age, sex, study location Independent variables: Patient population who had a surgical procedure, frailty score Dependent variables: post-operative mortality or major morbidity, post-operative complications, prolonged length of stay and discharge to residential care facility	PUBMED, MEDLINE, EMBASE and Cochrane online databases were searched using search terms of 'frail*' AND 'surg*' in combination with ('outcome' OR 'mor-bidity' OR 'complication'). The literature search identified 686 articles (187 from Pubmed, 169 from Medline, 300 from Embase and 28 from the Cochrane database). From these, 270 duplicate articles were removed. Articles were selected based on inclusion and exclusion criteria. The references of selected articles were hand searched	There is evidence that frailty is associated with in-creased mortality and morbidity in the older surgical patients. As patients over 75 years old are presenting more commonly for surgery, frailty assessment may have considerable value as a tool for peri-operative assessment.	The reliability of the study findings was increased since the odds ratio (OR) was > 1 The strength of this review is that it is inclusive of all types of surgery, both elective and acute.	Quality of life post-surgery was assessed in only one out of the 23 studies; similarly, functional decline and discharge to a care facility were only evaluated in three and two studies respectively. These two factors are important to elderly patients when making informed decisions. This systemic study lacks to predict some important outcomes post-surgery.	This systemic study reviewed 23 articles and found strong evidence in the association with increased 30-day, 90 day and 1 year mortality, post-operative complications, and length of stay. This study is vital to support the significance of our change project in implementing efficient and user-friendly frailty screening tool.

		fracture surgeries. There were 21 different instruments used to measure frailty. Regardless of how frailty was measured, the strongest evidence in terms of numbers of studies, consistency of results and study quality was for associations between frailty and increased mortality at 30 days, 90 days and one year follow-up, post-operative complications and length of stay. A small number of studies reported on discharge to institutional care, functional decline and lower quality of life after surgery, and also found a significant association with frailty. Conclusion: There was strong evidence that frailty in older-old and oldest-old surgical patients predicts post-operative mortality, complications, and prolonged length of stay. Frailty assessment may be a valuable tool in peri- operative assessment. It is possible that different frailty tools are best suited for different acuity and type of surgical patients. The association between frailty and return to pre-morbid function, discharge destination, and quality of life after surgery warrants further research.		for further eligible articles. There were 23 articles included in the final analysis.				
4. Lee et al	Lee, J.A., Yanagawa, B., An, K.R., Arora, R.C., Verma, S., & Friedrich, J.O. (2021). Frailty and pre-frailty in cardiac surgery: a systematic review and meta-analysis of 66,448 patients.	Abstract Background: The burden of frailty on cardiac surgical outcomes is incompletely understood. Here we perform a systematic review and meta-analysis of studies comparing frail versus pre-frail versus non-	Demographics: Age, sex Independent variable: frailty Dependent variables: Mortality, prolonged hospital stays, risk of	This study systematically searched OVID versions of MEDLINE and EMBASE. The initial search resulted in 1297. After	Patients that were classified as being frail were older (MD: +2.37, 95% CI [1.47-3.45], $p<0.0001$) and female (RR: 1.69, 95% CI [1.47-1.94]. Frail patients had lower hematocrit (	the odds ratio (OR) and relative risk ratio (RR) was noted > 1 which shows increase in reliability of the study findings. Statistical heterogeneity was estimated using the Higgins Statistic (I^2). For some of the studies or	In some of the studies, the CI is wide and $p >$ 0.05, which suggests the precision of the measurement is inadequate.	This is a strong systemic review and meta-analysis in defining frailty. It is also another study that supports the significance of assessing frailty clinically since frailty score regardless of the screening tool could predict some of the outcomes post-surgery. For our change project in instituting an efficient

	Journal of Cardiothoracic Surgery, 16(184), 1-10. https://doi.org/10.1186/s13019-021-01541-8 Type: A systematic review and meta-analysis Level 1, Quality B	frail patients following cardiac surgery. Methods: We searched MEDLINE and EMBASE databases until July 2018 for studies comparing cardiac surgery outcomes in "frail", "pre-frail" and "non-frail" patients. Data was extracted in duplicate. Primary outcome was operative mortality. Results: There were 19 observational studies with 66,448 patients. Frail patients were more likely female (risk ratio [RR]1.7; 95%CI:1.5–1.9), older (mean difference: 2.4; 95%CI:1.3–3.5 years older) with greater comorbidities and higher STS-PROM. Frailty (RR2.35; 95%CI:1.57–3.51; p < 0.0001) and pre-frailty (RR2.03; 95%CI:1.52–2.70; p < 0.00001) were associated with increased operative mortality compared with non-frail patients. Frailty was also associated with greater risk of prolonged hospital stay (RR1.83; 95%CI:1.61–2.08; p < 0.0001) and intermediate care facility discharge (RR2.71; 95%CI:1.45–5.05; p = 0.002). Frail (Hazard Ratio [HR]3.27; 95%CI:1.93–5.55; p < 0.0001) and pre-frail patients (HR2.30; 95%CI:1.29–4.09; p = 0.005) had worse mid-term mortality (median follow-up 1 years [range 0.5–4 years]). After adjustment for baseline imbalances, frailty was still associated with greater operative mortality (odds ratio [OR]1.97; 95%CI:1.51–2.57; p < 0.00001), intermediate care facility discharge (OR4.61; 95%CI:2.78–7.66; p < 0.00001) and	intermediate care facility discharge	duplicate studies were removed and inclusion criteria were applied, 19 unmatched observational studies with 66,448 patients were selected.	MD: 3.36%, 95% CI [-6.59, -0.80], and low albumin (MD: 1.93, 95% CI [-3.06, -0.80, p=0.01]. Frail patients had significantly greater concurrent comorbidities including diabetes, COPD, pulmonary disease and previous stroke, peripheral vascular disease, chronic kidney disease, congestive heart failure, dementia and other comorbidities. Frail patients had higher risk scores including Society of Thoracic Surgery-Predicted Risk of Mortality (STS PROM) Frailty and pre-frailty were associated with increased operative mortality compared to non-frail patients. Frailty was also associated with greater risk of perioperative stroke and sternal would complication. Frail	subgroups, the I2 was > 50% the extent of variation among the effects observed in different studies (between-study variance) was expressed using tau-squared (Tau^2).		and user-friendly frailty screening tool, this study will show support clinicians' ability to identify frail patients and predict outcomes.

		midterm mortality (HR1.37; 95%CI:1.03–1.83; p = 0.03). Conclusion: In patients undergoing cardiac surgery, frailty and pre-frailty were associated with 2-fold and 1.5-fold greater adjusted operative mortality, respectively, greater adjusted perioperative complications and frailty was associated with almost 5-fold risk of non-home discharge.			patients experienced longer ICU length of stay, prolonged mechanical ventilation and higher risk for discharge to an intermediate care facility .			
5. Gregorevic et al	Gregorevic, K.J., Hubbard, R.E., Katz, B., & Lim, W.K. (2016). The clinical frailty scale predicts functional decline and mortality when used by junior medical staff: A prospective cohort study. *BMC Geriatrics, 16*(117), 1-6. doi:10.1186/s12877-016-0292-4 Type: A prospective cohort study Level ll, Quality B	Background: Increasing frailty is associated with risk of mortality and functional decline in hospitalized older adults, but there is no consensus on the best screening method for use by non-geriatricians. The objective of this study is to determine whether the clinical frailty scale (CFS) can be used to identify patient baseline frailty status in the acute general medical setting when used by junior medical staff using information obtained on routine clinical assessment. Methods: This was a prospective cohort study in an acute general medical unit. All patients aged 65 and over admitted to a general medical unit during August and September 2013 were eligible for the study. CFS score at baseline was documented by a member of the treating medical team. Demographic information and outcomes were obtained from medical records. The primary outcomes were functional decline and death within three months. Results: Frailty was assessed in 95 % of 179	Demographics: Age (65-96), Sex (female and male), preferred language (English and non-English), residence Independent variable: Frailty score Dependent variables: Overall mortality, functional decline, length of hospital stay	Setting: a university associated tertiary hospital in general medical unit Sample: 179 eligible patients were admitted between august and September 2013. Doctors were asked to record a Clinical Frailty Screening (CFS) score based on the patient's functional status prior to admission Patients were divided into four groups based on their frailty scores. Patients who were scored at 1-3 on the CFS were	Patients who were more frail were less likely to live home alone ($p < 0.01$). Patients who were moderately to severely frail were most likely to live in residential care ($P < 0.01$). This study also shows that the CFS is highly acceptable to medical staff as there was a 95 % completion rate. There is a positive relationship between the degree of frailty and the risk of mortality and functional decline when frailty. The OR for inpatient mortality was 1.6 (95 % CI 1.48 1.74), which was comparable to the three-	The level of statistical significance was set at 0.05. Baseline characteristics between the groups were compared using the chi squared statistic. The reliability of the study findings is increased since the odds ratio was > 1 Adequate sample size and a high proportion of eligible patients were included.	Bias in selection of subjects and definition bias were identified in the study. All patients aged 65 and over admitted to a general medical unit during August and September 2013 were eligible for the study. Patients who are younger than 65 could be frail based on their philological condition. Author identified that unvalidated tool was used to measure the functional decline of samples; Patients who were from residential care were excluded from the analysis of functional decline, as some of the criteria used to define functional decline were not applicable to this group; unable to include some potential con-founders in the multivariate analysis (nutrition, cognition, delirium)	This article is relevant to our project. The article showed positive attitude of clinicians towards CFS, reflected in a high completion rate (95%) by the medical staff.

		eligible patients. 45 % of patients experienced functional decline and 11 % died within three months. 40 % of patients were classified as vulnerable/mildly frail, and 41 % were moderately to severely frail. When patients in residential care were excluded, increasing frailty was associated with functional decline (p = 0.011). Increasing frailty was associated with increasing mortality within three months (p = 0.012). Conclusions: A high proportion of eligible patients had the frailty measure completed, demonstrating the acceptability of the CFS to clinicians. Despite lack of training for medical staff, increasing frailty was correlated with functional decline and mortality supporting the validity of the CFS as a frailty screening tool for clinicians. Keywords: Aged, Frailty, Hospitalization, Survival, Frail elderly, Activities of daily living		defined as not frail (group 1), patients who were scored at 4-5 (group 2) as vulnerable -mildly frail, patients who scored 7-8 (group 3) as moderatel y to severely frail and patients who scored 9 were terminally ill but not otherwise frail (Group 4) Uni-variate analysis was performed for all variables. multivaria te analysis was performed using two models. All variables which had a P value of less than 0.1 were included in the multivaria te analysis.	month mortality rate in our study of 1.82, 95 % CI 1.14, 2.91			
6. **Basic and Shanley**	Basic, D., & Shanley, C. (2015). Frailty in an older inpatient population: Using the clinical frailty scale to	Objective: To evaluate the impact of frailty, measured using the Canadian Study of Health and Aging Clinical Frailty Scale (CSHA-CFS), on outcomes of older	Demographi cs: Age, sex, language, residence Independent variable: frailty, measured	-The study was undertake n at Liverpool Hospital, a tertiary referral hospital in	The overall in-hospital mortality was 10%. Patients who died were more likely to be within the higher CSHA-CFS	-The odds ratio was reported >1, which signifies the reliability of the study's findings. -Since the CI is narrow and p < 0.05, the precision	-The authors acknowledged that the interrater reliability of CFS were not measured -Basic and Shaley also stated that the results of the study	This study showed that CFS is an effective frailty screening tool in predicting outcomes in the hospital. It supports our PICOT as this article indicates that CFS is an effective screening tool in identifying and

	predict patient outcomes. *Journal of Aging and Health, 27*(4), 670-685. doi:10.1177/0898264314558202 Type: A prospective cohort study Level ll, Quality B	people hospitalized with acute illness. Method: Consecutive patients were randomly allocated to a model development sample or a model validation sample. Multivariate analyses were used to model in-hospital mortality, new nursing home placement, and length of stay. Variables selected in the development samples were tested in the validation samples. Results: The mean age of all 2,125 patients was 82.9 years. Most (93.6%) were admitted through the emergency department. Frailty predicted in-hospital mortality (odds ratio [OR] = 2.97 [2.11, 4.17]), new nursing home placement (OR = 1.60 [1.14, 2.24]), and length of hospital stay (hazard ratio = 0.87 [0.81, 0.93]). Discussion: Frailty is a strong predictor of adverse outcomes in older people hospitalized with acute illness. An increased awareness of its impact may alert clinicians to screen for frailty.	using the Canadian Study of Health and Aging Clinical Frailty Scale, total medical diagnosis (Diagnoses), malnutrition Dependent Variable: in hospital mortality, new nursing home placement, length of stay	Sydney, Australia -2125 participants admitted between 2010 and 2014 were included in the study. - Geriatrician determined the level of frailty using CFS. The determination was predominantly based on premorbid data collected and documented by allied health staff.	categories ($\chi2 = 207$, $p < .0001$; Mantel–Haenszel $\chi2$ for trend = 112, $p < .0001$). The death rates for CFS score 5,6,7 was 3.4%, 6.5%, and 27.4%, respectively. Patients with CFS score 6 (9.2%) and 7 (9%) were newly placed in nursing homes directly from the hospital. The median length of stay (LOS) in the hospital among all 2135 patients was 10 days. Significant predictors of LOS were CFS score, delirium, dysphagia, malnutrition, deconditioning, comorbid diseases, and nursing home residence (refer table 5). Patients admitted from nursing home comprised 19.4% of the total sample, and were more likely to be within the higher CFS categories ($\chi2 = 586$, $p < 0.0001$; Mantel-Haenszel $\chi2$ for trend =	of the measurement is adequate, and the results are reliable -Confounders such as medical diagnoses and malnutrition were analyzed to identify variables correlated to the measured outcomes. - The sample size was large, n = 2125 participants. The large sample size increases the generalizability of the study findings to other populations.	can't be extrapolated to all older inpatients and generalized beyond older people.	predicting outcomes of frail patients.

					365, p < 0.0001)			
7. Curtis et al	Curtis, E., Romanowski, K., Sen, S., Hill, A., & Cocanour, C. (2018). Frailty score on admission predicts mortality and discharge disposition in elderly trauma patients over the age of 65 y. *Journal of Surgical Research, 230*(1), 13-19. https://doi.org/10.1016/j.jss.2018.04.017 Type: Retrospective review Level III, Quality B	Abstract Background Although many frailty scales exist, a single scale has not been agreed upon to define frailty. Herein, we determined whether the Canadian Study on Health and Aging Clinical Frailty Scale (CSHA CFS) can predict the risk of elderly patients for hospital mortality and discharge to skilled nursing facilities (SNFs) following traumatic injury. Methods Charts from trauma patients aged ≥65 y admitted from December 1, 2011, to December 31, 2013, were retrospectively examined. Age, mechanism of injury, Glasgow coma score, systolic blood pressure and heart rate on arrival, injury severity score, hospital mortality, length of stay, and discharge disposition were recorded. Frailty scores were determined from admission data using the CSHA CFS. Univariate and multivariate analyses were performed. Results A total of 1403 patients were included. The mean age was 77.6 ± 8.6 y. Patients with falls presented higher frailty scores than patients who sustained injuries through other mechanisms (4.58 ± 1.2 versus 3.52 ± 1.15; P < 0.00001)	Demographics: Age Independent variable: Frailty score using CFS. Dependent Score: Mortality, Discharge to SNF, types of injury	A total of 1635 patients aged 65 y and older who were admitted to the hospital for trauma were screened. After inclusion criteria were met, 1403 patients had their frailty score assessed.	Frailty significantly correlated with age (Pearson correlation coefficient: 0.24, P < 0.05) In the study, CFS was a significant predictor of both mortality and discharge to SNF. When comparing patients who died versus those who lived, for every 1-unit increase in frailty score, the odds of death increased by 23%. Given an overall risk of death of 8%, an increase in odds of death of 23% for each one-point increase in frailty score is clinically meaningful. Similarly, when comparing patients discharged to SNF versus discharge to home, for every 1-unit increase in frailty score	The reliability of the study findings was increased since the odds ratio (OR) was > 1 Narrow confidence intervals were noted which increases the study's precision	The author noted that the sample for this study has a high percentage of uninsured patients, thus the result may not be generalizable to every elderly patient	This study support why screening frailty is significant using CFS. Providers can easily predict the risk of death or discharge to SNF after traumatic experience. Even if the population in this study is not our project's focus, it shows how CFS has a wide acceptance in different settings.

		and were significantly older (79.5 ± 8.6 versus 73.4 ± 7.4; P <0.00001). Frailty scores of nonsurvivors were significantly higher than those of survivors (4.6 ± 1.3 versus 4.2 ± 1.2; P <0.01). Age, Glasgow coma score, and CSHA CFS combined were associated with mortality (odds ratio: 1.52; confidence interval: 1.37-1.69). A higher frailty score was associated with earlier death and increased mortality. Conclusions CSHA CFS is simple and provides frailty scores that can help identifying elderly patients at high risk for in-hospital mortality and discharge to SNF following traumatic injury.						
8 Nidadavolu et al.	Nidadavolu, L. S., Ehrlich, A. L., Sieber, F. E., & Oh, E. S. (2020). Preoperativee valuation of the frail patient. *Anesthesia and Analgesia*, *130*(6), 1493–1503. https://doi.org/10.1213/ANE.0000000000004735 Type: prospective cohort study Level II	Background: Perioperative management of older adults is a complex field that is heavily influenced by the clinical heterogeneity of older adults. Frailty—a geriatric syndrome in which a patient is more vulnerable to stressors due to decreases in physical function and reserve—has been indicative of adverse postoperative outcomes. Many tools have been developed to measure frailty that incorporate a variety of factors including physical and cognitive function, comorbidities, self-reported measures of health, and clinical judgment. Most of these frailty assessment tools are able to identify a subset of patients at risk of adverse outcomes including postoperative	Demographics: Patients greater than or equal to the age of 65 who are undergoing surgery. The independent variable is the type of frailty score used. The dependent variable is the postoperative complications, length of stay, postoperative mortality, 30-day readmission rates	A total of 1869 titles were identified. The study identified 1510 titles and abstracts that were identified.	A higher rate of postoperative complications were associated with frailty status. This is relevant to our PICOT project because it shows that by identifying patients who are frail we can reduce the amount of postoperative complications. The odds ratio is 3.87. The 30-day readmission rate was higher in the frailty group with an odds ratio of 1.6.	The reliability and validity of the findings within the study is increased due to the odds ratio being greater than 1. The strengths of this narrative review include a comprehensive evaluation of frailty assessment tools that were specifically validated in surgical populations as well as postoperative outcomes that have been examined among individuals who were identified as frail using these tools.	Limitations of this review include focusing on adults over age 65. There are studies examining frail patients who are <65, particularly in cancer, cardiac surgery, and transplant medicine fields that were excluded based on our criteria. An additional limitation is that studies looking at oncologic surgeries and those with concurrent or pre-ceding chemotherapy were also excluded. The presence of cancer and chemotherapy can be an additional stressor to older adults, and patients with a history of cancer have significantly higher rates of frailty and vulnerability.	This article is very relevant to our PICOT question. It is important to know the relevance of postoperative complications in patients who are frail because we can intervene to reduce those postoperative complications with an effective frailty screening tool. The length of stay for individuals who are frail is longer. This is of significance importance because we can reduce the length of stay for the patient and improve the surgical outcomes. Post-operative mortality and 30-day readmission rates were increased in the frailty group showing that it is important to identify these factors and to intervene to prevent complications.

		complications, longer hospital length of stay, discharge to a higher level of care, and mortality. Frailty assessment before surgical interventions can also guide discussions among patients, their families, anesthesiologists, and surgeons to tailor operative plans for patients to mitigate this increased risk. Studies are ongoing to identify interventions in frail patients that can improve postoperative outcomes, but high-quality data in the form of randomized controlled trials are lacking at this time. Methods: Electronic databases including PubMed, Embase, and the Cochrane Library were searched with date restrictions of January 1, 2001 to August 22, 2019. We started our search in 2001 due to the publication of the Physical Frailty Phenotype (PFP) and the Deficit Accumulation Index (DAI) frailty assessments in 2001.[3,9] A combination of controlled vocabulary and keyword terms was used for the concepts of frail elderly, preoperative care, assessment, complications or outcomes, and survey instruments. A total of 1869 records were identified. Duplicate records were removed, and 1510 titles and abstracts were identified. Inclusion criteria are as follows: surgical population, age ≥65, frailty assessed by a validated tool, and reporting on postoperative complications and other clinical outcomes. Exclusion criteria are as follows: oncological surgeries or procedures, age <65, studies						

		assessing different surgical techniques or approaches, studies focusing on the economic and financial impact of frailty, and conference abstracts. In addition, studies that did not utilize all components of previously validated frailty tools (eg, only using gait speed or handgrip strength) were excluded. We also reviewed reference lists in relevant review articles to identify additional studies. Articles were reviewed by L.S.N. and A.L.E., and consensus was reached for final inclusion of eligible studies. Of the 1869 articles initially identified, 32 articles met all inclusion and exclusion criteria						
9 Panayi et al	Panayi, A. C., Orkaby, A. R., Sakthivel, D., Endo, Y., Varon, D., Roh, D., Orgill, D. P., Neppl, R. L., Javedan, H., Bhasin, S., & Sinha, I. (2019). Impact of frailty on outcomes in surgical patients: A systematic review and meta-analysis. *American Journal of Surgery*, *218*(2), 393–400. https://doi.org/10.1016/j.amjsurg.2018.11.020 Type: Type: A systematic review and meta-analysis Level I	**Age has historically been used to predict negative post-surgical outcomes. The concept of frailty was introduced to explain the discrepancies that exist between patients' chronological and physiological age. The efficacy of the modified frailty index (mFI) to predict surgical risk is not clear.** **Objective:** We sought to synthesize the current literature to quantify the impact of frailty as a prognostic indicator across all surgical specialties. **Data Sources:** Pubmed and Cochrane databases were screened from inception to 1 January 2018.	Demographics: Elderly individuals over the age of 65 undergoing surgery. Independent variable is different frailty scores and the dependent variables are mortality, major complications, wound complications, reoperation, and re-admission rate.	Articles were included that were prospective or retrospective and included cohort studies, randomized controlled trials and case-control studies were identified and analyzed. Articles were selected via a two-stage process. In the second stage the manuscript of eligible studies was assessed for inclusion.	Frail patients were more like to experience complications, major complications and wound complications. The risk ratio was greater than 1 in all three outcomes indicating an increased risk for the patients identified as frail with a confidence interval of 95%. Frailty patients were more likely to be discharged to a non-home facility such as a skilled nursing facility. Notably, the risk of mortality was 4.19 times more likely in frail	There was an adequate sampling size with 683,487 patients and 444,885 of those were deemed frail. The relative risk ratio was greater than 1 in the results of complications, wound infection and readmission rates. The higher the relative risk ratio the stronger the association between frailty and the development of complications.	This study carries limitations commonly seen with systematic reviews and meta-analyses. First, the quality of this meta-analysis is dependent on the quality of the studies it analyzes, all of which are non-randomized. Non-randomized studies carry inherent biases, including selection bias. All included studies are case series which tend to be perceived as lighter surgical research evidence because of several short-comings including having vague objectives and exaggerated conclusions. However, they carry relevance to a certain degree as proof of a potential cause-effect relationship.[56] Acce pting the limitations	This study is a valuable resource for our study. It is important to identify patients that are at risk for frailty. This study demonstrates with a high risk ratio that patients screened as frail are more likely to have wound infections and readmission rates. Furthermore patients identified as frail were more likely to have another operation to improve their illness. A mortality rate that is 4.19 times the rate of non-frail patients clearly indicates the importance of an effective frailty screening tool.

		Study Selection: Studies utilizing the modified Frailty Index (mFI) as a post-operative indicator of any type of surgery. The mFI was selected based on a preliminary search showing it to be the most commonly applied index in surgical cohorts. **Data Extraction and Synthesis:** Articles were selected via a two-stage process undertaken by two reviewers (AP and DS). Statistical analysis was performed in Revman (Review manager V5.3). The random-effects model was used to calculate the Risk Ratios (RR). **Main Outcome(s) and Measure(s):** The primary outcomes: post-operative complications, re-admission, reoperation, discharge to a skilled care facility, and mortality. **Results:** This meta-analysis of 16 studies randomizes 683,487 patients, 444,885 frail, from gastrointestinal, vascular, orthopedic, urogenital, head and neck, emergency, neurological, oncological, cardiothoracic, as well as general surgery cohorts. Frail patients were more likely to experience complications (RR 1.48, 95%CI 1.35–1.61; p<0.001), major complications (RR 2.03, 95%CI 1.26–3.29; p=0.004), and wound complications (RR 1.52, 95%CI 1.47–1.57; p<0.001). Furthermore, frail patients had higher		The last author was consulted to resolved inconsistency between the two reviewers. Of the 192 studies 88 studies were excluded based on the type of study, according to our exclusion criteria, and of the remaining 104 studies, seven were excluded based on their title, and 63 based on their abstract as they stratified frailty using indices other than the mFI. Full manuscripts were evaluated for 34 publications but only 16 fulfilled the entry criteria for the meta-analysis.	patients (95% CI 2.96—5.92; p< 0.001).		of case series allows surgeons to learn from such evidence.[57] Further more, according to the GRADE criteria, 12 of 14 studies included in this meta-analyses were of low or very low quality. We sought to overcome this limitation by repeating the analysis using data solely from studies deemed to be of moderate quality. Last, the study is subject to publication bias as all but one study were conducted in the US and Canada. Adding to the publication bias is the fact that our criteria excluded studies that were unpublished and included only studies published in the English language. In addition, the funnel plots indicate a lack of studies showing no effect.	

		risk of readmission (RR 1.61, 95%CI 1.44–1.80; p<0.001) and discharge to skilled care (RR 2.15, 95%CI 1.92–2.40; p<0.001). Notably, the risk of mortality was 4.19 times more likely in frail patients (95% CI 2.96—5.92; p< 0.001).						
10 Robinson et al.	Robinson, T. N., Walston, J. D., Brummel, N. E., Deiner, S., Brown, C. H., 4th, Kennedy, M., & Hurria, A. (2015). Frailty for Surgeons: Review of a National Institute on Aging Conference on Frailty for Specialists. *Journal of the American College of Surgeons*, *221*(6), 1083–1092. https://doi.org/10.1016/j.jamcollsurg.2015.08.428 Type: A Systematic Review Level II	Frailty represents one of the most critical issues facing health care due to its inherent relationship with poor health care outcomes. Frailty is present in 10% to 20% of individuals 65 years and older[1,2] and increases with advancing age. Currently, 15% of the United States population is 65 years and older; a number that is forecast to increase to 21% by the year 2030.[3] Older adults make up a large portion of surgical practice in the United States. In 2010, 37% of all inpatient operations performed in the United States were in patients 65 years and older,[4] and this percentage will rise in the coming decades.[5] Given the inevitable rise of the aging population, it is vital that surgeons understand the concept of frailty and how it may affect surgical decisions and outcomes. To address this gap in knowledge, the National Institute on Aging and the American Geriatrics Society sponsored a 2-day conference held March 2 and 3, 2015, specifically addressing the topic of frailty for specialists. Global leaders in frailty management and research served as faculty. The purpose of this manuscript is to summarize the key	Demographics- Older adults over the age of 65 undergoing surgery. The independent variable was the different definitions of frailty and different frailty screening tools. The dependent variable is surgical outcomes.	3 studies were examined to identify the relationship between frailty and poor surgical outcomes. Dasgupta and colleagues measured frailty preoperatively with the Edmonton Frail Scale. Robinson and colleagues found that an accumulation of a high number of frailty characteristics were related to an increased risk of 6-month mortality. Makary and colleagues examinated frailty after surgery and discharge to an institutional care facility.	From this analysis, it was identified that there was an increased risk of postoperative complications with an odds ratio of 5.02 for individuals who were frail. Dasgupta and colleagues[7] measured frailty preoperatively with the Edmonton Frail Scale and found that high frailty scores were associated with increased postoperative complications (odds ratio [OR] 5.02; 95% CI 1.55 to 16.25) and a lower chance of being discharged home (40%; p = 0.02). Robinson and colleagues[10] found that accumulation of a high number of frailty characteristics was related to an increased	The strengths of this study was that there were a lot of different screening tools identified that can help us sort out which ones are the most beneficial. Multiple factors that contribute to frailty were investigated including phenotypic frailty, deficit accumulation frailty index, resilience and frailty, frailty and social vulnerability, CHF, ESRD, and other factors. The reliability of the study findings is strong because there was an increased risk of postoperative complications with an odds ratio of 5.02. An odds ratio greater than 1 increases the strength of the relationship between frailty and complications.	One of the limitations of the study was that the systematic review relied on a relatively limited number of databases when identifying the eligible studies. Another limitation is that search strategies are not provided in detail.	One of the benefits of this article and how it applies to our project is that it breaks down the criteria from different frailty evaluation tools. For example, it looks in detail at the different criteria that make up the different tools. This will allow us to best choose the most appropriate frailty screening tool. For example certain aspects such as walking speed, history of dementia, and the presence of social support are identified and evaluated in detail with regards to the frailty screening tool.

		points regarding frailty and perioperative management in a clinically relevant context.			risk of 6-month mortality, with 81% sensitivity and 86% specificity. Makary and colleagues[8] measured preoperative phenotypic frailty and found an association between frailty and increased postoperative complications (OR 2.54; 95% CI 1.12 to 5.77), length of stay (incidence rate ratio 1.69; 95% CI 1.28 to 2.23), and discharge to an institutional care facility (OR 20.48; 95% CI 5.54 to 75.68).			
11 Sadiq et al.	Sadiq, F., Kronzer, V. L., Wildes, T. S., McKinnon, S. L., Sharma, A., Helsten, D. L., Scheier, L. M., Avidan, M. S., & Ben Abdallah, A. (2018). Frailty Phenotypes and Relations With Surgical Outcomes: A Latent Class Analysis. *Anesthesia and analgesia*, *127*(4), 1017–1027. https://doi.org/10.1213/ANE.0000000000003695	**Abstract** **BACKGROUND:** Frailty is an important concept in the care of older adults although controversy remains regarding its defining features and clinical utility. Both the Fried phenotype and the Rockwood deficit accumulation approaches cast frailty as a "burden" without exploring the relative salience of its cardinal markers and their relevance to the patient. New multifactorial perspectives require a reliable assessment of frailty that can validly predict postoperative health outcomes.	Demographic is elderly individuals undergoing surgery. The independent variable is whether the patient is classified into not frail, moderately frail or severely frail. The dependent variables are post-operative complications, quality of life after surgery, and the rate of hospital readmission rate.	Patients were consented to participate in the project during their preoperative clinical evaluation at the Barnes-Jewish Hospital Center for Preoperative Assessment and Planning (CPAP). Specifically, the registry includes patient-reported information from a baseline survey completed preoperatively at the	Severely Frail (OR =1.89, 95% CI =1.42 to 2.50) and Moderately Frail patients (OR =1.31, 95% CI =1.03 to 1.67) both had higher odds of experiencing postoperative complications compared to Not Frail patients. In a three-way comparison, a higher proportion of Severely Frail patients (10.7%) reported poorer	One of the strengths of this study is that it broke down the characteristics of each group based on the severity of frailty. Rather than grouping all frail patients together, there were separate groups that were either moderately frail or severely frail. This allows us to identify screening tools that can identify patients as moderately frail or severely frail. Furthermore, each group can undergo different interventions. One of the strengths of this study is that it correlated the degree of frailty with the odds ratio. In other words, the	There are several important limitations associated with this study. The surgical patients originated from a single center reflecting the demographic composition of this particular hospital and the region it primarily serves. In addition, most of the surgeries were elective, suggesting the need to validate the current findings with different and more heterogeneous cohorts of surgical patients in order to confirm that frailty subtypes exist independent of environmental conditions, cultural issues, and practice specialties. Other limitations	This study is beneficial to our study for a number of reasons. One of the unique features of this study is that it was conducted at Barnes-Jewish Hospital and is especially relevant to our study and data. Another beneficial aspect is that the study broke down frailty into 18 different frailty markers. By creating 18 different frailty markers it allows us to identify which aspects of frailty lead to worse outcomes in patients. Using this information will help guide us to choose an important frailty screening tool.

	Type: A Retrospective Cohort Study Level III	**METHODS:** In a retrospective study of 2,828 unselected surgical patients, we used item response theory to examine the ability of 32 heterogeneous markers capturing limitations in physical, functional, emotional, and social activity domains to indicate severity of frailty as a latent continuum. Eighteen markers efficiently indicated frailty severity and were then subject to latent class analysis to derive discrete phenotypes. Next, we validated the obtained frailty phenotypes against patient-reported 30-day postoperative outcomes using multivariable logistic regression. Models were adjusted for demographics, comorbidity, type and duration of surgery, and cigarette and alcohol consumption. **RESULTS:** The 18 markers provided psychometric evidence of a single reliable continuum of frailty severity. Latent class analyses produced three distinct subtypes, based on patients' endorsement probabilities of the frailty indicators: Not Frail (49.7%), Moderately Frail (33.5%), and Severely Frail (16.7%). Unlike the Moderate class, Severely Frail endorsed emotional health problems in addition to physical burdens and functional limitations. Models adjusting for age, sex, type of anesthesia, as well as intra-operative factors indicated that Severely Frail (OR =1.89, 95% CI =1.42 to 2.50) and Moderately Frail		time of consent, and data from follow-up surveys completed by the same patients approximately 30 days and one year postoperatively. Data available for this study covered seven months in 2014. At that time, the total number of surgical patients who were assessed preoperatively at the CPAP and had surgery was 18,735 of which 12,877 consented over the entire 2014 period. The number of actual surgeries performed in the 7-month window selected for this study involved 10,491 patients of which 7,043 (67%) consented to have their data included in the SATISFY-SOS registry and 4,042 (57% of those consented) actually completed both baseline and 30-day surveys, as of the beginning of this investigation. We then excluded patients with	quality of life after surgery compared to Moderately Frail (9.2%) and Not Frail (8.3%) patients (p <0.001). There was no significant difference among these groups in proportions reporting hospital readmission (5.6%, 5.1%, and 3.8%, respectively; p =0.067).	more severe the frailty, the higher the odds ratio and the stronger the association between the severity of frailty and postoperative complications.	mentioned within the study are potential missing information from the database but 70% of the original database maintained complete data.	

		patients (OR =1.31, 95% CI =1.03 to 1.67) both had higher odds of experiencing postoperative complications compared to Not Frail patients. In a three-way comparison, a higher proportion of Severely Frail patients (10.7%) reported poorer quality of life after surgery compared to Moderately Frail (9.2%) and Not Frail (8.3%) patients (p <0.001). There was no significant difference among these groups in proportions reporting hospital readmission (5.6%, 5.1%, and 3.8%, respectively; p =0.067). **CONCLUSIONS:** Self-report frailty items can accurately discern three distinct phenotypes differing in composition and their relations with surgical outcomes. Systematically assessing a wider set of domains including limitations in functional, emotional and social activities can inform clinicians on what precipitates loss of physiological reserve and profoundly influences patients' lives. This information can help guide the current discussion on frailty and add meaningful clinical tools to the surgical practice.		missing data in any of the selected data fields (demographic variables, frailty items, and patient-reported outcomes), yielding an analysis sample of 2,828 patients with complete information. An extensive literature review produced 52 common frailty measures across different assessment strategies. A total of 32 of these matched up against our medical institution's preoperative anesthesia electronic medical records.				
12 Rothenberg et al	Rothenberg, K. A., Stern, J. R., George, E. L., Trickey, A. W., Morris, A. M., Hall, D. E., Johanning, J. M., Hawn, M. T., & Arya, S. (2019). Association of Frailty and	**Importance** Ambulatory surgery in geriatric populations is increasingly prevalent. Prior studies have demonstrated the association between frailty and readmissions in the inpatient setting. However, few data exist regarding the	The demographics were geriatric population that was undergoing elective surgeries in an ambulatory outpatient setting.	The sampling size and sampling method consisted of 417,840 patients undergoing elective outpatient surgical	Table 2 breaks down the complications within 30 days amongst frail individuals and non-frail individuals. Certain complications were much more	One of the strengths of a retrospective cohort study is that it can analyze multiple outcomes. There were a lot of parameters related to frailty assessed during this study. In particular this study focused on the 30-day readmission rate which is an important aspect for	One of the limitations of this study is that it is difficult to follow a 30-day readmission rate. For example, if the patient is readmitted to a different hospital within 30 days those records might not coincide with the original hospitals	30-day readmission rate is a particularly important aspect in caring for post-operative patients. 30-day readmission rates can be harmful for the patient and can lead to further complications. Identifying the aspects of a frailty screening that screen out frail patients can be utilized

	Postoperative Complications With Unplanned Readmissions After Elective Outpatient Surgery. *JAMA network open*, *2*(5), e194330. https://doi.org/10.1001/jamanetworkopen.2019.4330 Type: A Retrospective Cohort Study Level III	association between frailty and readmissions after outpatient procedures. **Objective** To examine the association between frailty and 30-day unplanned readmissions after elective outpatient surgical procedures as well as the potential mediation of surgical complications. **Design, Setting, and Participants** In this retrospective cohort study of elective outpatient procedures from 2012 and 2013 in the National Surgical Quality Improvement Program (NSQIP) database, 417 840 patients who underwent elective outpatient procedures were stratified into cohorts of individuals with a length of stay (LOS) of 0 days (LOS = 0) and those with a LOS of 1 or more days (LOS ≥ 1). Statistical analysis was performed from June 1, 2018, to March 31, 2019. **Exposure** Frailty, as measured by the Risk Analysis Index. **Main Outcomes and Measures** The main outcome was 30-day unplanned readmission.	The independent variable was the level of frailty and frailty screening tool used and the dependent variable was the length of stay, complications from surgery, and the main outcome was 30-day unplanned readmission.	procedures.	pronounced than others. For example, urinary tract infections were 1.6% in frail individuals compared to 0.4% in the non-frail individuals. This demonstrates that frail individuals are more suspectable to urinary traction infections and renal insufficiency. Frail individuals were 10 times as likely to develop renal insufficiency compared to non-frail individuals.	surgical patients. We can use this information to reduce the 30-day readmission rate in future patients. In multivariate analysis, frailty doubled the risk of unplanned readmission (LOS = 0: adjusted relative risk [RR], 2.1; 95% CI, 2.0-2.3; LOS ≥ 1: adjusted RR, 1.8; 95% CI, 1.6-2.1). A relative risk ratio greater than 1 strengthens the association between frailty and unplanned readmission rate.	conducting the study. Another limitation is this study primarily evaluated outpatient surgical procedures in a ambulatory surgical setting and therefore might not translate to other surgery centers or hospital systems. Therefore, the results might not be generalizable.	to reduce the 30 day readmission rate.
13 Montgomery et al	Montgomery, C., Stelfox, H., Norris, C., Rolfson, D., Meyer, S., Zibdawi, M., & Bagshaw,	**Background:** The identification of frailty before complex and invasive	The demographics were patients who were 50 years old or older	This was a prospective observational cohort study. Patients	Of the available data, some of the data that is more pertinent to our PICOT	Some of the strengths of this particular study that it has a comprehensive collection of preoperative	One of the limitations of the study is that the clinical frailty scale (CFS) was derived and validated in an older ambulatory	During this study, the Clinical Frailty Scale (CFS) was specifically used to assess for frailty in patients. By studying frailty in cardiac surgery

	S. (2021). Association between preoperative frailty and outcomes among adults undergoing cardiac surgery: a prospective cohort study. *CMAJ open*, *9*(3), E777–E787. https://doi.org/10.9778/cmajo.20200034 Prospective Cohort Study Level II	procedures may have relevance for prognostic and recovery purposes, to optimally inform patients, caregivers and clinicians about perioperative risk and postoperative care needs. The aim of this study was to estimate the prevalence of frailty and describe the associated clinical course and outcomes of patients referred for nonemergent cardiac surgery. **Methods:** A prospective cohort of patients aged 50 years and older referred for nonemergent cardiac surgery in Alberta, Canada, from November 2011 to March 2014 were screened preoperatively for frailty, defined as a Clinical Frailty Scale (CFS) score of 5 or greater. Postoperatively, patients were followed by telephone to assess CFS score, health services use and vital status. The primary outcome was all-cause hospital mortality. Secondary outcomes included health services use, hospital discharge disposition, 1-year health-related quality of life and all-cause 5-year mortality.	referred for non-emergent cardiac surgery in Alberta, Canada. The independent variable was whether the patients were classified as frail and the dependent variables were post-operative surgical outcomes such as hospital mortality rate and length of stay.	aged 50 years and older referred to the adult (≥ 18 yr) cardiac surgery programs at the Foothills Medical Centre in Calgary and the Mazankowski Alberta Heart Institute in Edmonton, Alberta, Canada, for nonemergent surgery between November 2011 and March 2014 were eligible for enrolment. The 2 adult cardiac surgery programs perform an average of 2800 adult surgical procedures annually. Frailty was assessed using the validated 9-point ordinal Clinical Frailty Scale (CFS), a subjective global assessment of fitness	question is that frail patients were more likely to experience postoperative bleeding, as well as an acute kidney injury. This coincides with previous studies that demonstrated an increased risk of acute kidney injury. Frail individuals also experienced a higher rate of bleeding, blood transfusion, and renal replacement therapy compared to non-frail individuals. Hospital mortality was almost 10 times higher in frail individuals (9.8%) compared to nonfrail patients (1.0%).	validated frailty measures. Throughout our project, we can use this study to identify pertinent aspects of the frailty screening process. Furthermore, this study did a remarkable job at following the patients on a long-term objective outcome for patients living with frailty.	population and has not been specifically evaluated against a gold standard such as a comprehensive geriatric assessment in the cardiac surgery setting. Another limitation is that the study was somewhat small and therefore was predisposed to selection bias because it was not able to compare to patients not enrolled or patients counselled not to undergo surgery. Furthermore, the generalizability of the study might be limited to other health jurisdictions. Another limitation is that it might be subject to recall bias when individuals describe their quality of life. Another strength of the study is the p value. The lower the p value the greater the statistical significance of the observed difference. Frail patients were more likely to experience postoperative bleeding 15.7% compared to 4.8% with a p value of 0.002 and acute kidney injury had a P value of 0.007. The low p value indicates a strong relationship between frailty and bleeding and kidney injury.	patients, we were able to observe that screening for frailty could provide an opportunity to healthcare providers better plan and prepare for cardiac surgery procedures.
14 Tjeertes et al.	Tjeertes, E., van Fessem, J., Mattace-Raso, F., Hoofwijk, A.,	Frailty is increasingly recognized as a better predictor of adverse postoperative events than chronological age.	The demographics were elderly individuals	A search of literature was performed	Figure 3 shows the comparison of postoperative	The strengths of the systematic review is that it included eleven frailty assessments and	One of the limitations is the heterogeneity of the study, and another limitation is the	I chose this study because it evaluated eleven different frailty screening tools. Many of the studies used the

	Stolker, R. J., & Hoeks, S. E. (2020). Influence of Frailty on Outcome in Older Patients Undergoing Non-Cardiac Surgery - A Systematic Review and Meta-Analysis. *Aging and disease*, *11*(5), 1276–1290. https://doi.org/10.14336/AD.2019.1024 A Systematic Review and Meta-Analysis Level II	The objective of this review was to systematically evaluate the effect of frailty on postoperative morbidity and mortality. Studies were included if patients underwent non-cardiac surgery and if frailty was measured by a validated instrument using physical, cognitive and functional domains. A systematic search was performed using EMBASE, MEDLINE, Web of Science, CENTRAL and PubMed from 1990 - 2017. Methodological quality was assessed using an assessment tool for prognosis studies. Outcomes were 30-day mortality and complications, one-year mortality, postoperative delirium and discharge location. Meta-analyses using random effect models were performed and presented as pooled risk ratios with confidence intervals and prediction intervals. We included 56 studies involving 1.106.653 patients. Eleven frailty assessment tools were used. Frailty increases risk of 30-day mortality (31 studies, 673.387 patients, risk ratio 3.71 [95% CI 2.89-4.77] (PI 1.38-9.97; I2=95%) and 30-day complications (37 studies, 627.991 patients, RR 2.39 [95% CI 2.02-2.83). Risk of 1-year mortality was threefold higher (six studies, 341.769 patients, RR 3.40 [95% CI 2.42-4.77]). Four studies (N=438) reported on postoperative delirium. Meta-analysis showed a significant increased risk (RR 2.13 [95% CI 1.23-3.67). Finally, frail patients had a higher risk of institutionalization (10 studies, RR 2.30 [95% CI 1.81- 2.92]). Frailty is strongly associated	undergoing surgery. Eleven different frailty assessment tools were used. The independent variable was the type of frailty screening tool used and the dependent variable was postoperative complications, delirium and mortality rates amongst patients undergoing surgery.	and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement and MOOSE criteria. Initial literature search identified 2117 manuscripts as potentially relevant. Of these, 1904 were excluded due to unrelated research questions or study type. Full text was not available in one study; therefore 212 full text articles were thoroughly screened for eligibility. A total of 56 studies were found suitable for this systematic review.	complications and the frailty assessment tool. 30-day complications with a relative risk ratio of 2.39 was seen regardless of the frailty score used. Figure 4 compared frailty and one-year mortality rate. Frailty increased the risk of one-year mortality with a relative risk ratio of 3.40, increasing the reliability of the study.	compared the outcomes based on the frailty assessment tool used. Our main focus for our project is to find an applicable frailty screening tool and this allows us to compare the different frailty screening tools. Furthermore, the systematic reviews include a comprehensive search and access to a wise arrange of evidence. The strength of the study was it showed a high relative risk ratio with a RR value of 2.75 for 30-day mortality and a RR value of 4.79 for high-risk surgeries. The benefit is you can see the risk ratio between frailty and surgery.	variation among the discharge location. Even though the meta-analysis has a large scope of literature search, the broad scope of the research question may have omitted some studies. Many studies in this systematic review and meta-analysis are observational registry studies, but several studies have derived their outcomes from clinical trials.	Modified Frailty Index (mFI). From looking over each of these studies we can pinpoint what aspects make a successful frailty screening tool and what methods to take in identifying these screening tools. In each of the figures, the number of complications or outcomes were identified using the different screening tools. This lets us understand what screening tools are more accurate in identifying deleterious consequences in postoperative frail individuals.

		with risk of postoperative complications, delirium, institutionalization, and mortality. Preoperative assessment of frailty can be used as a tool for patients and doctors to decide who benefits from surgery and who doesn't.						

Appendix H

The Metabolic equivalents (MET)

MET	Activity
1	reading, watching television
	eating, getting dressed
2–3	walking on level ground at 3–4 km/h
	light housework
4	climbing a few stairs
	walking on level ground at ca. 6 km/h
	running (short distances)
	heavy household chores
	moderately strenuous sports (golf, dancing)
>10	highly strenous sports (tennis, soccer)

Appendix I

The Barthel Index

Activity	Score
FEEDING 0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent	_____
BATHING 0 = dependent 5 = independent (or in shower)	_____
GROOMING 0 = needs to help with personal care 5 = independent face/hair/teeth/shaving (implements provided)	_____
DRESSING 0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)	_____
BOWELS 0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent	_____
BLADDER 0 = incontinent, or catheterized and unable to manage alone 5 = occasional accident 10 = continent	_____
TOILET USE 0 = dependent 5 = needs some help, but can do something alone 10 = independent (on and off, dressing, wiping)	_____
TRANSFERS (BED TO CHAIR AND BACK) 0 = unable, no sitting balance 5 = major help (one or two people, physical), can sit 10 = minor help (verbal or physical) 15 = independent	_____
MOBILITY (ON LEVEL SURFACES) 0 = immobile or < 50 yards 5 = wheelchair independent, including corners, > 50 yards 10 = walks with help of one person (verbal or physical) > 50 yards 15 = independent (but may use any aid; for example, stick) > 50 yards	_____
STAIRS 0 = unable 5 = needs help (verbal, physical, carrying aid) 10 = independent	_____
TOTAL (0–100):	_____

Appendix J

Budget Table

Table 1.

Budget Table

Nature of Expenditure/Item	Cost per Unit	# Units	Total Estimated Cost
Direct Costs			
Personnel			
Project leader	$0.00/hour	100+ hours	$0
Project chair	$95.00/hour	15-20 hours	$1425.00-1900.00
Project team member	$51.00/ hour	1-2 hours	$51.00-102.00
Project team member #2 (mentor)	159.00/ hour	0.5-1 hour	$79.5-159.00
Statistician	$60.00/ hour	4-6 hours	$240-$360
Technology Hardware/Software			
Mobile App	$0	2	0
Online Educational Module	$0	2	0
SPSS software	$57	2	$114.00
Other			
Transportation	$5	16 days	$80.00
TOTAL			**$1989.5 - $2715.00**

Appendix K

Demographic Data

N = Number within sample

Age Range (N)	Sex (N)	Ethnicity (N)	Educational Background (N)
60-70 (37)	Female (43)	Caucasian (91)	Highschool Diploma (35)
71-80 (45)	Male (57)	Asian (2)	Some College (20)
81-90 (16)		African American (7)	Four Year Degree (35)
91-100 (2)			Postgraduate (10)

Appendix L

Correlation Coefficient (r) Values for CFS Score

	CFS Score researcher #1	CFS Score researcher #2
CFS Score researcher #1	1	
CFS Score researcher #2	0.812243596	1

	Novel Algorithm
Novel Algorithm	1
CFS Score researcher #1	0.66835

	CFS Score researcher #2	Novel Algorithm
CFS Score researcher #2	1	
Novel Algorithm	0.637807675	1

Appendix M

Average CFS Score for Different Ethnicities & Gender

Row Labels	Count of MRN	Average of CFS score researcher #1	Average of CFS score researcher #2	Average of Novel Algorithm
Asian				
Black/African American	7	4.857142857	5.142857143	4.428571429
White	36	4.085714286	4.085714286	4
Grand Total (F)	**43**	**4.214285714**	**4.261904762**	**4.071428571**

Count of MRN	Average of CFS score researcher #1	Average of CFS score researcher #2	Average of Novel Algorithm
Asian 2	4.5	4.5	5
white 55	3.509090909	3.690909091	3.927272727
Grand Total (M) 57	**3.543859649**	**3.719298246**	**3.964912281**

Total Count of MRN	Total Average of CFS score researcher #1	Total Average of CFS score researcher #2	Total Average of Novel Algorithm
Asian 2	4.5	4.5	5
Black/African American 7	4.857142857	5.142857143	4.428571429
White 91	3.733333333	3.844444444	3.955555556
Grand Total 100	**3.828282828**	**3.949494949**	**4.01010101**

Appendix N

Average CFS Score based Upon Educational Level

Row Labels	Count of MRN	Average of CFS score researcher #1	Average of CFS score researcher #2	Average of Novel Algorithm
Four years college	14	4.285714286	3.785714286	3.928571429
High School Diploma	18	4.176470588	4.764705882	4.235294118
Post graduate	5	5	4.6	4
Some college	6	3.5	3.666666667	4
Grand Total (F)	**43**	**4.214285714**	**4.261904762**	**4.071428571**

Count of MRN	Average of CFS score researcher #1	Average of CFS score researcher #2	Average of Novel Algorithm
Four years college 21	3.476190476	3.523809524	3.857142857
High School Diploma 17	4	4.352941176	4.588235294
Post graduate 5	3.4	3.2	3.6
Some college 14	3.142857143	3.428571429	3.5
57	**3.543859649**	**3.719298246**	**3.964912281**

Total Count of MRN	Total Average of CFS score researcher #1	Total Average of CFS score researcher #2	Total Average of Novel Algorithm
Four years college35	3.8	3.628571429	3.885714286
High School Diploma 35	4.088235294	4.558823529	4.411764706
Post graduate 10	4.2	3.9	3.8
Some college 20	3.25	3.5	3.65
100	**3.828282828**	**3.949494949**	**4.01010101**