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2021

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UNIVERSITY OF CALIFORNIA

Los Angeles

Advanced Practice Registered Nurse Pre-Procedure Clinic for Interventional Radiology

A dissertation submitted in partial satisfaction of the
requirements for the degree of Doctor of Nursing Practice

by

Wanchun Lu

2021

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ABSTRACT OF THE DISSERTATION

Advanced Practice Registered Nurse Pre-Procedure Clinic for Interventional Radiology

by

Wanchun Lu

Doctor of Nursing Practice

University of California, Los Angeles

Professor Nancy A. Pike, Committee Chair

Background: Procedure cancellations in outpatient interventional radiology (IR) can lead to delays in diagnosis, lost revenue and underutilization of department resources. Current practice at some centers is the use of registered nurses (RN) to conduct outpatient pre-procedure telephone screening. However, same-day procedure deviations requiring cancellations remains high. This quality improvement (QI) project evaluated the effectiveness of an advanced practice registered nurse (APRN) driven pre-procedure clinic to assess same-day cancellations, days to procedure, and cost-effectiveness compared to RN telephone screening for biopsies.

Objectives: To determine if an APRN interventional radiology pre-procedure clinic will reduce cancellation rates, days to procedure, and lost revenue in comparison to nurse telephone screening for outpatient biopsies.

Methods: Using a comparative design, 111 patients (47 APRN pre-procedure clinic group and 64 historical RN telephone group) were examined via retrospective medical record reviews between August 1, 2019 to January 1, 2020 [RN group] and August 1, 2020 to January 1, 2021 [APRN group]. Patient information extracted were demographics, insurance type, anesthesia classification, biopsy type, cancellation and reason, and days to procedure referral. Estimated lost revenue was calculated based on procedures cancelled and summed per group based on procedure reimbursement, facility and clinic fees, and professional fees [physician, RN or APRN]. Descriptive and inferential statistics were used to assess group differences.

Results: There were no statistically significant differences between patient groups for demographics and clinical conditions (similar types of biopsy procedures). The most common reasons for cancellation in both groups were patient factors, including elevated blood pressure and acute illnesses. There were significantly more cancellations in the RN group (18/28%) in comparison to the APRN group (9/14%; $p=0.018$). Additionally, the RN group had greater numbers of days to procedure (36.2 ± 21 vs. 21.3 ± 18 , mean \pm SD, $p < 0.001$), and lost revenue (\$160,956 vs. \$82,818, $p < 0.001$) compared to the APRN group. This reflects an institutional cost savings of almost \$80,000 (50%) over the 5-month period of this project.

Conclusion: Our findings show that an APRN pre-procedure clinic is effective in reducing same-day procedure cancellation, days to procedure (expediting diagnosis and treatment), and is cost-effective to the institution. Future QI is warranted to confirm these findings and to examine the potential impact of the expansion APRN pre-procedure clinic to include all IR procedures.

The dissertation of Wanchun Lu is approved.

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University of California, Los Angeles

2021

DEDICATION

To my parents: Thank you very much for sending me to America for higher education, providing me with supports, and always being there for me.

To my husband and Jo mama: Thank you for believing, encouraging, and comforting me during these times of need.

To Dr. Dungo: Thank you for giving me the best care you can and helping me through the treatment so I have the opportunity to finish this degree.

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ACKNOWLEDGEMENTS

I would like to acknowledge University of California, Irvine (UCI) vascular interventional radiology department section chief, Dr. Nadine Abi-Jaoudeh; department medial director, Dr. James Katrivesis; department director, Julie Limfueco; clinic mentor, Dr. Paulo Jusay, and clinical research coordinator, Permjeet Singh, for their support in this project. Nurse navigators for their willingness to participate.

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CHAPTER ONE: BACKGROUND

Interventional radiology (IR), a specialty established in the 1960s, provides innovative medical interventions for a variety of clinical conditions through minimally invasive image-guided procedures (Arnold et al., 2019). This specialty has become increasingly known and widely utilized in hospital settings because of its cost effectiveness and as a less invasive option with lower complication rates compared to open surgery that requires longer recovery time (Charalel et al., 2015; Rousseau et al. 2019). With patients' acuities becoming higher and their medical conditions becoming more complex due to multiple comorbidities, procedures are at a higher risk of cancellation when patients are not properly prepared or optimized.

Procedure cancellations related to inadequate planning or incomplete procedure preparation (e.g., missing imaging) are common in IR or catheterization laboratories and operating rooms across the country. Day of surgery cancellation rates ranged from 2% to 24% with the majority of reasons being avoidable (Grunwell et al., 2018; Kaddoum et al., 2016). Furthermore, 71% of cancellations were related to incomplete surgical workup or medical evaluation, acute illness, abnormal blood test, pre-operative instructions not being followed, or financial clearance (Kaddoum et al., 2016). From a clinical standpoint, these cancellations can result in delays in diagnosis, potential increase in morbidity and mortality due to delays in treatment, especially in oncology cases where survival and recurrence rates depend on timely detection (Coco-Pelaz et al, 2018; Jaiswal et al., 2018). The standard of practice for outpatient pre-procedure evaluations are done by referral services or primary care providers (PCPs). However, when PCPs are unfamiliar with IR procedures, their patients may not receive appropriate pre-procedure evaluation (e.g., blood work, relevant imaging, and anesthesia clearance) and preparation instruction (e.g., holding medications, skin or bowel preparation, and

fluid restrictions) (Lutjeboer et al., 2015; Zafar et al., 2016). Delayed or canceled cases can lead not only to treatment delay and suboptimal patient outcomes, but also to poor patient satisfaction and time wasted in travel and missed work. The hospital and departments involved lose revenues from unused IR suite time, have increased costs with rescheduling, and have an underutilization of resources and staff members. Hospital surveys estimated that the cost of unused operating room or procedure time related to cancellation of cases ranged between \$1,400 to \$3,600 per hour (Giroto et al., 2010; Lee et al., 2017).

Literature has suggested that pre-procedure screening clinics significantly decrease cancellation rates and that advanced practice registered nurses (APRNs) have important outcome advantages in comparison to Registered Nurses (RNs) in many clinical settings. Department pre-procedure consultation either by a RN, APRN, physician assistant, or physician can potentially identify early contraindications to the procedure or general anesthesia. This allows time for the patient to obtain further testing or treatment (if needed) or re-schedule (if sick) and for the department to adjust the upcoming schedule to eliminate gaps. Some studies assessed the effectiveness of RNs in making pre-procedure telephone calls to review cold symptoms, nothing by mouth (NPO) instructions, procedure preparation, and medication needs the morning of the procedure (Teh et al., 2016; Wittkugel & Varughese, 2015). However, the complexity of medical conditions may exceed the scope of knowledge of the RNs and their abilities to make immediate decisions related to cancellations (Teh et al., 2016; Wittkugel & Varughese, 2015). Furthermore, studies have shown that implementation of APRN roles in clinical setting improve patient outcomes/mortality and financial benefits (Chavez et al., 2017; Woo et al., 2017). Different specialties, such as cardiology or oncology have incorporated an APRN-led clinic into their departments and the results demonstrated outcome improvement as well as cost savings

(Smigorowsky et al., 2017; Walling et al., 2017; Wright et al., 2019). Thus, some centers have dedicated APRNs to assist in pre-procedure consultation screening. Findings suggested APRN pre-procedure screenings had lower adverse clinical events and clinic visit times compared to physicians in training. Utilization of an APRN-led clinic allowed the physicians to dedicate more time performing procedures that are part of their training (Smigorowsky et al., 2020; Varughese et al., 2013). An additional study by Wittkugel and Varughese (2015) showed that a RN-assisted pre-anesthesia evaluation program demonstrated quality metrics similar to evaluation by APRNs, including patient outcome and procedure complication. However, the population was limited to healthy patients and straightforward procedures and the process required the APRNs to complete the physical exam.

The impact of clinical management in the IR specialty with advanced planning performed by an APRN was discussed in this project. Studies have shown that advanced planning with pre-procedure clinic evaluation improved procedure deviations and same-day cancellation (Koetser et al, 2013; Lutjeboer et al., 2015; Sebach et al., 2015). Furthermore, Sebach et al. (2015) showed cancellations from APRN-screened patients were lower compared to those screened by PCPs. Accordingly, due to the decrease in cancellations, the department was able to save double in lost revenue. Not only the department delivered efficient patient care, it also minimized cost in unused IR suite time, avoided underutilization of physicians and staff members, reduced waste in resources, and decreased future cost in rescheduling and patient inconvenience with cancellations.

Problem Statement

Research has shown that same-day surgery cancellation rates among adult populations across the country ranged from 5.6% to 23.8% (Lee et al., 2017; Tan et al., 2019). This wide

variation between institutions and countries may be attributed to hospital policies or resources (e.g., no pre-anesthesia clinic, hospital capacity to handle emergency vs. elective procedures) and the population served (e.g., more low income, homeless or medically unfit) (Dimitriadis et al., 2013; Tan et al., 2019).

In a large teaching hospital in Southern California, there were 155 outpatient biopsy cases performed in a 5-month period with 28 cancellations. This accounted for an 18% cancellation rate for all biopsy cases. There was room for improvement given the cancellation rate at the current practice setting was above the national average (12.4%) (Tan et al., 2019). In addition, the expectation of a shorter turnaround time for outpatient biopsy referrals was important for patient experience and treatment outcome, especially in oncological patients. In previous departmental practices, RNs were the identified providers who screened outpatient procedures by telephone interviews and coordinated care among referring providers and IR physicians. Despite the hard work and countless hours of screening phone calls and patient care coordination by the RNs, there was no standardized pre-procedure evaluation protocol. An APRN has the ability to provide pre-procedure evaluation and management and function as a leader to employ consultative and effective communication skills for intraprofessional and interprofessional teams. This is especially vital for the current multi-tiered health care environment, where complex communication is key. According to The American Association of Colleges of Nursing (AACN), there are eight essentials for Doctor of Nursing Practice (DNP) education, one of which is interprofessional collaboration (IPC). Interprofessional collaboration is important knowledge and skills that emphasizes evidence-based practice, which is an underpinning for DNP profession (AACN, 2006). With patients' complex medical conditions that involve multiple specialties to coordinate care, a DNP practitioner is prepared to deliver safe patient-centered care by

facilitating IPC practice with advanced planning and effective communication among patients, healthcare providers, and care team members. Therefore, the identified DNP essentials VI (IPC for Improving Patient and Population Health Outcomes) and VIII (Advanced Nursing Practice) will be the focus of this proposal with establishing intraprofessional and interprofessional team communication and collaboration in a specialty APRN practice role in IR.

Studies have shown that many procedure cancellations are associated with insufficient patient preparation, and 19% of IR procedure inefficiency is the result of ineffective planning or coordination (Lutjeboer et al, 2015; Morbi et al., 2012). According to the Society of Interventional Radiology (SIR) guidelines, renal and liver biopsies are considered high risk for bleeding (Charalel et al., 2015; Patel et al., 2019). Data suggested that renal biopsies have up to 65% of post procedure bleeding incidents, and the risks increase significantly when patients have comorbidities, such as hypertension or elevated creatinine level (Bhagavatula & Shyn, 2017). Liver biopsies have up to 1.7% risk of bleeding or developing hematoma. The risk of bleeding increases to 4.9% for patients with underlying liver diseases and 11.7% for patients with malignancy (Sandrasegaran et al., 2016). When patients have complex medical conditions that require extensive preparation and coordination, hours spent on collaboration and delay in procedure are not uncommon.

This project explored the impact of an APRN-driven pre-procedure clinic compared to a non-standardized RN pre-procedure telephone screening on IR outpatient procedure cancellation rates, duration from referral to procedure, and cost-effectiveness as its specific aims given the high IR cancellation rates, significance of timely diagnosis, frequency of incomplete preparation, and lack of standardized RN pre-procedure screening.

PICOT Question

In outpatient IR biopsy referrals (P), APRN-driven pre-procedure clinic visits (I) compared to non-standardized RN pre-procedure telephone screening (C) will reduce same-day cancellation, duration from referral to procedure, and improve cost-effectiveness (O) within a 5-month period (T).

CHAPTER TWO: THEORETICAL FRAMEWORK

This project used the *Model for Improvement* (MFI) framework, which consisted of Aim, Measure, and Changes and used a rapid cycle process termed plan, do, study, act (PDSA; Agency for Healthcare Research and Quality [AHRQ], 2013; Institute for Healthcare Improvement [IHI], 2016). Implementation of the PDSA cycles provided incremental data-driven system change to test the effects of changes (Figure 1). This quality improvement (QI) project aimed to improve and streamline a process in reducing procedure cancellation and improving duration from referral to procedure. The MFI served as a tool to accelerate improvement at the current practice setting. The model guided the project simply by setting aims with specific time and measurable goals, establishing measures to evaluate and determine efficacy, and selecting changes that were potentially innovative and effective. With the identified intervention, the project applied the PDSA model to test, modify, and refine the change with its action-oriented repeated cycle. The PDSA has been shown to create effective management in QI and is IHI-recommended for implementing system changes (Christoff, 2018). For the purpose of this project, the proposed intervention (Plan) was a dedicated APRN-driven pre-procedure clinic. A patient who had been referred for an outpatient biopsy attended (Do) a pre-procedure clinic and received an evaluation by an APRN. Completion and duration from referral to procedure were measured (Study). The

APRN pre-procedure clinic arranged (Act) additional outpatient IR referral for screening and evaluation.

The *aim* of the project was to reduce IR procedure cancellations with an APRN pre-procedure clinic. During the APRN clinic visit (either in-person or telehealth), the patient was screened and evaluated with a history and physical exam. Review of medications, laboratory tests, images, informed consent, and patient education related to the procedure were provided with written pre-procedure instructions (e.g., NPO). Clinic effectiveness was *measured* by monitoring the same-day cancellation rates, duration from referral to procedure, and cost effectiveness over a 5-month period and compared to the rates 7 months prior to the start of the APRN pre-procedure clinic. The *change* or APRN pre-procedure clinic would continue within the IR department if there was a significant reduction in these outcome measures.

CHAPTER THREE: REVIEW OF LITERATURE

Literature Search

PubMed and CINAHL Complete were two search engines used in the literature search for this project. Three separate literature searches were conducted with publication dates between 2010 and 2020. The first MeSH terms used were (interventional radiology) AND (procedure deviation) AND (outpatient clinic). The second MeSH terms used to conduct another literature search were (elective surgery) AND (cancellation) AND (preoperative) and (clinic). The third literature search focused on effects of preoperative clinic by APRNs and RNs. Main Boolean phrases used for CINAHL were (preoperative) AND (nurse practitioner) AND (cancellation of surgery) AND (registered nurse). Out of the three searches, a total of 79 articles were identified. After eliminating older articles, duplicates, non-databased, or review articles, 12 articles were examined in full text. Four articles were selected and three additional ones were identified from

bibliography and database suggestions. Furthermore, articles that studied specific reasons for cancellation, such as anxiety, blood pressure, blood test or HgbA1C, and targeted interventions to improve outcomes were excluded.

The literature search process used preferred reporting items for systematic reviews and meta-analyses (PRISMA) (Figure 2 and 3). Search results revealed clinical studies and review articles that supported process improvement in procedure cancellation with APRN pre-procedure clinic intervention. In fact, advance planning with clinical evaluation and management are keys to successful outcome and safe procedures (Crum & Varma, 2019; Taslakian et al., 2016; Tariq et al., 2016). Several clinical studies demonstrated the success of pre-procedure planning in improving cancellation, procedure deviation, and cost-effectiveness. However, there were no studies that evaluated the effectiveness of a pre-procedure clinic on improvement in duration from referral to procedure or overall process of outpatient referral.

Literature Review

Although not every procedure cancellation is avoidable, identifying the reasons can potentially support the system to better target and correct the cause. Tan et al. (2019) conducted a cohort study between June 2015 and December 2016 to analyze reason for cancellation within 24 hours of scheduled surgery in a single tertiary teaching hospital. Results showed a 9.8% rate of cancellation within 24 hours of surgery in a total of 4,060 scheduled surgeries. Most common reasons for cancellation were related to patients' chronic medical conditions (39%) and low socio-economic status, such as personal or financial reasons (25%) (Table 1). The author suggested that because the patients were more likely to be medically optimized when they attended the clinics, and patients' compliance and readiness for surgery were greater (OR 0.45, 95% CI 0.36-0.58). In comparison, patients with chronic medical illness (e.g., heart failure,

chronic kidney disease, or hip fracture) were likely to cancel surgeries (OR 2.34, 95% CI 2.34-4.25) (Tan et al., 2019).

Lutjeboer et al. (2015) also demonstrated the significance of pre-procedure clinics. The authors conducted a quasi-experimental prospective study where pre-procedure consultation and screening were done by an IR specialty clinic. Both patient safety and patient satisfaction were measured in elective IR procedures before and after implementation of IR clinic in a sample of 220 patients (110 with intervention, 110 without). The results showed a decrease in numbers of procedure deviation and an increase in patient satisfaction score (Table 1). Although the study showed limitations in Hawthorne effects and experimental methodology where changes were affected by changes in time, the results of this study suggested the implementation of a pre-procedure IR clinic reduces procedure deviation and improves patient safety as well as patient satisfaction.

Another study that examined the efficacy of pre-procedure clinic, conducted by Rubenstein et al. (2016), analyzed outpatient pediatric IR clinic consultations prior to elective procedures. This prospective study design included both quantitative (n = 91) and qualitative (n = 80) measurements. Patient satisfaction surveys concluded that 95% of patients who received pre-procedure clinic visits found the visit was helpful and allowed them time to think and ask questions. The clinic also provided opportunity to obtain consents for the procedures and 100% of participants agreed that their questions were sufficiently addressed and felt the clinic prepared them adequately for what to expect on the day of procedure. Despite sampling bias toward English only speaking participants and lack of generalizability, the findings strongly supported the use of and effectiveness of the pre-procedure clinic based on the results of patient satisfaction surveys in the study (Rubenstein et al., 2016).

Wittkugel and Varughese (2015) piloted a QI project where RNs conducted pre-procedure assessments on healthy children undergoing anesthesia procedure. Registered nurses received six weeks of training and practiced alongside APRNs for pre-procedure assessment. The weekly percentage of outpatients evaluated by RNs went from 0% to 55%. The study found RN-assisted pre-procedure evaluation did not have negative effects on procedures and parent satisfaction remained high compared to APRN pre-procedure evaluation. Anesthesiologists were able to dedicate more time to procedures because the patients had already been screened. The major limitations of this study were the low acuity (mostly healthy children for elective procedures) patient population and RNs evaluations having an overall longer assessment time compared to APRNs. In addition, the study did not mention if RNs required assistance or sought advice from APRNs that could support the values of APRN evaluations.

Sebach et al. (2015) implemented an APRN pre-procedure clinic in a large multispecialty orthopedic practice that demonstrated reduction in surgical cancellations and improvement in preoperative care coordination. The results showed that cancellations decreased from 77 out of 2,789 cases (2.7%) to 36 out of 2,372 cases (1.5%). Among the 36 cancellations in the intervention group, 35 cancellations were in the PCP group whereas one cancellation was in the APRN group. Additional analysis further showed the impact of APRN pre-procedure evaluation on lost revenue. Because of the reduction in cancellations, the department was able to save \$201,553 in potential lost revenue. Though, the study suggested that early established rapport with patients and preoperative coordination could have contributed to the lower cancellation rate compared to the PCP group. Furthermore, the APRN group also spent significantly more evaluation time with each patient, whereas the PCP group might not have had the same available time.

Teh et al. (2016) also suggested APRN pre-procedure clinic effectiveness in same-day surgery cancellation. The authors conducted a study on APRN pre-procedure comprehensive telephone assessment in reducing surgical cancellation by identifying important medical conditions that require further evaluations. The results showed that 200 patients received preoperative telephone assessment and 93.5% of them proceeded for surgery. The rate of same-day cancellation reduced from 4.5% to 0% after the intervention ($p = 0.01$). The limitations of the study included single site setting and lack of generalizability. There was also potential sampling bias where patients who received telephone assessment were healthy or had low acuity, which possibly made the assessment simple and straightforward.

Edalat et al. (2017) provided another aspect of IR clinic intervention. The authors demonstrated that a dedicated pediatric IR clinic that offered evaluation and management increased the number of new outpatients and the procedural conversion¹ rate. Revenues that were generated from the outpatient clinic increased by 158%, and procedure revenues from the clinic increased by 228% (Table 1). The implication of the study is that a dedicated outpatient IR clinic has strong financial incentive and positive public relations. Limitations of the study included that estimated revenues were calculated based on Medicare claims only and that new hire of a pediatric IR physician could have been the reason for increased patient volumes and procedures offered.

Synthesis of Literature Review

This literature search identified seven articles related to the APRN role in a pre-procedure clinic (five surgical and two IR based) in pediatric or adult populations. The most common outcome measures were same-day cancellations or deviations (Lutjeboer et al., 2015; Sebach et

¹ Procedural conversion: Patients seen in clinic and have subsequent procedure.

al, 2015; Tan et al., 2019; Teh et al., 2016; Wittkugel & Varughese, 2015), patient satisfaction, safety, and efficacy (Lutjeboer et al., 2015; Rubenstein et al., 2016), and cost-effectiveness (Edalat et al., 2017; Sebach et al., 2015; Wittkugel & Varughese, 2015). The majority of studies were descriptive or retrospective comparing pre- and post-intervention (Edalat et al., 2017; Lutjeboer et al., 2015; Teh et al., 2016; Sebach et al., 2015; Wittkugel & Varughese, 2015) with only one prospective study (Rubenstein et al., 2016) and one mixed methods (Tan et al., 2019). Some studies had shown RN-led and APRN-led clinics with complimentary effect in same-day cancellation, however, there was no direct study that compared the differences in RN and APRN pre-procedure clinic. In addition, there were no studies that evaluated the effectiveness of an IR clinic or an APRN pre-procedure clinic related to duration from referral to procedure.

Reduced Cancellations / Deviations

Many studies demonstrated the effectiveness of the APRN role in pre-procedure clinics in identifying both procedure and anesthesia contraindications that reduced same-day cancellations (Sebach et al., Smigorowsky et al., 2020; 2015; Teh et al., 2016; Varghese et al., 2013). Though many IR procedures are minimally invasive, they still require preparation. Extant literature suggested that advanced planning with a pre-procedure clinic visit reduced cancellations, improved patient satisfaction, and generated additional revenues. Tan et al. (2019) found that 73% of surgery cancellation were patients factors, 3% were surgeon factors, and 20% were system factors. Among patient factors, the majority of reasons for cancellation were lack of medical optimization, pre-operation instruction not followed, and financial reasons. In the adult population, existing chronic medical conditions were the main reasons for cancellations whereas in the pediatric population, acute illnesses and a NPO violation were the main reasons (Grunwell et al., 2018; Tan et al., 2019).

Additional studies showed that pre-procedure evaluation reduced procedure deviations and cancellations (Lutjeboer et al., 2015; Koetser et al., 2013; Sebach et al., 2015; Tan et al., 2019; Teh et al., 2016; Wittkugel & Varughese, 2015). In Tan et al. (2019), patients who attended preoperative assessment clinics had lower cancellation rates at 7% compared to patients who did not (9.8%), and Lutjeboer et al. (2015)'s quasi-experimental prospective study showed that procedure deviations decreased significantly (from 0.39 to 0.06), especially in cancellation among patients who received pre-procedure visits (Table 1). Several studies identified the effectiveness of APRN in-person and / or telephone pre-procedure assessment visits as evidenced by successfully lowering cancellations for same-day surgeries (Smigorowsky et al., 2020; Varughese et al., 2013; Teh et al., 2016). The study by Sebach et al. (2015) illustrated that the APRN group had only an 0.8% cancellation rate compared to PCP group, which had 7.7%. In another study, Teh et al. (2016) showed that the cancellation rate was reduced to 0% after implementation of the APRN telephone pre-procedure assessment. While both Teh et al. (2016) and Wittkugel and Varughese (2015) included RN-led pre-procedure assessment and also demonstrated effectiveness of the screening process, the participants were limited to healthy patients or low acuity American Society of Anesthesiologists (ASA) I category.

Duration from Referral to Procedure

None of the articles in this review collected duration from referral to procedure as an outcome measurement. Standard of practice in most surgical specialties is an initial consultation with the surgeon to review the diagnosis and planned procedure. Many of the studies reviewed evaluated surgical cancellations using an RN or APRN clinic. The diagnosis was already confirmed and patients were receiving surgical intervention so the duration from referral to procedure cannot be measured. However, IR studies could measure this outcome variable

between pre-procedure clinic evaluation versus other types of screenings because most IR biopsy procedures are often performed to confirm or dispute a diagnosis. The project assessed this important outcome measure as delays in IR procedures can effect delays in diagnosis and initiation of treatment. This is particularly important in the oncology population where delays can be life threatening.

Cost-effectiveness

Besides improvement in procedure deviations and cancellation with implementation of APRN pre-procedure IR clinic visits, this type of clinic service also increased patient volumes, procedure conversions, and department revenues. Edalat et al. (2017) and Sebach et al. (2015) demonstrated the potential cost-effectiveness of pre-procedure clinic. The data collected from Edalat et al. (2017) showed a significant increase in patient volume (112%), clinic revenue generated (158%), and procedural revenue generated (228%). The APRN-managed pre-operative clinic was able to save almost 50% of lost revenue from successfully lowering cancellation cases (Sebach et al., 2015). The Return on Investment (ROI) of the IR clinic implementation had positive effects on cost saved from reduced cancellation and revenues generated from increased clinic patient volume. Furthermore, the indirect benefit of this project also saved time for RNs in lengthy phone calls and coordination and provided expedited patient care services. While an RN pre-procedure assessment had positive impact on cancellation rates and screening effectiveness, the APRN pre-procedure clinic had an added value which was the reimbursement of its professional fees generating revenues for the department (Edalat et al., 2017). Furthermore, the APRN role in pre-procedure clinics promotes IPC practice in facilitating process improvement in outpatient procedures so IR can provide timely service and reduce hospital costs from unnecessary admission or repeat procedures.

Other Outcomes Measures

Patient safety and efficacy were demonstrated in two studies related to the benefit of APRN pre-procedural clinics (Lutjeboer et al., 2015; Rubenstein et al., 2016) (Table 1). Rubenstein et al. (2016) suggested that the majority of patients / parents believed the clinic consultations were useful and prepared them adequately for what to expect on the day of procedure. The logistics of obtaining consents can be challenging in an IR environment due to the setting and secondary referral from another clinician. Pre-procedure clinic visits can provide the opportunities to obtain informed consents and give the patients enough time to consider their options in a non-rushed environment. It is imperative that patients are fully informed and be provided with sufficient time to weigh the risks and benefits of the procedures (Lutjeboer et al., 2015; Rubenstein et al, 2016).

Gaps in the Literature

The major gaps identified in the literature were related to no findings in APRN-led IR pre-procedure clinics on cost and limited comparison of APRN-led versus RN-led pre-procedure clinic. Other gaps include the Hawthorne effect, lack of randomized control trials, sampling bias, and lack of measurement in duration from referral to procedure or overall outpatient referral process. Some studies provided evidences in efficacy of APRN-led pre-procedure clinic, however, there were no study that analyze APRN-led IR clinic or differences of APRNs versus RNs (Sebach et al., 2015; Teh et al., 2016; Wittkugel & Varughese et al., 2015). The Hawthorne effect could have affected the outcome related to the human factor in which staff performance could be heighten (e.g., more vigilant screening and customer service) during the study period (Lutjeboer et al., 2015; Rubenstein et al., 2016). Furthermore, studies were not randomized-controlled trials that could have contributed to a higher level of evidence. One prospective study

lacked a comparison group (Rubenstein et al., 2016) while others were able to use nonequivalent comparison groups (not assigned based on condition, period of time assessed or exposure to intervention) (Lutjeboer et al., 2015; Sebach et al., 2015). Some studies used historical controls as a comparison group which could reflect the medical or procedure era verse the intervention. Sampling bias was another concern that could have affected the study findings, such as the inclusion of only English-speaking or healthy patients (Rubenstein et al., 2016, Sebach et al., 2015; Tan et al., 2019; Wittkugel & Varughese, 2015). Lastly, there were no studies that measured duration from referral to procedure and only a few studies that assessed the effectiveness of APRN pre-procedure clinics in the IR specialty. The objective of this project was to provide additional supporting evidence in the effectiveness of an IR pre-procedure clinic, especially in APRN-managed program, to contribute to the nursing literature.

CHAPTER FOUR: METHODS

The project evaluated cancellation rates, duration from referral to procedure, and cost-effectiveness with the implementation of an APRN-driven pre-procedure clinic. The clinic provided a consistent pre-procedure evaluation process and ensured patients were medically optimized for undergoing IR procedures.

Design

A comparative design was used for this project with an RN group (telephone screening) and APRN-group (pre-procedure clinic). Retrospective chart review data was collected from the electronic medical records (EMR) on group characteristics and the outcome variables.

Institutional review board (IRB) application for category 5: Research involving materials that have previously been collected for non-research purpose was submitted at the study site for this

project. Informed consents were waived due the retrospective nature of the study with no direct patient contact and all data was collected de-identified.

Sample and Setting

A convenience sampling method was used to select participants for this project. The setting was a single IR department at an academic teaching hospital in Southern California. All outpatient IR biopsy referrals who either received telephone screening by RNs or pre-procedure in-person/telehealth visit by an APRN during the period of August 2019 to January 2020 and August 2020 to January 2021 were included in the review.

Inclusion / Exclusion Criteria

All outpatient biopsy referrals (except thyroid, bone and muscle biopsies which are done in another radiology department) who were 18 years and older were included in the project. Combination procedures (e.g., renal mass biopsy with cryoablation or liver mass biopsy with microwaves ablation) and patient procedures that occurred during the COVID surge between February, 1 2020 and July 1, 2020 were excluded in the project.

Sample Size

A power analysis based on both the cancellation rates and cost were used to justify the sample size of 90 (45 pre- and 45 post-) subjects to detection a moderate to large effect size (0.6) on an independent sample *t*-test at a *p*-value of 0.05, and a power of 0.80 (G*Power, 3.1). We will determine effect size if statistical significance is not achieved with our analyses.

Data Collection Instruments

Two data collection instruments / forms were used to extract data for this project:

- **EMR:** The EMR is considered a standard or a valid method to obtain clinical and demographic data. Reliability was established via inter-rater reliability (IRR), two

blinded reviewers, independently extracting data from the EMR on 9 randomly selected subjects (10%); if their results have > 90% agreement, then the EMR data collection will be determined to be reliable. The IRR for this projects was 93% agreement for EMR data extraction.

- **Financial Office Current Procedural Terminology (CPT) and Salary Codes:**

Individual CPT and employee hourly wage codes are considered a standard or a valid method to obtain departmental billing / financial costs in the clinical settings. Reliability was established via IRR, two blinded reviewers, independently collected and calculated the estimated costs on 9 randomly selected subjects (10%); if their results have > 90% agreement, then the data collection will be determined to be reliable. The IRR result showed 100% agreement in calculation of estimated cost based on CPT codes.

Data Collection

Retrospective chart review data was collected from the EMR system. Demographic data of outpatient biopsy cases including age, gender, ethnicity, ASA classification, type of insurance, type of visit, and type of biopsy were recorded for both RN group and APRN group to assess for patient differences between groups (Appendix A). Information on RN and APRN age, education, nursing experience, IR experience, and job status (full-time and part-time) were collected to describe for providers' differences between groups (Appendix B). Numbers and reasons of same-day IR cancellations were collected for RN group and APRN group for comparison (Appendix C). Reasons for cancellation were categorized into three separate groups, patient factor, physician / surgeon factor, or health system related factors (Appendix C). *Patient factors* included incomplete evaluation (e.g., cardiac clearance, anesthesia clearance, missing / abnormal lab, blood pressure / blood glucose not controlled, not holding certain anticoagulants, or not

taking pre-medication), NPO violation, acute illness, late / no show, ride / no time off, patient cancel, and insurance. *Physician factors* were unavailability of IR physicians or anesthesiologists either due to illness or other emergent cases or sedation change and sedation change. *System factors* included unavailability of IR suites, malfunction / missing equipment / missing imaging, nurses / technologist shortage, or wrong scheduling.

Duration from referral to procedure (measured in days) were collected in RN group and APRN group for comparison (Appendix A). Referral date was defined as the day when a referring provider entered an IR consult in the computer system and procedure date as the day of the scheduled procedure. These dates were subtracted to calculate the duration from referral to procedure.

Lastly, cost-effectiveness (measured in dollars) was calculated based on the sum of procedure reimbursement, facility cost (direct + indirect cost), physician procedure pro-fee, clinic Evaluation and Management (E&M) reimbursement, and cost of screening (APRN vs. RN) (Appendix D). The CPT codes assigned for specific outpatient IR biopsy procedure including the types and modalities were used to search the procedure reimbursement. The average procedure reimbursement and facility cost were based on fiscal year (FY) 2019 (July 2018 – June 2019) data. Direct cost was described as produced revenue and performed services or supplies billable to a patient and nursing care. Indirect cost was described as equipment and spaces that were required to operate the business, ancillary staff, human resource, or information technology. Clinic visit reimbursement from E&M was estimated based on Level II-III visits. Cost of screening was calculated based on type of screener (APRN vs. RN) and average hours spent preparing a case. In RN group, the average time spent to screen a patient was two hours per patient versus one hour per patient in APRN group. The final estimate cost in IR department due

to cancellations was calculated based on estimate IR department cost per procedure multiply by the number of cancellations per group (RN vs. APRN). The cost-savings between groups was compared.

Timeframe / Process

The RN group (telephone screening) data collection of outpatient biopsy cases was collected retrospectively from **August, 1 2019 to January 1, 2020** (5 months). These biopsy cases were prepared by referring services and screened by RNs via a telephone screening (Figure 4). The RN's also assessed for sedation risks and completed an anesthesia screening form, entered blood tests (if needed), and provided pre-procedure instruction. When the patient required additional clearance, imaging, or medical optimization, the RNs contacted the referring provider for orders / prescriptions or instruct the patient to obtain necessary records.

The APRN group (pre-procedure clinic) data collection occurred from **August 1, 2020 to January 1, 2021** (5 months). In the APRN group, the provider conducted an in-person or telehealth visit. The visit included history and physical (for in-person visits), sedation evaluation, anesthesia screening, and a detailed discussion of the biopsy procedure to be performed. In addition, APRN reviewed images, obtained procedure consent, referred for additional clearance or tests when required, temporarily managed acute / chronic illness for medical optimization, prescribed pre-procedure medications, and provided pre- and post- procedure instruction at the end of the visit (Figure 5).

Primary Outcomes

The independent variable for this project was the type of pre-procedure evaluation (either RN telephone screening or APRN pre-procedure clinic). The dependent variables were the numbers and reasons of cancellation (measured in cases), the duration from referrals to

procedures (measured in days), and cost-effectiveness (measured in dollars). Demographic data of patients were used for baseline sample characteristics (Appendix A) and RNs and APRN level of education and work experience to assess group differences (Appendix B). The expected outcome was that the pre-procedure clinic will reduce same-day IR procedure cancellations and / or decrease duration from referral to procedure and is cost-effective.

Statistical Analysis

Using IBM SPSS Statistic 26.0 software (Chicago, IL), descriptive statistics (mean, SD, percentages) was used to describe patients and providers differences between groups. Outcome measurements were evaluated below:

- Same-day Cancellation (Yes or No) and reason for cancellation (1 = patient, 2 = physician, and 3 = system) described using numbers and percentages and compared between groups using an independent sample *t*-test.
- Duration from referral to procedure (number of days) described using means with standard deviation and compared between groups using an independent sample *t*-test.
- Cost-effectiveness (dollars) described using means with standard deviation and compared between groups using an independent sample *t*-test.

CHAPTER FIVE: RESULTS

A total of 111 IR biopsy patients were included in the study review period with 64 in the RN group and 47 in the APRN group. The patient characteristics between groups are listed in **Table 2**. There were no statistically significant differences between the RN and APRN group except for visit type. The RN group was 100% telephone pre-procedure screening while the APRN group had 51% in-person verses 49% video pre-procedure clinic visit secondary to the

COVID pandemic. The majority of patients in both groups are ASA classification III and IV categories.

The RN (n=3) and APRN (n=1) provider group characteristics are listed in **Table 3**. The RN group had either a bachelor's or master's degree in nursing, approximately 10 years' RN and five years' IR experience, and over 50% working part-time. The only APRN had a master's degree, five years' RN and three years IR APRN experience, and works full-time.

Cancellations, days to procedure and lost revenue between RN and APRN group are listed in **Table 4**. The APRN group (pre-procedure clinic) showed reduced cancellations (9 vs.18, $p = 0.018$), fewer days to procedure (21.3 ± 18 vs. 36.2 ± 21 , $p < 0.001$), and less lost revenue (\$82,818 vs. \$160,956, $p < 0.001$) compared to the RN (telephone screening) group, respectively. The project reduced the estimated cost by \$78,138 (49%, $p < 0.001$) in cancellations over the five months of this project.

Reasons for cancellation in both groups are listed in **Table 5**. The most common reasons for cancellation were patient related factors (84% in the RN group and 56% in the APRN group). In the RN group, lack of medical optimization (elevated blood pressure; $n = 4$) was the main reason for patient factor cancellations whereas as in the APRN group it was acute illnesses ($n = 4$). Although the APRN group had lower cancellations due to patient factors, there were higher cancellations due to physician and systems factors than the RN group.

CHAPTER SIX: DISCUSSION

This project demonstrated that an APRN pre-procedure clinic was associated with improving cancellation rates, decreased time from referral to procedure, and improved cost effectiveness compared to RN telephone screening. These findings were comparable to previous studies which showed a reduction in outpatient procedural cancellation related to an APRN pre-

procedure visits (Lutjeboer et al., 2015; Rubenstein et al., 2016; Sebach et al., 2015; Tan et al., 2019; Teh et al., 2016; Wittkugel & Varughese, 2015). In addition, the majority of screeners in our study had advanced education and greater than three years of IR experience; thus, the findings suggest that our results were less likely due to staff education or experience.

Though the APRN group cancellation rate was slightly above the project goal (10%), one possible explanation for this finding may be that data collection for the APRN group occurred during a national pandemic with the most prominent reason for cancellation being acute illness. Patients' conditions could have worsened due to delay in seeking care or COVID infection. In the RN group, over a third of the cancellations were due to lack of medical optimization in patients with chronic medical conditions, in particular uncontrolled hypertension or missing laboratory studies. This finding is consistent in previous studies that suggest "ineffective planning" (e.g., financial or insurance issues, incomplete surgical work-up or missing labs, lack of medical optimization or stabilization of chronic medical conditions) to be one of the main reasons for IR procedure cancellations or inefficiency (Kaddoum et al., 2016; Lutjeboer et al., 2015; Morbi et al., 2012; Tan et al. 2019). In addition, cancellation due to acute illnesses were high in both RN and APRN groups. In the current practice setting, patients were already screened days or even weeks before the procedure date and their conditions could have either changed or deteriorated. Unlike the study in Teh et al. (2016), surgery cancellation rate was down to zero from an assessment phone call three days prior to surgery that allowed the opportunity to identify contraindications especially in acute illness.

Another interesting finding of this project was the reduction in days from referral to the actual procedure in the APRN group. Unfortunately, there is very little information on this important outcome measure that can potentially affect the timing of treatment and patient

outcomes. This could reflect the lack of literature in the IR population with using an RN verses APRN pre-procedure screening or clinics. The IR specialty is often focused on confirming or seeking a diagnosis where surgical or anesthesia pre-procedure clinics are often treating a diagnosis. This project provides a new finding related to the reducing the number of days to procedure in an APRN pre-procedure clinic. This attests to the efficiency of the APRN role to provide medical optimization, identify early contraindications, ordering and following through with diagnostic and laboratory testing, adjusting medications or treatments, and expediting the facility or approval processes compared to the lack of autonomy or limitations in the RN role. However, some studies did demonstrate the RNs' capability of appropriately and safely screening low acuity patients (Teh et al., 2016; Wittkugel & Varughese, 2015). In our project, the majority of patients the RN's screened were ASA classification III and IV which represent a higher acuity and more complex screening compared to the previous studies. Other studies have endorsed the APRN provider in the pre-procedural clinical setting to improved patient outcomes, identified early contraindication, and facilitated procedure planning (Chavez et al., 2017; Sebach et al., 2015; Teh et al., 2016; Woo et al., 2017).

Cost effectiveness that was measured by estimated loss in dollars of cancelled cases was greatly improved due to lower cancellation rates, less time screening by the APRN group, and additional E&M reimbursement for APRN provider screening visits. Our findings showed almost an \$80,000 cost savings for the five months of this project. This calculates to a potential cost savings of approximately \$200,000 projected over one year. One study reported saving double in lost revenue by using APRN's to screen patients resulting in lower cancellation rates compared to primary care providers screening (Sebach et al., 2015). Furthermore, another study in a pediatric IR department, identified APRN pre-procedure clinic visits that were able to be

reimbursed which increased revenue (Edalat et al., 2017). Although the study was not able to compare the clinic revenue given there were no prior established APRN clinics in IR, the estimated E&M reimbursement for the APRN clinic visits was \$12,972 for the department during the period. Overall, the pro forma of APRN pre-procedure clinic not only lowered costs from improvement in procedure cancellations but also increased revenues from clinic E&M visits.

Limitations

The smaller sample size and potential selection bias in the APRN compared to the RN group due to scheduling issues limited the project. We did not meet our target sample for the APRN group due to the department's lack of scheduling all biopsy patients for the pre-procedure clinic. In addition, 15 patients received APRN pre-procedure clinic screening but were not included in the analyses secondary to not being scheduled for an IR procedure (e.g., lack of insurance / case approval or patient refusal). However, even with a smaller number of APRN subjects, the project results still achieved statistical significance in all outcome measurements demonstrating a large effect size.

The duration from referral to procedure was significantly shorter in APRN group compared to RN group could have been related to almost 50% of outpatient biopsy referrals were requested as urgent which requires less than 72 hours turnaround time and cases were being approved promptly due to additional support from two newly-hire IR physicians.

Lastly, only outpatient biopsies were included in the chart review instead of all IR outpatient procedures, which could affect the generalizability. Many biopsy patients were typically higher acuity (85% ASA III-IV); hence, the complexity of these patients may contribute to higher cancellation rates than others with lower acuity volumes despite APRN pre-procedure

screening. Another project limitation could be the effect of the COVID-19 pandemic either due to active infection or worsening of condition causing delays in seeking treatment.

Clinical Implication

The APRN pre-procedure clinic improves procedure cancellation and shorten the duration from referral to procedure potentially expediting diagnosis and treatment. These findings support the benefit of an APRN pre-procedure clinic in the outpatient biopsy IR setting. The advanced planning, medical optimization, closed-loop patient care coordination provided by APRNs have shown to make a positive impact in patient care and cost-effectiveness by saving lost revenue. These outcomes highlighted the value of the APRN in this subspecialty practice and provides supportive evidence in expansion of the APRN group in order to offer pre-procedure visits to all outpatient IR procedures.

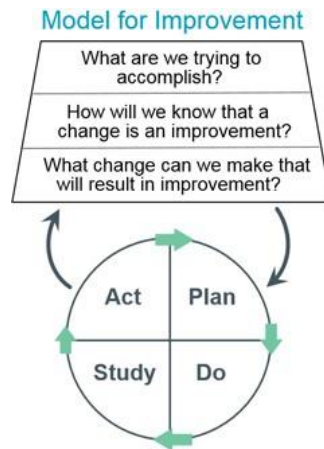
CONCLUSION

Our findings show that an APRN pre-procedure clinic is effective in reducing same-day procedure cancellations, days to procedure (expediting diagnosis and treatment), and is cost-effective to the institution. This QI project fills an important gap in the literature regarding non-surgical subspecialty APRN pre-procedure clinics, in particular interventional radiology, and their effectiveness to improve system throughput and patient outcomes. Future expansion of the APRN staff is needed to provide coverage for all IR procedures performed and not solely biopsies. Ultimately, this QI project will need to be replicated in the to verify our findings and to assess outcomes based on all types of IR procedures continuing the PDSA cycle for system changes to improve patient outcomes.

APPENDICES

Figure 1

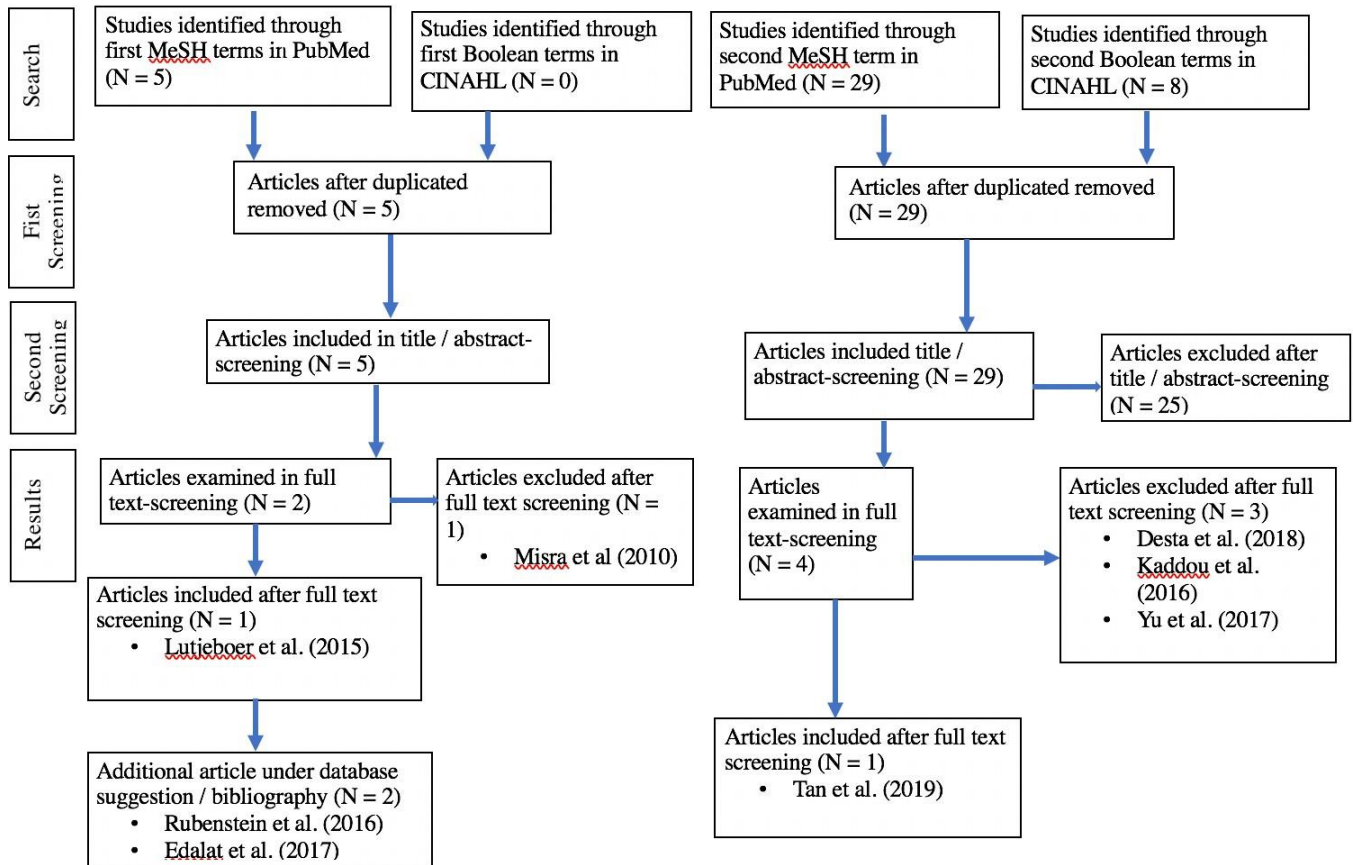
Model for Improvement and PDSA Cycle



Source: Langley, G. L., Moen, R., Nolan, T. W., Norman, C. L. & Provost, L. P. (2009). *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance* (2nd ed.). San Francisco: Jossey-Bass Publisher.

Figure 2

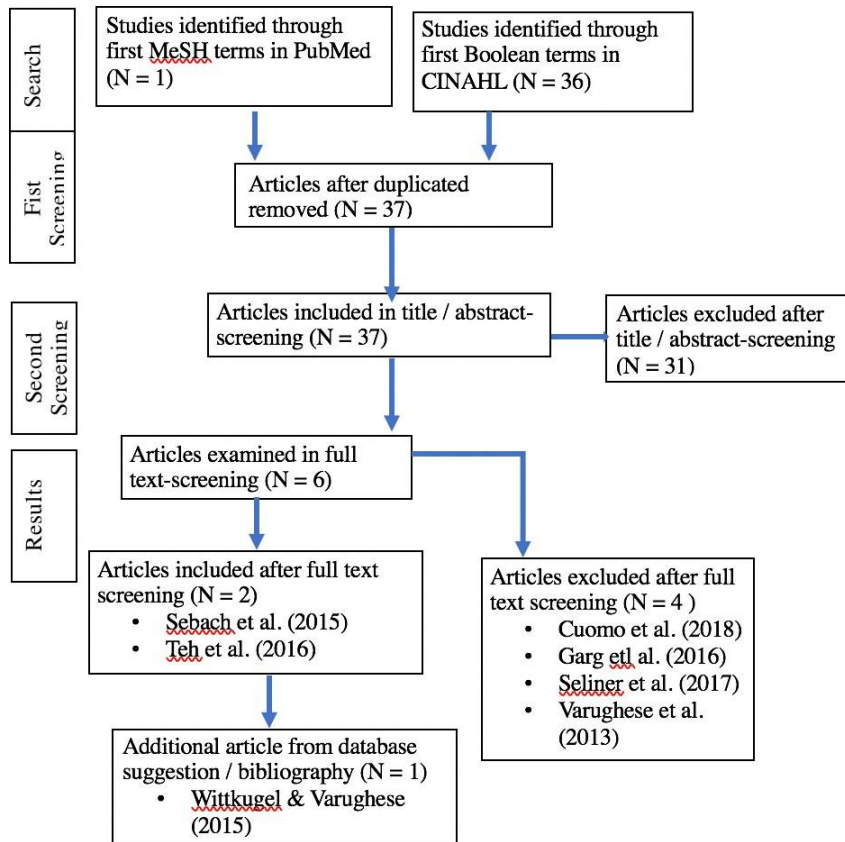
PRISMA Flow Diagram of Literature Review Process for IPD



Note. IPD = Individual Patient Data; PRISMA = Preferred Reporting Items for Systematic reviews and Meta-Analyses.

Figure 3

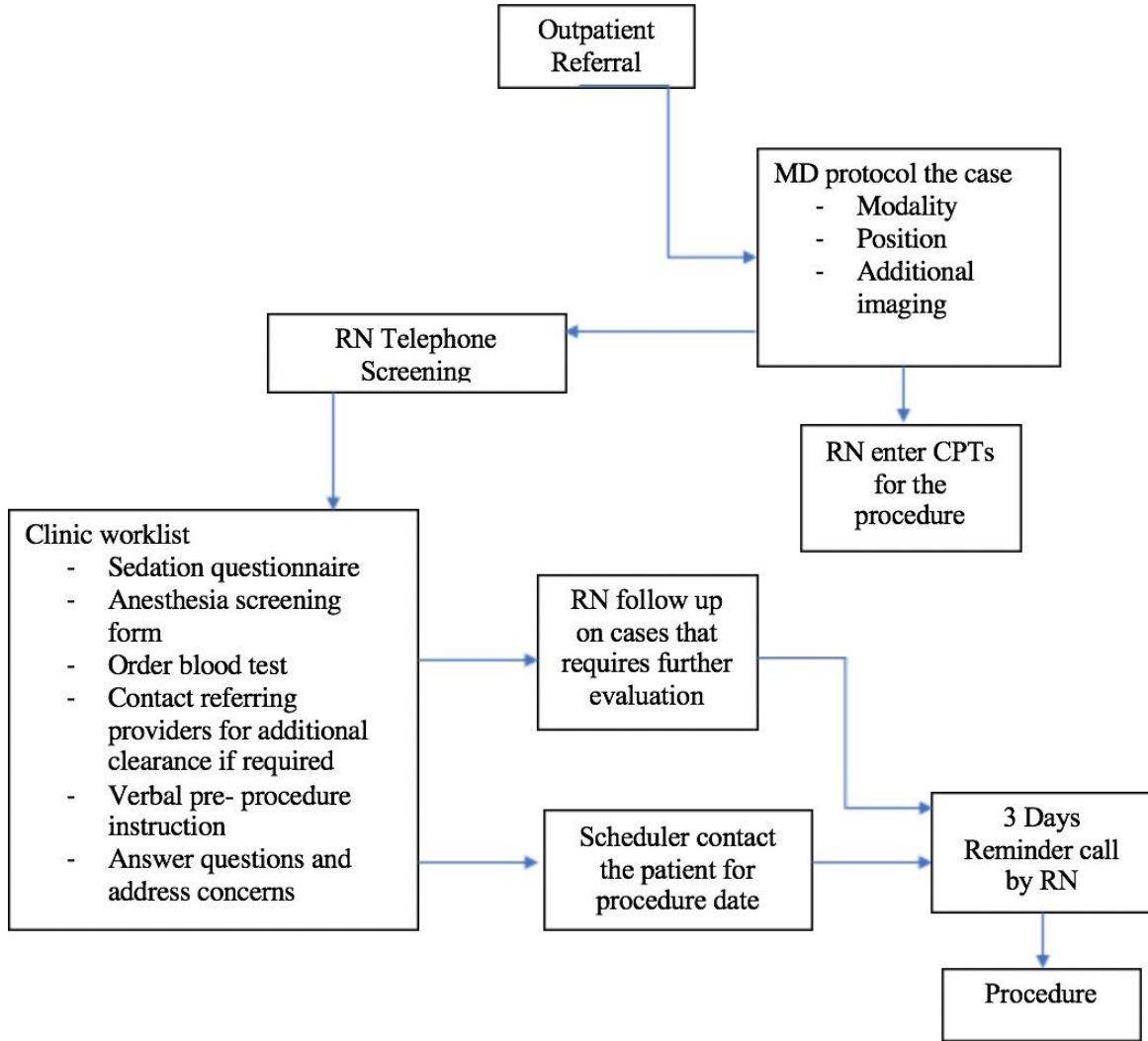
PRISMA Flow Diagram of Literature Review Process for IPD



Note. IPD = Individual Patient Data; PRISMA = Preferred Reporting Items for Systematic reviews and Meta-Analyses.

Figure 4

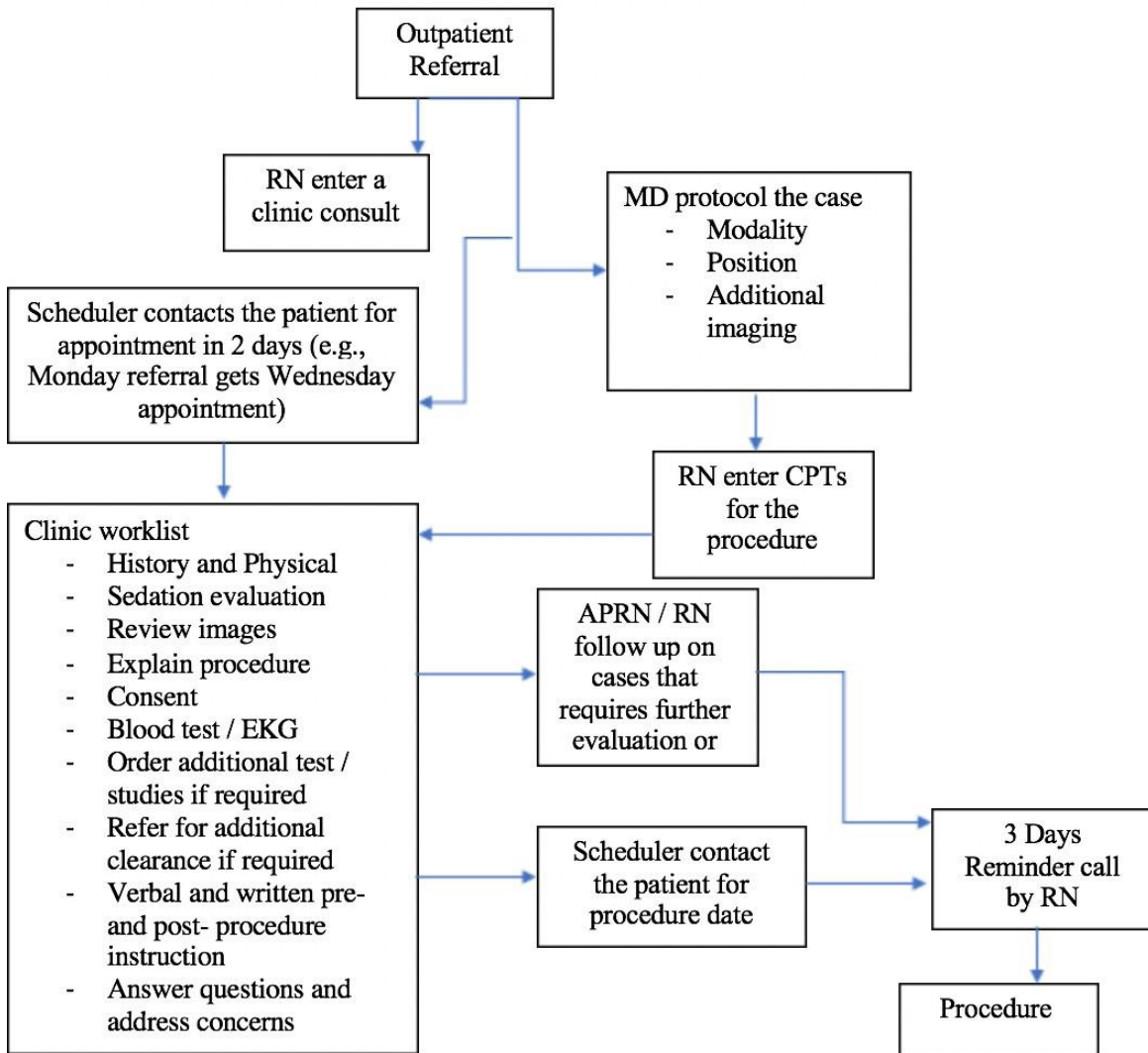
RN Group Telephone Screening Flow Sheet



Note. CPT = Current Procedural Terminology; MD = Medical Doctor; RN = Registered Nurse.

Figure 5

APRN Group APRN Pre-procedure Clinic Visit Flow Sheet



Note. APRN = Advanced Practice Registered Nurse; CPT = Current Procedural Terminology; EKG = Electrocardiogram; MD = Medical Doctor; RN = Registered Nurse.

Table 1

Table of Evidence

CITATION	PURPOSE	SAMPLE/SETTING	METHODS (Design, Intervention, Measures)	RESULTS	DISCUSSION, INTERPRETATION, LIMITATIONS
<p>Tan, A., Chiew, C. J., Wang, S., Abdullah, H. R., Lam, S. S., Ong, M. E., Tan, H. K., & Wong, T. H. (2019). Risk factors and reasons for cancellation within 24H of scheduled elective surgery in an academic medical centre: A cohort study. <i>International Journal of Surgery</i>. 66, 72-78. http://doi.org/10.1016/j.ijssu.2019.04.009</p>	<p>retrospective cohort study to identify reasons for cancellation within 24 hours of scheduled surgeries.</p>	<p><u>Sample:</u> N = 4,060, adult > 18y/o who were scheduled for elective surgery. Orthopedic surgery (38%), Colorectal (11%), General surgery (9%). <u>Median age:</u> 68y/o <u>Gender:</u> male(44%) <u>Ethnicity:</u> Chinese (80%) <u>Socio:</u> Singapore citizens (98%), subsidized (66%), Medifund assistance (2%). <u>Setting:</u> main operating</p>	<p><u>Design:</u> De-identified electronic medical records were reviewed. The association between patient, surgeon, and system factors from time of listing for surgery, proceeding with surgery, or late cancellation (24 hours of scheduled surgery) were analyzed from 06/2015-12/2016. <u>Variables:</u> <u>Patient factors:</u> Age, gender, ethnicity, resident status, socioeconomic status. <u>Surgeon factors:</u> Admitting department, seniority of the operating surgeon. <u>System factors:</u> Timing, duration, location, types, preoperative anaesthesia clinic. <u>Other factors:</u> Public holiday, cultural significant period, school holiday. <u>Exclusion:</u> Patients with multiple surgeries (only</p>	<p>9.8% cancellation within 24 hours of surgery <u>Univariate analysis:</u> Males > females (11 vs 9%), non-Chinese ethnicities > Chinese (Malays 16%, Indians 14%), low socioeconomic had higher rates. <u>73% Patient factors:</u> 39% medically related (heart failure, chronic kidney disease, history of hip fracture, low socioeconomic status, history of cancelled surgeries, scheduled time in the afternoon and scheduled time in the evening. Reduced cancellations on</p>	<p><u>Interpretation:</u> Patient behavior (non-compliance), socioeconomic factors, chronic medical conditions (heart failure, ESRD, hip fracture) were the identified causes of 24 hours of scheduled surgery cancellation. Patients who attended preoperative assessment clinics had lower cancellation rate. Morning surgeries and more complex surgeries were less likely cancelled. <u>Discussion:</u> Significant portion of same-day cancellations were related to patients</p>

		theater or ambulatory surgical center of	the first surgery was included), minor surgery with local anesthesia, urology procedures, and patients without prior admission.		
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		Singapore General hospital at an urban city in Singapore.	<p><u>Measurement:</u> Numbers and reason of cancellation within 24 hours of the scheduled surgery.</p> <p><u>Instrument:</u> Data was analyzed using univariate and multivariable logistic regression to compare surgical cancellation and predictors in patient, surgeon, or system factors.</p>	<p>patients who went to preoperative anesthesia assessment clinic, morning surgery, and complex surgeries.</p> <p><i>2.5% Surgeon factors</i></p> <p><i>20% System factors</i></p> <p><u>Multivariate analysis:</u> Patients with low socioeconomic status, co-morbidities, and history of previous cancellations were associated with cancellations (c-statistic of 0.7).</p>	<p>medical conditions. More in-depth analysis should be studied to identify treatable causes of cancellations.</p> <p><u>Limitations:</u> Single center setting and sampling bias due to patients with prior admissions were excluded.</p>
Lutjeboer, J., Burgmans, M. C., Chung, K., & van Erkel, A. R. (2015, June). Impact on patients safety and satisfaction of implementation of an	Quasi-experimental prospective study to determine the effect of outpatient IR pre-procedure	<p><u>Sample:</u> N = 220, pre- and post- quasi-experimental study with n = 110 for control and n = 110 for experimental.</p> <p><i>Age:</i></p> <p>Control: 56.6 (SD</p>	<p><u>Design:</u> PS and PSAT were assessed in patients undergoing elective IR procedure before and after implementation of the IR outpatient clinic between 04/2013-01/2014.</p> <p><u>Exclusion:</u> unwilling to visit the IR clinic, patients undergoing the following IR procedures (endovascular aortic repair, cerebral intervention,</p>	<p>PS: Number of process deviations per patient 0.06 for experimental group and 0.39 for control group ($p < 0.001$).</p> <p>PSAT: Higher Likert score 2.69 (SD 0.314) for experimental group</p>	<p><u>Interpretation:</u> PS and PSAT improved when patients received outpatient IR pre-procedure clinic visits.</p> <p><u>Discussion:</u> Pre-procedure clinic evaluation for elective IR procedures</p>

outpatient clinic in		16.1),			
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<p>interventional radiology (IPSIPOLI-Study): A quasi-experimental prospective study. <i>Cardiovascular and Interventional Radiology</i>, 38(3), 543-551. https://doi.org/10.1007/s00270-015-1069-4</p>	<p>clinic visit in improving patient safety (PS) and patient satisfaction (PSAT).</p>	<p>experimental: 57.9 (SD 14.7) <i>Gender:</i> Control: 63 males, 47 female Experimental: 77 male, 33 female <i>Setting:</i> Single center, radiology department of Leiden University Medical center at Leiden, The Netherlands.</p>	<p>drainage/catheter, combined procedure, and biopsy). <u>Measurement:</u> <i>PS:</i> Measure the number of process deviation by using IR safety checklist from The Cardiovascular and Interventional Society of Europe. <i>PSAT:</i> 19 questions Dutch three dimensions questionnaire. <u>Instrument:</u> Data was analyzed using the SPSS statistic 20. X^2 was used to evaluate the baseline characteristic difference between the two groups and <i>t</i> test was used to measure mean process deviation difference between the two groups.</p>	<p>and 2.48 (SD 0.381) for control group ($p < 0.001$).</p>	<p>improves patient safety and decreases procedure deviations. Practices might defer from other institutions but outcomes can be applicable to many IR centers. <u>Limitation:</u> <i>Hawthorne effect:</i> Staff enhanced their efforts to reduce deviations. <i>Regression-to-the-mean</i> <i>Quasi-experimental design:</i> Results were due to changes in time.</p>
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<p>Rubenstein, J., Zwttel, J. C., Lee, E., Cote, M., Aziza, A., & Connolly, B. L. (2016). Pediatric interventional radiology clinic –How are we doing? <i>Pediatric Radiology</i>, 46, 1165-72</p>	<p>Prospectively study to analyze the care provided by a pediatric interventional radiology clinic from the perspective</p>	<p><u>Sample:</u> N = 111 with n = 91 for quantitative metrics and n = 80 for qualitative survey. Pediatric < 18 y/o who were scheduled for elective IR procedure.</p> <p><u>Setting:</u> quaternary</p>	<p><u>Design:</u> clinic efficiency (quantitative) and family satisfaction (qualitative) were measured in pediatric patients undergoing semi elective or elective IR procedures between 06/2012-11/2012.</p> <p><u>Exclusion:</u> Patient who did not attend the clinic or did not undergo their procedures, and patients/family with significant language barrier.</p> <p><u>Measurement:</u></p>	<p><u>Quantitative data:</u> 91 visits were analyzed with mean duration of 66 minutes (range 15-150 minutes) in a clinic visit, 28 min spent by nurse, 21 min by physician, total wait time of 19 min.</p> <p><u>Qualitative data:</u> 80 respondents and</p>	<p><u>Interpretation:</u> Patient and or parents were satisfied with the clinic efficiency and experiences and found the visits helpful and prepared them for IR procedures.</p> <p><u>Discussion:</u> Pre-procedure IR clinic visits improve patient care experiences and</p>
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	of efficiency and parent satisfaction.	pediatric hospital at Toronto, Canada.	<p><i>Quantitative:</i> Clinic visit with different time components (overall duration, wait time for nurse and physician, time spent with nurse and physician) were recorded.</p> <p><i>Qualitative:</i> Patient/parent satisfaction survey using 5-point Likert scale and free text comments.</p> <p><u>Instrument:</u> Data was analyzed by calculating the means with standard deviation for time components and satisfaction scores.</p>	98% of participants checked 'agreed' or 'definitely agreed' for good overall clinic experiences.	<p>satisfaction when patients are undergoing for elective IR procedures.</p> <p><u>Limitations:</u> Lack of generalizability due to small sample size, some members of the population may be underrepresented due to sampling bias, selection bias due to voluntary participants.</p>
Sebach, A. M., Rockelli, L. A., Reddish, W., Jarosinski, J. M., & Dolan Jr, C. L. (2015). Development of a nurse practitioner--managed preoperative evaluation clinic within a multispecialty orthopedic practice. <i>Journal for Nurse</i>	Prospective study to examine the effects on surgical cancellations and lost revenues in an evidence-based NP managed preoperative evaluation clinic.	<p><u>Sample:</u> N = 5,161 with n = 2,789 (77 cancellations) for RN group and n = 2,372 (36 cancellations) for post intervention group. Adult > 18y/o and both private and public insurance plans.</p> <p><u>Setting:</u> multispecialty</p>	<p><u>Design:</u> Surgical cancellations, process improvement, and lost revenues were analyzed in patients undergoing elective orthopedic surgeries (joint replacement, spinal surgery, sport medicine surgery, hand/wrist surgery) before and after implementation of NP-managed preoperative evaluation clinic between 10/1/2013-12/31/2013 and 10/1/2014-12/31/2014.</p> <p><u>Inclusion:</u> English speaking, competent,</p>	<p><u>Cancellation:</u> 77 out of 2,789 for RN group and 36 out of 2,372 for post intervention group. In the post intervention group, 571 required clearance.</p> <p><u>Clearance:</u> 450 out of 571 received clearance from PCPs and 121 received clearance from NP-managed clinics.</p>	<p><u>Interpretation:</u> Overall cancellation rates improved with implementation of NP-managed pre-operative assessment clinic. Due to reduction in cancellation, the department was able to prevent missed revenues due to cancelled surgeries.</p> <p><u>Discussion:</u> NP-managed clinics have shown cost effectiveness in preoperative care as</p>

<p><i>Practitioners,</i> 11(</p>		<p>orthopedic practice on the East Coast in US</p>	<p>>18 y/o. <u>Exclusion:</u> All others. <u>Measureme</u> <u>nt:</u></p>		
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<p>9), 869–827. https://doi.org/10.1016/j.nurpra.2015.06.006</p>			<p><i>RN:</i> Numbers of surgical cancellation and missed charges due to the cancellations.</p> <p><i>Post intervention:</i> Numbers of patients who required pre-op assessment, surgical cancellation, patients who were evaluated by PCP versus NP, cancellations that were evaluated by PCP versus NP, missed revenues due to surgical cancellation in PCP versus NP.</p> <p><u>Instrument:</u> Variable for each group were examined (age, gender, race, type of insurance, service line). Data was analyzed using X^2 test of independence to study surgical cancellation rates between each group. Post hoc analyses was used to determine adequate power for the detection of a moderate to large effect size.</p>	<p><u>Cancellations for patients who received clearance:</u> 35 (7.7%) cancellations were prepared by PCP and 1 (0.8%) cancellation was prepared by NP-managed clinic.</p> <p><u>Lost revenues:</u> \$386,033 for RN group and \$ 184,480 for post intervention group. Lost revenues attributed to PCP was \$180,204 and NP-managed clinic was \$4,276.</p> <p><u>Statistical significance:</u> $p = 0.007$ in the relationship between preoperative care provider and surgical cancellation.</p>	<p>evidence by reduced surgical cancellations and prevented lost revenues. Additional NPs and modified visit types to consultation can potentially increase reimbursement from the actual clinic visit</p> <p><u>Limitations:</u> Bias due to setting and time spent with patients. More coordinated care and times were spent with NP-managed clinic group than PCP group.</p>
<p>Teh, H. M., Turner, A., Tan,</p>	<p>Pre- and post-study to</p>	<p><u>Sample:</u> N = 445, pre- and post- study with n</p>	<p><u>Design:</u> Same-day of surgery cancellations was measured in patients undergoing elective surgeries before and</p>	<p>Rate of day of surgery cancellation decreased from 4.5%</p>	<p><u>Interpretation:</u> Day of surgery cancellation rate was reduced to</p>

<p>S. B., & Tham, Ch. S. (2016). Effectiveness of an advanced practice nurse-led preoperative telephone assessment. <i>Journal of Nursing Care Quality, 31</i>(2), 191–196. https://doi.org/10.1097/NCQ.000000000000152</p>	<p>determine the APRN-led preoperative telephone assessment in reducing same day of surgery cancellation by evaluating healthy patients and identifying high risk patients for further assessment.</p>	<p>= 200 for pre- and n = 225 for post, adult > 18 y/o patients who were scheduled for elective surgery.</p> <p><u>Setting:</u> Preoperative Evaluation Clinic for Ambulatory Surgery Center in Singapore</p>	<p>after implementation of APRN-led preoperative telephone assessment 3 business days before the scheduled surgery between 08/2014-11/2014.</p> <p><u>Inclusion:</u> ASA I and ASA II patients undergoing general anesthesia or regional anesthesia, BMI < 35, surgeries that do not require blood transfusion, minimal risk of serious complication, procedures that allowed resume po intake soon, or patients with responsible adult caregivers.</p> <p><u>Exclusion:</u> Cognitive or hearing impaired patients and pregnant women.</p> <p><u>Method:</u> RNs conduct telephone assessment on ASA I and APRNs conduct telephone assessment on ASA II using structural questionnaire. Three attempts will be made. On the day of surgery, anesthesiologists will complete the physical exam and determine the case status.</p> <p><u>Measurement:</u> Cancellation</p>	<p>to zero ($p = 0.01$). 225 patients were scheduled for telephone assessment, 200 (88%) received telephone assessment. 187 (93.5%) required no further assessment, 10 (5%) required additional evaluation, and 3 (1.5%) referred to dentists. Average telephone preoperative assessment lasted between 20-30 minutes.</p>	<p>zero after implementation of NP-led telephone assessment to screen and manage patients undergoing elective surgeries.</p> <p><u>Discussion:</u> NP-led telephone assessment with succinct history and evaluation can identify needs for further preoperative assessment for high risk patients and reduce the rate of same day surgical cancellation. Integration of telemedicine evaluation for low risks patients have positive effects on preoperative surgery preparation and same day surgery cancellation.</p> <p><u>Limitations:</u> Single center, lack of generalizability, and the study did not</p>
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			<p>rates of dayof surgery before and after intervention of telephone assessment.</p> <p><u>Instrument:</u> Demographic data was analyzed using descriptive statistics. Data was analyzed using X^2 to evaluate</p>		
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			cancellation rates for pre- and post-intervention.		measure patient satisfaction.
Wittkugel, E., & Varughese, A. (2015). Development of a nurse-assisted pre-anesthesia evaluation program for pediatric outpatient anesthesia. <i>Pediatric Anesthesia</i> , 25(7), 719–726. https://doi.org/10.1111/pan.12640	QI project to assess nurse-assisted pre anesthesia evaluation will provide effective pre anesthesia care.	<u>Sample:</u> 3 anesthesia nurses and 1 anesthesia NP <u>Setting:</u> Liberty outpatient center of Cincinnati Children’s Hospital Medical Center at Cincinnati in US.	<u>Design:</u> Proportion of pre-anesthesia evaluations by anesthesia nurses and cases of unintended outcomes or complications were measured before and after nurse-assisted pre-anesthesia evaluation between 10/14/2010- 9/26/2011. <u>Method:</u> Anesthesia nurse assist with pre anesthesia evaluation (H&P, ROS, patient/family education) and PE was completed by NP. Anesthesiologist complete all pre anesthesia evaluations and makes decisions about case cancellation. <u>Intervention:</u> Anesthesia nurses received education, training, and observation for preoperative evaluation with NPs x 6 weeks before conducting pre anesthesia evaluation independently. <u>Measurement:</u> Proportion of pre anesthesia evaluations by anesthesia nurses. Postoperative respiratory	Percentage of outpatients evaluated by anesthesia nurses increased from zero to 55%. No increased in incidence of postoperative respiratory complication, no decrease in parent satisfaction. Anesthesiologists initially were more satisfied with NP evaluation but no difference after 6 months of study. Anesthesia nurses required 3.8 minutes longer in evaluation than NP. Anesthesia serious event decreased from 4.2 to 2.3/1,000 cases and distress during	<u>Interpretation:</u> No negative effects or serious events in nurse-assisted evaluation that suggested insufficient preoperative assessment. <u>Discussion:</u> Nurse-assisted preoperative evaluation for healthy children undergoing outpatient procedure with anesthesia may be cost effective, safe, and beneficial and thus free-up anesthesiologists to perform more cases/procedures. <u>Limitations:</u> Selection bias in healthy children with low ASA levels. No mention of frequency on anesthesia nurses seeking advice or assistance with NP.

			complication, parent satisfaction with 2 questions, and staff satisfaction and time required for the NP to complete their exams.		
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			<p><u>Instrument:</u> Data was analyzed by calculating the percentage of outpatients and by anesthesia nurses, incidence of postoperative complication, satisfaction score, and average time spent with each patient.</p>	<p>anesthesia induction remained the same.</p> <p>No changes in patient satisfaction or cancellation rate</p>	
<p>Edalat, F., Lindqueter, W.S., Gill, A. G., Simoneaux, S. F., Gaines, J., & Hawkins, C. M. (2017). The effects of expanding outpatient and inpatient evaluation and management services in a pediatric interventional radiology practice. <i>Pediatric Radiology</i>, 47(3), 321–326. https://doi.org/10.1007/s00261-017-0410-1</p>	<p>Chart review to measure the financial and clinical effects through expanding evaluation and management services in both outpatient and inpatient pediatric interventional radiology service.</p>	<p><u>Sample:</u> Non-human subject research using CPT cods(99201-99205, 99241-99245). <u>Age:</u> 0-18 years at the time of clinic visit or hospitalization.</p> <p><u>Setting:</u> Outpatient and inpatient of a single tertiary-care children’s hospital at Georgia in US.</p>	<p><u>Design:</u> Pediatric IR outpatients with CPT codes that identify new patients between November 2014 to August 2015 and inpatient with CPT codes that identify initial consultation and subsequent hospital care between July 2015 and September 2015 were studied. Data was used to compare historical data prior to pediatric IR clinic between 07/2012 and 06/2014.</p> <p><u>Measurement:</u> Number of new patients, procedural conversion rate, estimated clinic revenue, number of procedures, estimate revenues per procedure, and procedure revenues were analyzed.</p> <p><u>Instrument:</u> Relative change in revenue were calculated under Centers for Medicare and Medicaid Service (CMS)</p>	<p><u>Outpatient:</u> 112% (5.5/month) increase in number of new patients. 74% (19% increase) in procedural conversion. 158% increase in clinic revenue per month. 241% increase in numbers of procedure per month. 7% decrease in estimate revenues per procedure. 228% increase in procedure revenue.</p> <p><u>Inpatient:</u> 7.3 procedures per month and 88% procedure conversion rate.</p>	<p><u>Interpretation:</u> Expansion of evaluation and management through outpatient pediatric IR clinic and inpatient consultation increased overall numbers of clinic patients, procedure conversion rate, and clinic revenues.</p> <p><u>Discussion:</u> Dedicated IR clinic provides integrated patient care services, generates additional revenues, improves overall numbers of procedure scheduled.</p> <p><u>Limitations:</u> Medicare claims data might not represent pediatric population</p>

1007/s00247-016-3747-z			and 2015 part B physician fee schedule (MPFS) allowable payment method. Data was analyzed by using paired <i>t</i> test with Microsoft Excel and <i>p</i> -value less than 0.05 was considered statistically significant.		
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					A new hired dedicated pediatric IR physician Short time period Design procedures
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Table 2

Patient Characteristic Based on RN Group (Telephone Screening) vs. APRN Group (Pre-procedure Clinic)

Characteristics	RN Group (Telephone Screening) (n = 64)	APRN Group (Pre-procedure Clinic) (n = 47)	P- Value
Age (mean ± SD)	61.4 ± 15.6	60.0 ± 14.8	.747
Gender n (%)			.879
- Male	28 (43%)	18 (38%)	
- Female	36 (56%)	29 (62%)	
Ethnicity n (%)			.241
- Asian	12 (19%)	12 (25%)	
- Hispanic	20 (31%)	9 (19%)	
- White	29 (45%)	21 (45%)	
- Other	3 (4%)	5 (11%)	
ASA classification n (%)			.396
- I-II	3 (0.5%)	1 (2%)	
- III-IV	52 (81%)	40 (85%)	
- Not identified	9 (14%)	6 (13%)	
Insurance Type n (%)			.195
- Private	12 (19%)	17 (36%)	
- Public	47 (73%)	28 (60%)	
- Research	5 (8%)	2 (4%)	
Type of Visit n (%)			<.001**
- In-person		24 (51%)	
- Video		23 (49%)	
- Telephone	64 (100%)		
Types of Biopsy n (%)			.678
- Renal / Renal Mass	22 (34%) 14 (22%)	12 (25%) 12 (25%)	
- Liver / Liver mass	9 (14%)	6 (13%)	
- Lung / Lung mass	19 (30%)	17 (36%)	
- Lymph node/Soft tissue			

Note. ** $p < .001$

APRN=Advanced Practice Registered Nurse; RN=Registered Nurse.

Table 3*RN / APRN Characteristics*

Characteristics	RN (n = 3)	APRN (n = 1)
Age (years)	39.3 ± 5.0	41
Education		
- Bachelor's Degree	1	
- Master's Degree	2	1
RN Experience (years)	10.7 ± 2.1	5
APRN Experience (years)	N/A	12
IR Experience (years)	5.7 ± 3.2	3
Work Status		
- Full-Time	1	1
- Part-Time	2	

Note. APRN=Advanced Practice Registered Nurse; IR = Interventional Radiology; RN=Registered Nurse.

Table 4

Outcome Variables Based on RN Group (Telephone Screening) vs. APRN Group (Pre-procedure Clinic)

Characteristics	RN Group (Telephone Screening) (n = 64)	APRN Group (Pre-procedure Clinic) (n = 47)	P-Value
Cancellation n (%)			.013*
- Yes	18 (28%)	9 (19%)	
- No	46 (72%)	38 (81%)	
Referral to Procedure (# days; mean \pm SD)	36.2 \pm 20.8	21.0 \pm 17.3	<.001**
Lost Revenue in Cancelled Cases	\$160,956	\$82,818	<.001**

Note. * $p < 0.05$; ** $p < .001$

APRN=Advanced Practice Registered Nurse; RN=Registered Nurse.

Table 5

Reasons for Cancellation by RN Group (Telephone Screening) vs. APRN Group (Pre-procedure Clinic)

Reason	RN Group (Telephone Screening) (n = 18)	APRN Group (Pre-procedure Clinic) (n = 9)
Patient Factors		
- Missing lab	1	
- Abnormal lab	2	
- Elevated Blood pressure	4	
- Not holding medication	1	
- Acute illness	3	4
- Late/no show/no ride	3	
- Patient cancel	1	
- Insurance	1*	1
Physician Factors		
- Provider cancel		2
- Sedation change	2	1
System Factors		
- Not scheduled correctly (no longer needed)	1	
- Poor imaging		1

Note. *Two reasons for cancellation

APRN=Advanced Practice Registered Nurse; IR = Interventional Radiology; RN=Registered Nurse.

Appendix A

Patient Demographic Data

Characteristic	RN Group (Telephone Screening) (<i>n</i> = 45)	APRN Group (Pre-procedure Clinic) (<i>n</i> = 45)
Age (mean ± SD)		
Gender n (%)		
- Male		
- Female		
Ethnicity n (%)		
- Asian		
- Black		
- Hispanic		
- Other		
- White		
ASA classification n (%)		
- I-II		
- III-IV		
- Not Identified		
Type of insurance n (%)		
- Public		
- Private		
- Research		
Type of visit n (%)		
- In-person		
- Video		
- Telephone		
Types of biopsy n (%)		
- Renal / Renal Mass		
- Liver / Liver Mass		
- Lung / Lung Mass		
- Lymph node / Soft Tissue		
Cancellation n (%)		
- Yes		
- No		
Referral to Procedure (# days; mean ± SD)		
Estimate Lost Revenues in Cancelled Cases		

Note. APRN = Advanced Practice Registered Nurse; ASA = American Society of Anesthesiologists RN = Registered Nurse.

Appendix B

RN / APRN Characteristic and Experience Data Collection Form

RN Group RN Experience Data Collection Form

Characteristic	Answer	Total number ($n = 3$)
Age (years)		
Education		
- Associate Degree		
- Bachelor Degree		
- Master Degree		
RN Experience (years)		
RN IR Experience (years)		
Work Status		
- Full-Time		
- Part-Time		

APRN Group APRN Experience Data Collection Form

Characteristic	Answer	Total number ($n = 1$)
Age (years)		
Education		
- Master Degree		
RN Experience (years)		
APRN Experience (years)		
APRN IR Experience (years)		
Work Status		
- Full-Time		
- Part-Time		

Note. APRN=Advanced Practice Registered Nurse; IR = Interventional Radiology;
RN=Registered Nurse.

Appendix C

Reason for Cancellation Data Collection Form

Reason	RN Group (Telephone Screening) (n = 45)	APRN Group (Pre-procedure clinic) (n = 45)
Patient Factors		
<ul style="list-style-type: none">- Cardiac clearance- Anesthesia clearance- Missing lab- Abnormal lab- Elevated blood pressure- Not holding anticoagulants- Not taking pre-medication- NPO violation- Acute illness- Late- No show- No ride		
Physician / Surgeon / Anesthesiologist Factors		
<ul style="list-style-type: none">- Illness- Emergent cases		
System Factors		
<ul style="list-style-type: none">- IR suites unavailability- Malfunction / missing equipment- Nurses / technologist shortage- Not scheduled correctly		

Note. APRN=Advanced Practice Registered Nurse; IR = Interventional Radiology;
RN=Registered Nurse.

Appendix D

Cost Estimate for Interventional Radiology Department

	RN Group (Telephone Screening)	APRN Group (Pre-procedure clinic)
Procedure Reimbursement	\$2,326	\$2,326
Facility Cost	\$5,913	\$5,913
Clinic Visit Reimbursement	N/A	\$148
Physician Procedure Pro-fee	\$597	\$597
Screener (RN \$53/hours; APRN \$90/hours)	\$106	\$90
Estimate Total Cost	\$8,942	\$9,074

Note. APRN=Advanced Practice Registered Nurse; RN=Registered Nurse.

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