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IDENTIFYING TRANSFER OF CARE GAPS: ELECTRONIC HEALTH RECORD CAPTURE OF PERIOPERATIVE HANDOFF COMMUNICATIONS

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ABSTRACT

Transitions in patient care are held together by interdisciplinary handoff communications intended to coordinate the patient's ongoing care requirements. Patients with complexity in care encumber the transfer of care process requiring a higher level of care coordination between the interdisciplinary team (Coleman, 2003; Naylor et al., 2004). While the literature is abundant on the characteristics and quality of handoff communications, it is limited on the requirements of what data is necessary for ongoing care following transfer communications (Galatzan & Carrington, 2018).

This dissertation explores the verbal information transferred during Operating Room (OR) to Post Anesthesia Care Unit (PACU) nursing handoff communications and whether the data is captured in the electronic health record (EHR) to represent the information critical to ongoing patient care and care planning. The study builds on the Kennedy Integrated Theoretical Framework (KITF) (Kennedy, 2012) integrating cognition theory, patterns of knowledge theory, and clinical communication space theory to support the human-technology characteristics within perioperative handoffs. Evidence of wisdom was present in the KITF in addition to elements of non-verbal communication patterns emerging from shared common ground contributed to the framework's expansion. To understand the contributions of the perioperative nursing interface terminology, the Perioperative Nursing Data Set (PNDS), makes to postsurgical care transitions, the study examines nursing diagnoses, interventions, interim outcomes and goals relationships to the handoff data communicated between OR and PACU Registered Nurses.

Study findings revealed a complex fragmented process of verbal communications and electronic documentation for the handoff process. While the EHR is prominent in data procurement for the handoff process, the design of handoff artifacts (e.g., paper, electronic) significantly impact the value of information received. Incomplete handoff tools or missing EHR data adds to a cycle of information decay while contributing to increase cognitive load and potentiating opportunities for information and knowledge loss. The absence of nursing diagnoses in the automation of the PNDS challenges the integrity of the language within the documentation platform and raises considerations for hierarchical representation within interface terminologies.

This study reinforces literature to reconsider user requirements in the design and functionality of healthcare information technology (HIT) to enable data and information flow and preserve knowledge development. The inclusion of mobile technology, cognitive support aids including clinical decision support tools, and other HIT will further enable the effectiveness of transfer communication, knowledge development, and the safety of ongoing patient care.

CHAPTER ONE

INTRODUCTION

Communication and Transitional Care

The effectiveness of communication and coordination of care have been targeted as one of six priorities of the National Quality Strategy for Quality Improvement in Healthcare (United States Department of Health and Human Services [HHS], 2015). Communication is considered a major influencer in the coordination of patient care and a contributor to egregious adverse patient events. Failed communications continue to rank within the top four categories for all reported sentinel events leading to serious physical injury or harm (Institute of Medicine [IOM], 2001; The Joint Commission [TJC], 2016) and account for 28% of surgical errors during patient care handoff (Gawande, Zinne, Studdert & Brennan, 2003). Handoff communications occur during transitions in patient care from one care provider to another or from one care environment to another, presenting significant challenges to the coordination of individualized patient care and care planning. Examining the dynamic relationship between dialogue exchanges between the operating room (OR) and post anesthesia care unit (PACU) and how these exchanges influence meaning may uncover new insight into why some postoperative patient care plans do not receive follow-through. By harnessing technology to accurately capture the intent of communications, the knowledge of practice in explicit concepts, could become a vehicle to represent patient care coordination. If integrated into electronic clinical quality measures, measurement of the nursing care coordination process could uncover areas of care deficiencies related to inaccurate

representations as captured in the EHR.

Perioperative Transfer of Care

As a central focus for nursing care, transfer of care process is closely associated with the continuity of care delivery and the patient's ability to move from illness to healing. Transfer of care processes are patterns of transition which are compilations of human experience in context of the diversity and complexity of adaptation and the impact on personal (e.g., patient) well-being. Research conducted on transitions identifies a minimum of two types of transitions occurring simultaneously, with multiplicity in transitions not being discrete or mutually exclusive from one another (Im, 2010; Schumacher & Meleis, 1994). Care transitions are characterized by patient flow and movement over time (Im, 2010; Chick & Meleis, 1985) between levels of care and across care settings (Coleman & Boult, 2003). Communications during care transitions include the rendering of critical patient information with the physical transfer of supportive technologies (e.g., monitors, invasive lines) to facilitate subsequent healthcare interventions (Petrovic et al., 2015). Patients with complexity in care needs burden the transfer of care process by requiring a higher level of care coordination between interdisciplinary team members (Coleman, 2003; Coleman & Boult, 2003; McDonald et al., 2014; Naylor et al., 2004). As the number of interdisciplinary team members increase, the likelihood of preventable adverse events increases (Baines, de Bruijne, Langelaan & Wagner, 2013) with failures in information transfer a common factor contributing to delays in needed therapeutic interventions (e.g., imaging, medication administration) (Symons, Almoudaris, Nagpal, Vincent, & Moorthy, 2013).

Transitions in care within the perioperative experience occurs between the OR and the PACU. The immediate postoperative period is embedded with complexity in care coordination

between the interdisciplinary team as the patient returns to metabolic stability following anesthesia. During this period of transition, a high number of individualized interventions are implemented to advance recovery accompanied by a collective transfer of responsibility to the next level of care providers with differing skill sets, knowledge, training, perspectives, and expectations (Cohen & Hilligross, 2010; McDonald et al., 2014; Weinger et al., 2015). Information communicated during this transition establishes the foundation for the immediate and future care interventions provided in the PACU and in subsequent clinical or post-acute care environments. This critical point of information transfer is further challenged by the environmental factors of time limitations, interruptions, multitasking, and interdisciplinary tensions to accommodate requirements to prepare for the next scheduled surgical intervention.

Transfer of Care Communication

Research on transitional communications, or transfer of care communication, often referred to as handoff or handover, identifies differing perspectives on how information is shared. While the transfer communications of patient care needs are an important activity between clinicians, how information is shared within the environment of care determines the effectiveness of the communication of information (Coiera, 2000). The intent of what is communicated is equally dependent on the experiences and situations of the author of the content and receiving clinician. Meaning derived from the empirical knowledge shared is produced from the active interpretation and translation occurring between the participating clinicians who form a common ground of understanding creating shared significance in the information exchanged (Binding & Tapp, 2008; Gadamer, 1977; Hess, Lynn, Holmboe & Lipner, 2009). This common ground of understanding facilitates the sharing of knowledge and the retention of information necessary for the ongoing coordination of care (Coiera, 2000; Brattheim, Faxvagg & Toussaint,

2011).

The shift away from the paper-based healthcare environment to EHRs brings dramatic changes in how information is understood and processed. The application of these asynchronous channels (e.g., EHR) in healthcare is shown to inhibit collaboration across disciplinary boundaries (Brattheim et al., 2011). The empirical representation of data in EHRs introduces novel approaches to interpreting patient care information. When the active engagement by the authoring and receiving clinicians is omitted, the full cycle of understanding regarding the patient experience may not be completely established. Additionally, nurses viewing documentation in the EHR as a universal communication source have subsequently abridged verbal interactions with other patient care providers (IOM, 2012). This can lead to missed information critical to ongoing patient care. When used as a tool versus a communication source, the EHR can facilitate clinical communications especially when extracted data encourages an active dialogue between provider, nurse, and patient (Brattheim et al., 2011; Englebardt & Nelson, 2002; IOM, 2012; Samal et al., 2013).

Handoff Communications

Handoff Process

Handoffs are a complex process requiring coordination between differing healthcare professionals with varying levels of clinical expertise. Distinctions in the types of handoff processes by classification are made according to the type of care provider and the environment where they occur (Agency for Healthcare Research and Quality [AHRQ], 2013; Bonifacio et al., 2013; Cohen & Hilligross, 2010; IOM, 2012; Smeulers, Lucas & Vermeulen, 2014). Information may be transferred within or across disciplinary roles (e.g., nurse-to-nurse, nurse-to-physician), during shift changes, for temporary patient care assignments, following treatments or invasive

interventions, with the physical transfer of the patient between care departments (e.g., OR to PACU), or across healthcare settings including acute care to outpatient services (AHRQ, 2013; Bonifacio et al., 2013; Cohen & Hilligross, 2010; IOM, 2012; Patterson & Wears, 2010; Smeulers et al., 2014).

Handoff Intention

The intent of handoff interactions is to transfer accountability and responsibility of patient care between healthcare professionals (Association of periOperatie Registered Nurses [AORN], 2019; TJC, 2017). Equally, the information exchanged is indented to facilitate the coordination of an uninterrupted care continuum (AHRQ, 2014; Dusek, Pearce, Harripaul, & Lloyd, 2015; Smuelers et al., 2014; Wasserman, 2014). During the handoff process, the information communicated regarding the patient status contributes to the individualized plan of care involving an interdisciplinary care team with the goal of increasing the safety of care delivery by the receiving healthcare professional (Cohen & Hilligross, 2010; Cohen, Hilligoss & Amaral, 2012). Patient information may be conveyed using paper or electronic records, and with or without exchanges of personal clinician insights of the patient care experience. The variability in the methods of transferring information during handoff is loosely structured around different pneumonics (e.g., SBAR - Situation-Background-Assessment-Recommendation), checklists, and integrated EHR tools tailored to address specific categories of information to be shared (Abraham, Kannampallil, & Patel, 2013; AORN, 2019; Institute for Healthcare Improvement [IHI], 2013).

Perioperative Handoffs

The topic of handoff bares significant consideration on how the process affects the outcome of surgical interventions. The effectiveness of handoff communications within the

perioperative patient experience is uniquely influenced by synchronous complex patient interventions combined with frequent interrupted communications. To mitigate potential harm, several recommendations have been made in an effort to improve communication transfer across the perioperative continuum with standardization in content and process being stressed for efficiency and patient safety (AORN, 2019; Hughes, 2008; Leighton Robinson, 2016; TJC, 2017). The need for active listening and unencumbered exchange of information is cited as a primary strategy to enable uncompromised communications in perioperative care (Nagpal et al., 2010a).

Handoff issues. The complexity of the handoff process has contributed to communication breakdowns in surgery resulting in patient injury (Gawande et al., 2003; Greenberg et al., 2007; Cohen et al., 2012). Studies examining the continuum of perioperative care identify handoff communication presenting a substantial risk to care coordination across all phase of perioperative care. Frequent information loss includes detailed patient information (e.g., test results, diagnosis, and needed interventions) necessary for a comprehensive plan of care (Caruso et al., 2015; Greenberg et al., 2007; Nagpal et al., 2010a; Nagpal, Vats, Ahmed, Vincent & Moorthy, 2010b). The high stress culture and characteristics of the perioperative environment further contribute to the ineffectiveness of communications which often threatens the safety of patients (Leighton Robinson, 2016). Tensions related to the transfer of responsibility and accountability of care during the immediate postoperative period have contributed to inconsistent information exchange between interprofessional care team members (Nagpal et al., 2010b; Weinger et al., 2015) and, once the cycle of information degradation begins, it continues as the patient transitions to the next level of care within or across the healthcare continuum (Ong & Coiera, 2011).

Measuring Transitional Care Coordination

The 2009 American Recovery and Reinvestment Act's (ARRA) derivative legislation, the Health Information Technology for Economic and Clinical Health (HITECH) Act, initiated the adoption and meaningful use of EHRs for reporting the quality of care aimed at improving population health (HealthIT.gov, 2015). The subsequent electronic clinical quality measures (eCQMs) generated for inclusion into the EHR Incentive Program currently do not focus on patient care transitions (CMS.gov, 03/27/2018). Existing eCQMs covering patient safety and care coordination target care processes and effectiveness of interventions provided.

The structural measurement of care transitions requires a framework inclusive of the inherent contributions made by nurses in the care coordination process. The American Nurses Association (ANA) (2013) calls for interprofessional representation in the national activities related to the electronic specification of care coordination measures. Pointing to nurses as the central profession in orchestrating the patient care continuum, the goal oriented, and outcomes-based measurement of transitional care necessitates parsimonious data constructs to frame eCQMs that may not currently be available in the EHR. Examining the relationship of nursing communication during patient care transitions may provide insight into vital data necessary to ongoing care which has not been structured into the EHR but is responsible for gaps in care planning that adversely affects patient outcomes.

CHAPTER TWO

LITERATURE REVIEW

Information Transfer in Communication

The human communication process is an iterative active exchange of information. When performed in healthcare, the goal of communication is to establish a common ground or shared mental model between clinicians of information about specific patient care situations. This chapter will address the human attributes for information exchange, its influence on transitional care coordination, and the intersection of health technology in promoting information transfer before introducing the conceptual and theoretical models guiding the proposed study.

Interdisciplinary Communication

To more fully explore the process of information transfer in communication, the literature was reviewed on the concept of 'interdisciplinary communication' and completed using PubMed and Dissertation and Thesis (ProQuest) electronic databases available through the Loyola University library services. Key search terms included, interdisciplinary communication, cross-disciplinary communication, team communication, communication, and team dynamics. Literature was obtained from the healthcare, sociology-communication services and sociology-business databases. This review established the foundation of how information is communicated, and the necessary behaviors required to establish a common ground of understanding or shared mental model.

Healthcare. The healthcare database included both nursing and medical literature

addressing care coordination, and the exchange of information with consideration to patient outcomes. Themes in this database focus on trust, tools/information communication technology (ICT), teams/teamwork, and time/timeliness.

The quality of perceived trust is clearly prevalent in the healthcare literature. Trust is viewed as a significant trait affecting the flow of communication (Ayres, Brand & Faules, 1973; Curry et al., 2012; Main et al., 2007; Richardson, West & Cuthbertson, 2010). Ayres and associates (1973) first identified communication flowing downward from senior nursing staff more freely than the reverse when perceptions of trust were absent from junior nursing staff regardless of degree level. This process is also referred to as an authoritative direction and is considered a pervasive interdisciplinary team issue (Richardson et al., 2010). For teams to function well, communications should be unhindered and open to facilitate information transfer throughout the healthcare hierarchy to prevent adverse surgical outcomes (Gurses, Xiao, & Hu, 2009; Main et al., 2007; Mahmud, Olander, Eriksen, & Haglund, 2013; Shannon, 2012). Curry and associates (2012) identified the quality of interpersonal team relationships as the primary source for biased group communication. Restricted or distorted communication is influenced by the individual perceptions of team members and relationship histories, which can angulate the meaning of interactions and be projected negatively between groups. A variety of safety stakeholders are advocating the promotion of unhindered interdisciplinary communications to protect patients from harm and improve healthcare team effectiveness (ANA, 2010; AORN, 2019; ECRI, 2009; IOM, 2001, 2004; Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2005).

Coordination of care continuity. Care coordination to promote continuity in care is not a linear process and requires active participation by all members of interdisciplinary teams.

The emphasis on active mutually shared patient goals is facilitated by timing of collaboration and the amount of time dedicated to the interaction (Curry et al., 2013; Gurses, Xiao & Hu, 2009; Main et al., 2007; Richardson et al., 2010; Shannon, 2012; Smallman et al., 2013). Time dedicated to participation in face-to-face communication encourages opportunities for reciprocal interaction reducing misunderstanding and validating of what is communicated (Curry et al., 2012; Doty, Fryer & Audet, 2012; Gurses et al., 2009; JCAHO, 2005; Mahmud et al., 2013; Shannon, 2012; TJC, 2017; Walsh et al., 2010). Delays in timing of physician-nurse communication have been positively correlated to pressure ulcers and ventilator-associated pneumonia, suggesting timeliness of information exchanges may raise physician awareness about clinical conditions (Richardson et al., 2010). Rushed or incomplete information transfers contribute to interrupted care coordination and poor patient outcomes, while adequate time in combination with use of communication tools prevents gaps in care coordination (Mehrotra, Forrest & Lin, 2011).

Electronic communication tools. The integration of information communication technologies into clinical care is moving healthcare clinicians away from paper-based information sources (e.g., fax, notes, checklists) to electronic applications with hopes of improving clinical productivity (Kossman, Bonney & Kim, 2013; Gurses et al., 2009; IOM, 2004; IOM, 2012; Mehrotra et al., 2011; Smallman et al., 2013). Technology offers efficiencies to mediate complex workloads and can facilities information transfer between and among interdisciplinary teams but at the same time may reduce the time spent in direct communication with other healthcare clinicians (Kossman et al., 2013; Gurses et. al, 2009; Smallman et al., 2013). Multiple studies have been conducted to determine where best to introduce electronic tools into the patient care process without negatively impacting the quality of information

transfer (Cashen et al., 2006; Kossman et al., 2013; Gurses et al., 2009; Mehrotra et al., 2011; Smallman et al., 2013) and ideally capturing objective data to promote a shared mental model and understanding of the patient situation (Yee, Wong & Turner, 2013).

Sociology-business. The interdisciplinary business literature is clustered in the sociology database. Themes emerging from the business communication database are similar the healthcare discipline and focus on trust, knowledge, and productivity.

Trust is related to team dynamics and the level of emotional intelligence of team members (Bradley, Baur, Banford, & Postlethwaite, 2013; Brady-Harnett, 2005; Chang, Sy, & Choi, 2012). Trust is associated with the interdisciplinary team's capacity to mediate miscommunication, and efficiently represent organizational goals and knowledge of operational strategies. The ability to interpret verbal and nonverbal messaging effectively determines the capacity of team productivity. Productivity, interpretation of communicated meaning, and promotion of organizational goals are dependent on the emotional intelligence (EI) level of individual team members (Bradley et al., 2013; Brady-Harnett, 2005; Chang et al., 2012). Those with higher EI demonstrate higher aptitude for interrelationships perceiving individual members as dependable and trustworthy and perform cognitive and decision-making task more effectively (Brady-Harnett, 2005; Chang et al., 2012). EI has more bearing on in face-to-face team interactions where physical displays of emotion are intrinsic to communications than virtual teams (Chang et al., 2012).

Within virtual teams, trust is communicated through messaging styles (Wang, 2011). The variability between male and female communication patterns and tonal quality can affect confidence in a member's ability to complete assigned work increasing disharmony in team dynamics and reducing the focus on deliverables (Bradley et al., 2013; Brady-Harnett, 2005;

Wang, 2011). The use of ICT and computer-mediated communications have demonstrated improvement in trust levels over time when perceived behavioral cues are reduced and eliminating group inhibitions and the need to mediate negative group performance (Wang, 2011). Additionally, how virtual teams learn and assimilate knowledge has a direct relationship with communication patterns and perceived trust in an individual member's ability to perform well (Brady-Harnett, 2005, Chang et al., 2012, Wang, 2011).

Sociology-communication sciences. Communication sciences literature is heavily focused on risk communication strategies stemming from recent national disasters (Andreas, 2010). For this review dissertations were selected, representing the risk literature and team communications. Recurring themes in the database also include trust in addition to tools, iterative exchanges, and transmission formats.

Communication literature uses the term trust to depict the emotional and perceived security found in communication processes (Andreas, 2010; Baker, 2011; Thompson, 2007). Interdisciplinary collaboration can be hindered by a team's inability to trust how individuals identify and agree upon meaning and definitions in language (Andreas, 2010; Thompson, 2007). Teams achieve meaning through iterative exchanges of information (Andreas, 2010; Baker, 2011; Thompson, 2007). The ability to complete the iterative communication process requires individuals to self-regulate emotions to accurately interpret behavioral cues and prevent stereotypical assumptions from encumbering information exchanges (Baker, 2011; Thompson, 2007). The reciprocal exchange of communicated information develops a relationship between the sender and receiver introducing power (i.e., truth) into interdisciplinary collaboration (Andreas, 2010; Thompson, 2007). Delivery of the same information using persuasive dialogue or authoritarian posturing can introject unwanted intention in meaning for team members and

reduce team effectiveness (Andreas, 2010; Thompson 2007). Perceived ambiguity with individual team roles amplify tensions within the group leading to degradation in the ability to problem-solve, negotiate, or find agreement on resolutions (Andreas, 2010; Baker, 2011; Thompson, 2007). Virtual teams can circumvent misconceptions in team dynamics by providing structure around work processes, defining information transmission formats, and developing consistency in communication processes (Baker, 2011; Thompson, 2007).

Intrahospital Information Transfer for Care Continuity

The transfer of patient care information between patient care departments (e.g., OR to PACU, OR to ICU) or healthcare facilities (e.g., acute care hospital to outpatient care facility) requires coordinated communications to maintain continuity in care delivery (Koenig, Maguen, Daley, Cohen & Seal, 2013; Mills, Neily & Dunn, 2008; Wu, 2016). While the literature clearly addresses processes and interventions to promote effective communications and information transfer for patients transitioning from acute care facilities (Coleman, 2003; Dusek, Pearce, Harripaul & Lloyd, 2015; Garg, Lee, Evans, Chen, & Shieh, 2015; Hesselink et al., 2012; Hirschman, Shaid, McCauley, Pauly, & Naylor, 2015; Kind & Smith, 2008; Koenig et al., 2012; Kripalani et al., 2007; Rennke et al., 2013), consideration for intrahospital transfer communications and related information transfer is gaining interest.

Communications during patients transfers from one hospital department to another reflect similar patterns of data loss that have been identified during interhospital transitions (i.e., between hospital transfers) (Bigham et al., 2014; Jensen, Sanders, Doty, Higbee & Rawlings, 2014; Kulshrestha & Sigh, 2016; Ong & Coiera, 2011; Rennke et al., 2013; Siddiqui et al., 2012). Despite agreement in the importance of content to be relayed during handoff, interruptions, poor organization, and the morbidity of patient information contributes to data loss

when a structured process to communicate patient concerns is absent (Borofsky, Bartsch, Howard & Repp, 2017; Kessler et al., 2014; Kulshrestha & Sigh, 2016). Subsequently, the use of structured face-to-face handoff communication protocols and the integration of electronic tools have demonstrated improvement in reducing the barriers to information transfer between interdepartmental care teams (Caruso, Marquez, Gipp, Keller & Sharek, 2017; Coiera, 2000; Manser, Foster, Flin & Patey, 2013; Ong & Coiera, 2011; Segall et al., 2012).

Perioperative information transfer. The perioperative handoff literature focuses primarily on the postoperative phase of information transfer from the OR to PACU or the Intensive Care Unit (ICU) (Agarwal et al., 2012; Boat & Spaeth, 2013; Greenberg et al., 2007; Main et al., 2007; Malley & Young, 2017; Manser et al., 2013; Mills, Neily & Dunn, 2008; Mukhopadhyay et al., 2018; Nagpal et al., 2010c; Petrovic, Martinez & Aboumatar, 2012a; Ridout, Aucoin, Browning, Piedra & Weeks, 2014; Riley, Merritt, Mize, Schuette & Berger, 2017) with emerging literature investigating standardization of transfer of care communications from clinical departments (e.g., ICU, surgical ward) to the OR (Caruso et al., 2017; Malley, Kenner, Kim & Blakeney, 2015). Much of this literature is dedicated to the development of communication tools to structure, standardize or streamline the types of data necessary for postoperative care coordination (Agarwal et al., 2012; Boat & Spaeth, 2013; Caruso et al., 2017; Greenberg et al., 2007; Manser et al., 2013; Mukhopadhyay et al., 2018; Nagpal et al., 2010c; Petrovic et al., 2012b; Riley et al., 2017; Leighton Robinson, 2016). Alternately, the evidence suggests communication breakdowns affecting the coordination of postoperative care are the result of, or magnified by, inadequacies of data transferred or captured in the EHR by any level of the interdisciplinary perioperative team (Greenberg et al., 2007; Keenan, Yakel, Dunn Lopez, Tschannen & Ford, 2007; Lee, Cumin, Devcich & Boyd, 2014; Ridout et al., 2014; Riley et al.,

2017; Segall et al, 2012). Even when information is shared, the multiplicity in how it is shared (i.e., verbal, written, electronic) contributes to inadequate data capture due to asynchronous processes used to communicate the information and the lack of verification of what was conveyed (Berger, Stein & Stockwell, 2012; Brattheim et al., 2011; Ridout et al., 2014).

Knowledge Transfer in Nursing

Clinical reasoning. Carper (1978) identified knowledge acquisition by nurses as a conceptual and syntactical structure which derives meaning from the empirical science of nursing, the esthetic art of nursing, personal knowledge gained from practice, and the ethical and moral foundation of the discipline. The knowledge gained from these combined patterns of knowing shapes the heuristic and analytic processes in how nurses reason (Evans, 1984). As information is processed, a heuristic judgment is made on the relevance of the information towards the patient care situation. The judgment is further processed through a parallel intrinsic analysis in relation to the information received (Evans, 1984). The output of the analyzed judgment is articulated as a rationalization or expressed as tacit knowledge which is infrequently captured in clinical documentation (Evans, 1984; Manser et al., 2013; Jefferies, Johnson & Nichols, 2012). These cognitive inferences of insight or intuition stimulate discussion when ambiguity exists; helping to clarify needed patient care interventions (Yee et al., 2013; Edmonson, Pearce & Woerner, 2009; Newham, Curzio, Carr, & Terry, 2014).

Wisdom in reasoning. When clinical reasoning relies on the interconnection of knowledge and ambiguity to respond to patient care situations, professional wisdom is displayed (Edmonson et al., 2009). Exchanges of tacit knowledge in decision making are often viewed as insignificant or generalized opinion, but are the extractions of intelligence, creativity, and knowledge contributing to characteristics of wise decisions for common good (Benner, 1984;

Edmonson et al., 2009; Matney, Avant, & Staggers, 2015). By using the available information within the context of a clinical situation, wise decision making reflectively evaluates the choices to ethically satisfy the direction of desired outcomes (Berger et al., 2012; Edmonson et al., 2009). This empathetic display of ethical and moral components with the application of knowledge in reasoning is the hallmark of nursing wisdom (ANA, 2016; Benner, 1984; Matney et al., 2015).

Nursing artifacts. The reliance on paper-based displays of information used to help inform and increase knowledge about patient care are ubiquitous in the healthcare setting. Cognitive artifacts are the external customizable knowledge tools used by nurses to support communications, critical thinking, and clinical reasoning by organizing and prioritizing patient care content not readily available in EHRs (Blaz, Doig, Cloyes & Staggers, 2016; 2018; McLane et al., 2010). Clinical reasoning, and subsequently clinical practice, is facilitated by internal knowledge interacting with the external information representations (i.e., cognitive artifacts) to reinforce existing knowledge based on personal validation that the data presented is accurate (McLane et al., 2010).

Cognitive artifacts are not universal in structure and evolve throughout use to accommodate the changing information needs of the user. Developed and personalized by individual nurses to accommodate work schedule, patient considerations, and preferences, cognitive artifacts are temporary information displays that are destroyed when the intended purpose is completed (Blaz. Doig, Cloyes & Staggers, 2016; 2018). Because they contain personal and professional knowledge, external artifacts influence perception, reasoning, knowledge development, and decision making by informing the way nurses understand their patients, the patient care experience, and documentation of nursing care in the EHR (Blaz et al., 2016; 2018; Giarrizzo-Wilson, 2016a; McLane et al., 2010). The accuracy of the information

captured on cognitive artifacts promotes their use in transfer of care (i.e., handoff) communications, alongside the EHR, as a reference point for information to be shared and interpret patient care considerations that may not be captured in electronic documentation (Blaz et al., 2016; 2018; Jefferies et al., 2012; Staggers, Clark, Blaz, & Kapsandoy, 2012).

Theoretical Propositions

Nursing informatics (NI) is the specialization of the nursing domain applying nursing science, information science, and health information technology to support decision making for healthcare stakeholders in an effort to promote improved patient outcomes (ANA, 2016). The practice of NI is established on the framework of data, information, knowledge and wisdom borrowed from computer and information science and adapted to nursing (ANA, 2016; Englebardt & Nelson, 2002). From this framework the study of human communication, decision making, and technology is joined. How information transforms to wisdom is an important step to the decision-making process for continuing patient care planning. The probability of representing nursing wisdom as decision making in the EHR is still unknown, but current research is driving interest in mapping this process (Matney, Staggers & Clark, 2016; Matney et al., 2015; Topaz, 2013). This study uses the NI conceptual model of Data-Information-Knowledge-Wisdom (DIKW) to establish a foundation for this study's theoretical propositions and to expand understanding of the human communication process during transfer of care communications (i.e., handoff).

Conceptual Model

Philosophical tenets. Hans-George Gadamer (1900-2002) proposed a practical philosophy, hermeneutics, as a necessary guide to human understanding in the age of technology. Gadamer claimed the information overload from technology was barraging humanity and

reducing human interactions, skills and ideas (praxis) into a scientific application (Di Cesare, 2013; Gadamer, 1977; Swayne Barthold, 2012). Disciplined in Aristolian and Platolian philosophy, Gadamer believed in the centrality of dialogue (Plato) which leads to human understanding and the application of what Aristotle termed practical wisdom (phronesis). Phronesis guides ethical actions and contributes to recognition and understanding of the correct response to a situation. Praxis and phronesis are bound in Gadamer's explications on "Being," a hermeneutic principle expressing the relationship of lived experiences informing language and establishing the structure of hermeneutic philosophy. Being shapes the common bond in the relationship of dialogue and affirms the nature of human knowing. Foreknowledge or pre-understanding in dialogue is informed from historical background and establishes the foundation for human judgment and practice. Being is further interpreted as the characteristic which creates understanding and meaning gained through language.

Gadamer's use of ontology derives meaning from the reciprocal exchange within human interactions (e.g., communication, art, play) which expands knowledge within communication and creates participant understanding. This reciprocity and understanding is acknowledged as the "Hermeneutic Circle" that encompasses the change of meaning over time. (Di Cesare, 2013; Dobrosavljev, 2002; Gadamer, 1977; Rodgers, 2005; Swayne Barthold, 2012). Meaning is in constant motion during human interaction, evolving from original intent to a new definition (i.e., common ground) based on the experiences of the participants.

Data, information, knowledge, wisdom. The discipline of nursing informatics is supported by the foundational concepts of data, information, knowledge and wisdom (DIKW). The conceptual framework, Figure 1, is represented as a progressively upward, interactive model in constant flux that helps to define the process of knowledge development and critical thinking

used in nursing practice (ANA, 2016).

Figure 1. The Relationship of Data, Information, Knowledge, Wisdom Framework

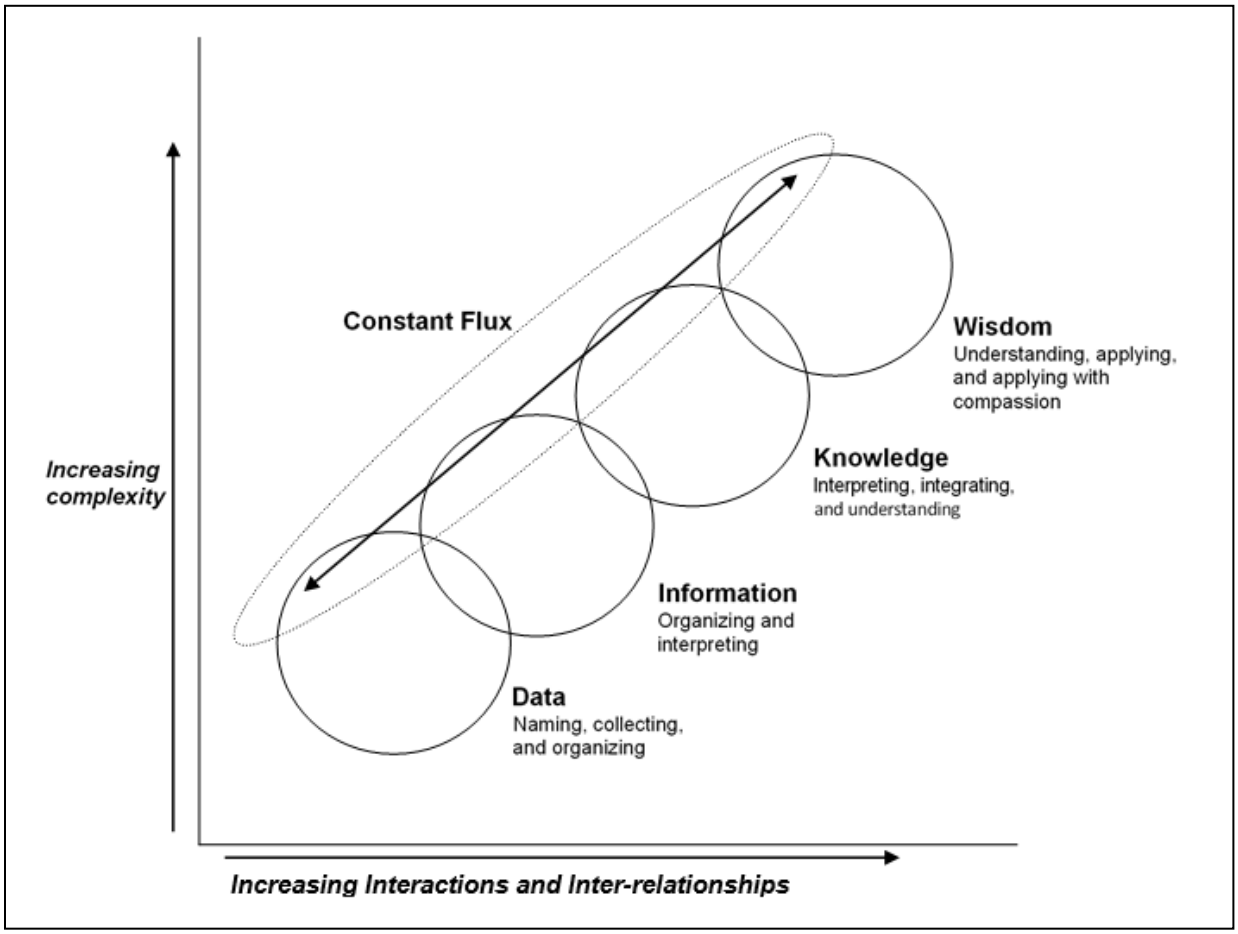

Figure 1.The Relationship of Data, Information, Knowledge, Wisdom Framework. Copyright 2002 Ramona Nelson, Ramona Nelson Consulting. All rights reserved. Reprinted with permission.

Data are symbols of single meaningless units such as a number, a word, or visual object. Data are the structural elements found within nursing ontologies, or standardized terminologies, and represent the discipline's desire to name, codify, and communicate the essential activities of the profession. Each precise term (data element) exemplifies the knowledge of the profession which has gone through a rigorous process of research and validation before adoption by the respective terminology associations. When data are extracted or gathered and analyzed, information is formed. By examining the conceptual intent of captured data, meaning is derived,

and information created. Information answers the who, what and why questions of the human thought process. Synthesized information is transformed into tacit or explicit knowledge (ANA, 2016; Englebardt & Nelson, 2002; Matney, Brewster, Sward, Cloyes & Staggers, 2010). Tacit knowledge is the contextualized 'what is known,' the personal background knowledge developing from lived experiences. Alternately, explicit knowledge is more formal knowledge being produced, validated, and encoded within nursing terminologies and EHRs as patient information.

The uppermost concept in the DIKW framework is wisdom. Wisdom is the tacit knowledge nurses gain and internalized during practice experiences to manage and solve human problems. Nurses demonstrate wisdom by the appropriate application of knowledge exercised during clinical decision making and implementation of patient care interventions with the moral intentions of achieving good (ANA, 2016; Benner, 1984; Englebardt & Nelson, 2002; Haggerty & Grace, 2008; Matney et al., 2010; Matney et al., 2016; Newham et al., 2014).

An overlap exists between the DIKW framework and hermeneutic philosophy evidenced by Gadamer's philosophical tenets of praxis and phronesis. Hermeneutics seeks to understand the meaning within the experience of the spoken word during dialogue. While the DIKW framework cannot capture meaning, it does provide a model to describe the process of finding meaning from data and information. The DIKW information synthesis is an active process of iterative analysis to create understanding and knowledge. The Hermeneutic Circle represents this as continuous interpersonal exchanges leading to understanding through the shared experience of meaning and the basic structure of cognition. Phronesis, or practical wisdom, is realized through the behavior or actions of applied knowledge by nurses (Rodgers, 2005).

Hermeneutics and meaning. Building on the interplay of partners in dialogue to

generate shared meaning, pre-understanding through lived experience forms the universality of philosophical hermeneutics and occurs through the interchange of a common language. The interpretation of text or dialogue is established on foreknowledge to guide understanding (Di Cesare, 2013; Sammel, 2003). This shared mental model also provides perspective to interpret and understand one's surroundings and helps to initiate engagement (Dobrosavljev, 2002).

Meaning derived through interpretation of text or dialogue is not fixed but develops through the constant exchange during conversation. The original intent of the written or spoken word is equally dependent on experiences and situations of the author and listener, or reader. Meaning is produced from active interpretation with a progressive translation occurring between the engaged parties who form a new understanding of meaning. The new meaning that results is a progressive understating of the discussion and the development of a shared mental model revealed as truth about the point of discussion (Dobrosavljev, 2002; Gadamer, 1977; Sammel, 2003).

Hermeneutic foundation in communication. The precepts of nursing are derived from knowledge-based sciences. Knowledge supports nursing practice through a synthesis of information and concepts. Knowledge is stored, shared, and can generate new knowledge to improve practice and promote better patient outcomes. Knowledge about the patient is communicated between healthcare clinicians (i.e., nurses and physicians) and stored as data in patient health records. Communication of patient care data and information is a key process to coordinating care modalities for the patient within the healthcare organization, during patient care transitions, and after discharge. The conceptual model for the study, Figure 2, represents this human transaction of knowledge development, sharing, and integration into the EHR.

Clinician dialogues are often concise, brief, interrupted or do not occur, and contribute to

Figure 2. Conceptual Model for the Study

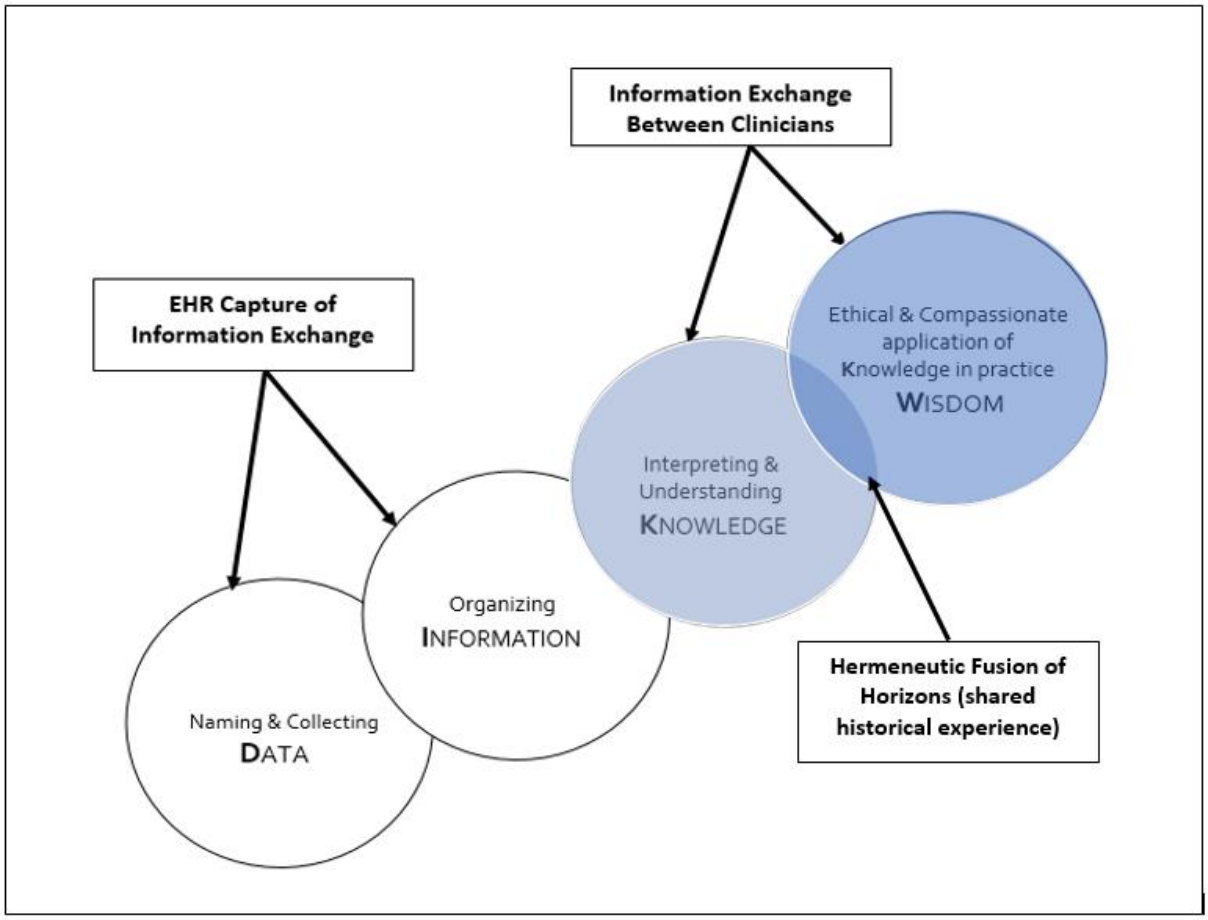

Figure 2. Conceptual Model for the Study. Adaptation of Topaz, M. (2013). The hitchhiker's guide to nursing informatics theory: Using the Data-Knowledge-Information-Wisdom framework to guide informatics research. *Online Journal of Nursing Informatics*, *17*(3). Retrieved from http://ojni.org/issues/?p=2852

miscommunications (IOM, 2004; Maxfield, Grenny, Lavandero & Groah, 2011; Pimentel, Choi, Fiumara, Kachalia, & Urman, 2017). Breakdowns in clinical communication have led to serious adverse patient events (e.g., life-threatening injury, death) and are persistently identified as a primary contributor to patient harm and reportable sentinel events (TJC, 2017). Multiple interventions have been implemented across the United States to prevent disrupted communications including checklists, read-back policies, and communication acronyms (e.g., SBAR -Situation-Background-Assessment-Recommendation) without a significant reduction in

harmful events related to communication (IOM, 2012; TJC, 2017; World Health Organization [WHO], 2008).

When communication includes a shared historical experience, the experience contributes to mutual understanding and provides a similar appreciation for the topic of discussion. Conversely, communication breakdowns are a translation problem at the level of discussion occurring with the language used and not from the interpersonal interaction (Kuhn, 2012). Meaning is lost from the lack of reciprocal sharing of knowledge. Communication can be repaired with extended dialogue and adaption to one another's behavior to promote understanding of the ideas expressed (Kuhn, 2012). This restoration occurs with introspection and reestablishing the Hermeneutic Circle (synthesis of information) and praxis (interactions, skills, ideas) through an ethical choice to engage personally in rebuilding meaning within the conversation (Di Cesare, 2013; Dobrosavljev, 2002; Gadamer, 1977; Swayne Barthold, 2012). As nurses enter into the Hermeneutic Circle, they enter into a period of prejudgments (foreknowing) focusing on their understating of nursing phenomena. This subtle but personal awareness of the mental model allows the nurse to gain greater understanding during communications and more freely engage in dialogue with clarity and appreciation for what is being expressed (Pascoe, 1996).

Electronic health records. The ongoing efforts by the United States government to pursue a triple aim for healthcare (Berwick, Nolan & Whittington, 2008) by improving care quality, population health, and reducing the per capita costs of healthcare, has quickened the pace for EHR adoption by hospital systems and independent providers of care. EHRs hold the promise of reducing healthcare cost and improving access to care when fully and appropriately implemented. While technology provides many benefits for care coordination, including real-

time access to patient data, clinical support solutions, and physician ordering efficiencies, there are often unintended consequences of incorporated informatics solutions. Communication issues occur when clinical workflows become disrupted delaying the nurse's ability to relay needed patient care information. Unsafe workarounds may result, or increased engagement with the technology may occur, while time spent on patient care is decreased (HealthIT.gov, 2017; IOM, 2004; Samal et al., 2013).

With the shift away from the paper-based healthcare environment comes dramatic changes in pre-understanding. Encounters in new unfamiliar experiences will occur over multiple exposures to EHR documentation. Interpretation of patient care data housed within electronic records also occurs, but the complete cycle of understanding about the patient experience requires engagement with the patient to complete the Hermeneutic Circle (synthesis of information). Mobilizing EHRs to facilitate human communication will help to reduce missed information critical to patient care if the conceptual elements of praxis are applied as choices are made during the progression of patient care (Dobrosavljev, 2001).

Clinical Quality Measurement

Clinical quality measurement in healthcare is transitioning from chart-abstracted measures to electronically specified clinical quality measures (eCQMs) that can be fully extracted from a certified EHR as a requirement for Meaningful Use incentive payments (Centers for Medicare & Medicaid Services [CMS], 10/11/2019). The goals of eCQM development are to more accurately capture patient care data, improve population health, provide safer patient-centered efficient care, and reduce the burden of healthcare expenditures. eCQMs are modeled according to the Quality Data Model (QDM), a standardized and structured format to uniformly develop measure phrases applicable across all hospital and provider quality

measures (CMS, 2019, November 20). The QDM incorporates codified clinical terminologies to communicate the required data elements for extraction from the EHRs. The QDM also helps to facilitate the interoperability of eCQM data through the Health Level 7 (HL7) quality messaging standards, the Quality Reporting Document Architecture and the Clinical Document Architecture. These standards provide a series of templates used by EHR vendors to extract and transmit eCQM data to healthcare quality reporting organizations (e.g., CMS, TJC) (CMS, 2019, September 24). The current library of eCQMs include clinical processes measures (e.g., administration of preoperative antibiotics) and are expanding to include measures of patient outcomes with the 2019 Promoting Interoperability Programs reporting requirements (CMS, 10/11/2019).

Electronic clinical quality measures (eCQM) are modeled in a linear format for EHR processing to represent the human thought process used in patient care. Though eCQM logic phrases do not appear to be readable by humans, there is a technology connection between the documented data element and the knowledge of the healthcare clinician. Nurses examining the EHR output of measurement data obtain new knowledge about the patient from the synthesis of information. Hermeneutic philosophy expands the nurse's understanding of the interpretive results. As the data are reused for patient care, a new pre-understanding of measure constructs is obtained with applicability to patient care being realized (e.g., patient outcome metrics).

Kennedy Integrated Theoretical Framework

The Kennedy Integrated Theoretical Framework (KITF), Figure 3, represents the intersection of distributed cognition theory, patterns of knowledge theory, and clinical communication space theory supporting the distributed flow of data and information exchanged between caregivers during acute to home care patient transitions. (Kennedy, 2012). The

theoretical foundations expand the conceptual framework by informing how artifacts and variables, embedded in transfer of care communications (i.e., handoff), influence the dynamic progression from data-to-information-to-knowledge.

Figure 3. Kennedy Integrated Theoretical Framework (Updated)

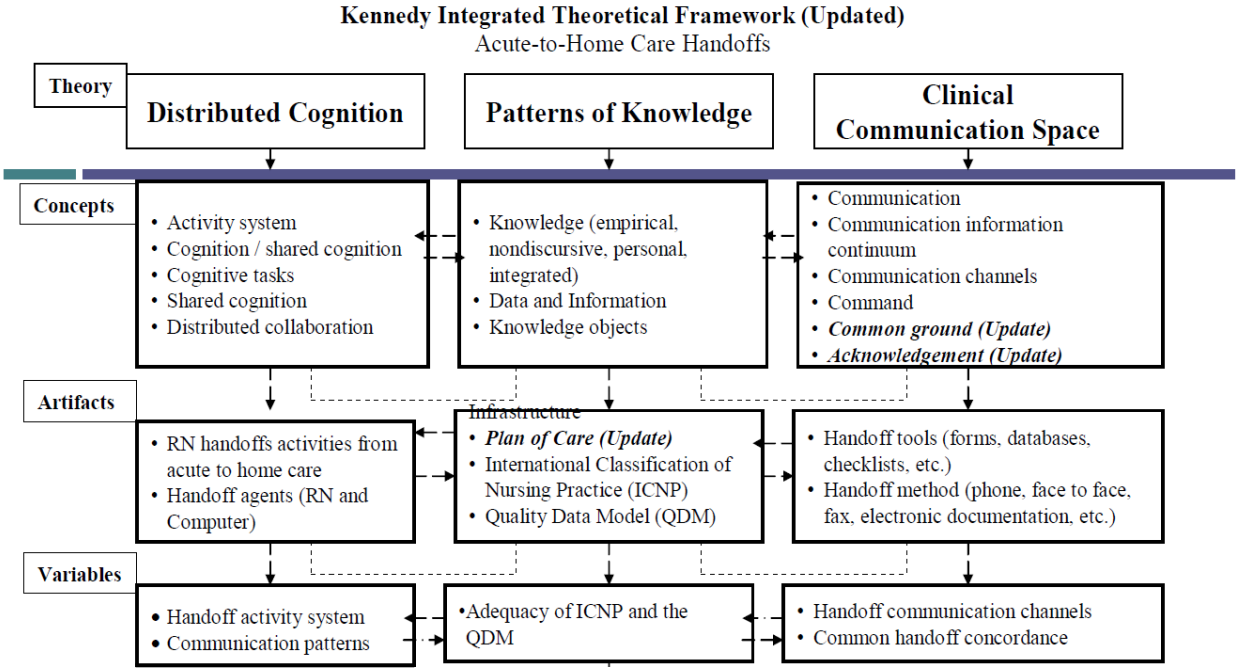

Figure 3. Kennedy Integrated Theoretical Framework (Updated) developed for Acute-to-Home Care Handoffs.

Distributed cognition. Knowledge procurement is attributed to the interaction between tacit knowledge and explicit knowledge representation, the cognitive artifacts found within the environment (Liu, Nersessian & Stasko, 2008; McLane et al., 2010). Cognitive artifacts are purposeful displays of information facilitating the interpretation of data used for human used for human reasoning and decision making (McLane et al., 2010). These ensuing representational states are functional information patterns (e.g., graphical display, verbal expression, printed word) within the environment contributing to situational awareness or working memory of participants (Hazlehurst, Gorman, & McMullen, 2008; Walker et al., 2010; Patel & Currie, 2005)

and can "model the properties of other objects or events when engaged by interpretive processes" (Hazlehurst et al., 2008, p 229).

Representational states occur during perioperative transfer communications as information is exchanged between the OR and PACU nurses using cognitive artifacts (static or electronic ques), designed to facilitate the handoff process. The propagation of representational states moves data between individuals or the electronic system by way of cognitive artifacts accessed to complete the transfer of patient information (Hazlehurst et al., 2008; McLane et al., 2010; Patel & Currie, 2005). The use of cognitive artifacts during transfer communication also increases coordination of activities by augmenting tacit knowledge through non-verbal communication patterns (Xiao, 2004).

Patterns of knowledge. The KITF distinguishes patterns of knowledge in handoff communications based on Phenix's (1964) six realms of meaning with an emphasis on four subrealms of knowledge leading to human understanding; *symbolics, empirics, synnoetics*, and *synoptics* (Kennedy, 2012; Phenix, 1964). From the first realm of *symbolics*, nondiscursive knowledge are the formal patterns for spoken and unspoken language; the symbolism embedded into deciphering behavioral expressions, desires, and ritualist agreements used to communicate meaning (Phenix, 1964). Nondiscursive knowledge may be expressed as patient preferences (e.g., nickname) or posturing of a team member to identify patient assessment findings during communications.

The second realm of *empirics*, or empirical knowledge, draws from the physical, biological, psychological and social sciences and provides the factual narratives and detail of the patient's condition and interventions performed. It is the captured and shared data of the patient care experience. Personal knowledge is found in the fourth realm of *synnoetics*. Phenix (1964)

describes *synnoetics* as the cognitive process of "relational insight" or "direct awareness" of feelings and "existential knowing" (p. 7). Within the KITF, personal knowledge represents expressed "values, morals, and impressions" (Kennedy, 2012, p. 30) during transfer communications and may manifest as personal intuition regarding the patient's condition or needed care. The last category of knowledge incorporated into the KITF is integrative knowledge or *synoptics* from the sixth realm of meaning. The composition of integrative knowledge is the composed of history, philosophy, and religion (Phenix, 1964) which collectively generates meaning from a synthesis of empirical, personal, and nondiscursive knowledge while supporting situational fore-knowing or predictions (Kennedy, 2012; Phenix, 1964). Integrated knowledge is articulated as nursing judgments or critical thinking about patient care needs and the interventions of clinicians during patient care and future care planning.

Clinical communication space. Established on the psychological foundations of common ground (Coiera, 2000) and embedded within the hermeneutics tenet of shared meaning (Gadamer, 1997), communication space theory suggests a relationship exists between human communication and technology to effectively support collaborative care delivery (Brattheim et al, 2011; Coiera, 2000; Kuziemsky & Varpio, 2010). As the complexity of care increases, so do the related activities for establishing common ground or a shared mental model. In critical periods of patient care, a high degree of common ground establishes trust in the information shared and is completed through active exchanges of information (e.g., verbal, telephone) and augmented by visual representations of structured data (e.g., EHR) (Coiera, 2000; Kuziemsky & Varpio, 2010). Conversely, when the time to relay patient information is minimized, requirements for asynchronous messaging using information technology (e.g., EHR) is supported (Coiera, 2000; Brattheim et al., 2011).

Wisdom. To capture the unexplored concept of personal knowledge application in contextual information exchange (i.e., tacit knowledge in decision making) during perioperative handoff communications, "Wisdom" is represented as an overlap between Patterns of Knowledge and the Clinical Communication Space (see Figure 4). Indicated as personal knowledge by Phenix in the realm of *synnoetics,* wisdom is demonstrated in the KITF as phronesis, the moral responsibility of implementing specific actions in response to concrete situations based on intellectual virtues of practice (Matney et al., 2015; Staudinger & Glück, 2011).

Additional framework modifications. Additional artifact modifications to the KITF include substituting nursing handoff activities from the OR to the PACU for acute to home care handoff, replacing the International Classification of Nursing Practice with the Association of periOperative Registered Nurses (AORN) Perioperative Nursing Data Set (PNDS), and mapping the PNDS to the QDM (see Figure 4). The PNDS is an empirically validated standardized nursing language with a single focus on the contributions of perioperative nurses caring for patients undergoing surgical or invasive procedures (Petersen, 2007). The PNDS is the only nursing language fully integrated into an automated standardized documentation solution to capture the perioperative patient care experience (AORN Syntegrity, n.d.). The PNDS incorporates the clinical workflow for the perioperative plan of care and has been embedded into the reference terminology SNOMED CT®, one of the clinical terminologies authorized by the United States government for development of eCQMs (CMS 210/11/2019; Petersen, 2011).

Figure 4. Modifications to the Kennedy Integrated Theoretical Framework

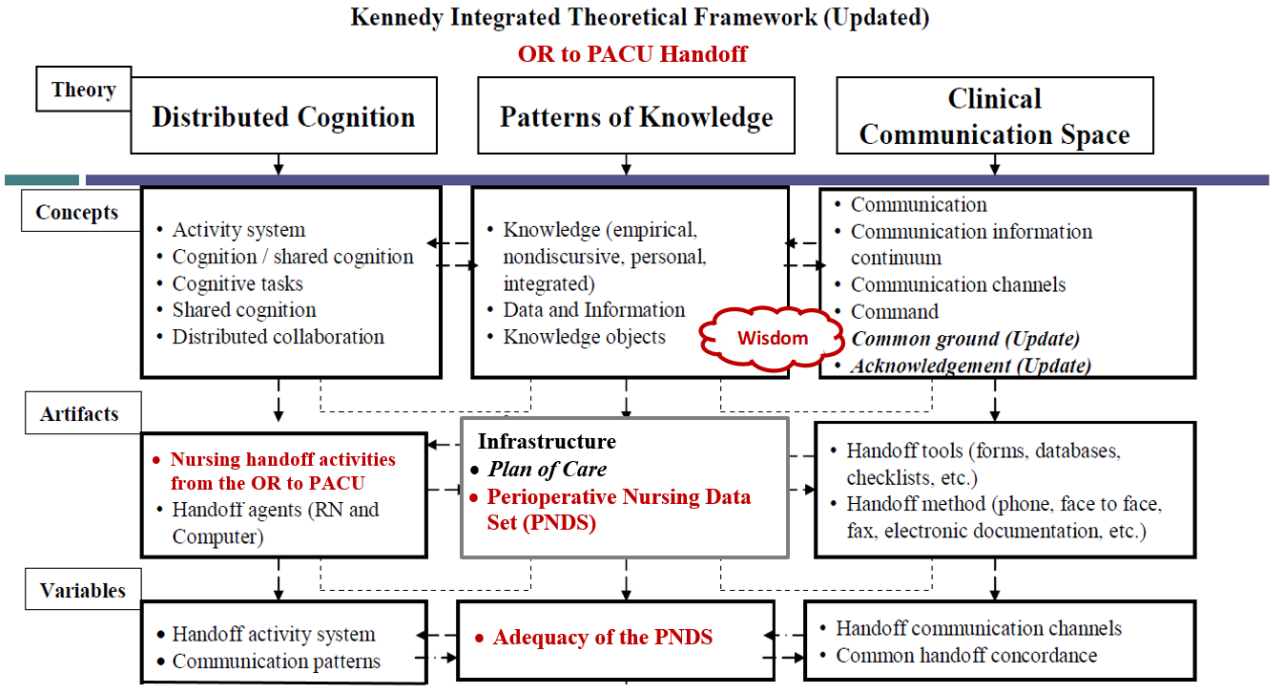

Figure 4. Modifications to the Kennedy Integrated Theoretical Framework. Modifications to the Kennedy Integrated Theoretical Framework completed with permission from the author.

CHAPTER THREE

METHODS

Purpose

The purpose of this research is established on the premise the EHR reflects the medical model of problem-oriented charting (Jacobs, 2009; Weed, 1968; Weed & Weed, 1999). This research explored whether all essential patient care information verbally transferred during the Operating Room (OR) to Post Anesthesia Care Unit (PACU) nursing handoff communication is captured in the EHR. Contextual exchanges of nurses' personal knowledge about the perioperative patient care experience have not been explored for inclusion as structured EHR data and may have significance for continuing patient care requirements and avoiding re-hospitalization or serious adverse events. The research is the first step to more fully understanding (1) what information is exchanged between nurses in the operative and postoperative care area, (2) what data elements are necessary for continuity in postsurgical patient care, and (3) if the data present in the EHR supports transitioning postsurgical patient care needs. This chapter provides the approach to explore human communications during perioperative patient care transitions, identify what continuing care data shared during perioperative transfer communications are captured within the EHR, and if new data elements can be incorporated into the PNDS to support ongoing intrahospital postoperative patient care.

Theory, Research Aims and Research Questions

The research aims and research questions employed in this study follow:

Primary Aim

Determine what information for postoperative patient care (e.g., hospital handoff criteria) is exchanged between the OR and PACU nurses during handoff communications and is captured in the EHR.

1.1 What patient care information verbally exchanged between OR and the PACU nurses during the handoff period is accurately captured in the electronic health record?

1.2 What contextual patient care information exchanged during postoperative handoff communication is necessary for uninterrupted continuity in ongoing patient care?

1.3 Do the hospital handoff tools, routinely embedded within the electronic health record, facilitate the accuracy of transitional patient care information exchanged between the OR and PACU nurse?

1.4 Does the Perioperative Nursing Data Set (PNDS) nursing terminology support the electronic capture of perioperative transfer of care communication for ongoing postoperative patient care needs?

The results from this study may provide evidence for new data requirements for EHRs contributing to measurable improvements in perioperative transitional patient care outcomes. The findings may also be applicable for expanding the national Quality Data Model used for electronic quality measure development, allowing for more accuracy in quality measurement and reporting of the efficiency and effectiveness of care coordination beyond perioperative patient care transitions. Table 1 displays the research aims and questions aligned with the study's guiding theories.

Table 1. Theories, Research Aims, and Research Questions

Research Aims	Theory	Research Questions
1. Determine what information for postoperative patient care (e.g., hospital handoff criteria) exchanged between the OR and PACU nurses during handoff communications and are captured in the EHR.	Clinical Communication Space Theory	1.1 What patient care information verbally exchanged between OR and PACU nurses during the handoff period is accurately captured in the EHR?
	Patterns of Knowledge Theory	1.2 What contextual patient care information exchanged during postoperative handoff communication is necessary for uninterrupted continuity in ongoing patient care?
	Distributed Cognition Theory	1.3 Do the hospital handoff tools routinely embedded within the health information system facilitate the accuracy of transitional patient care information exchanged between the OR and PACU nurse?
	Patterns of Knowledge Theory	1.4 Does the PNDS nursing terminology support the electronic capture of perioperative transfer of care communication for ongoing postoperative patient care?

Concept and Operational Definitions

To align the current study as closely as possible with KITF (2012), the conceptual and operational definitions displayed in Table 2 replicate the framework developer's intent with only modifications for specificity for the study site and practice area (i.e., perioperative patient care).

Table 2. Conception and Operational Definitions

Concept	Concept Definition	Operational Definition
Agents	A person or an electronic system responsible for a particular action within systematic teamwork efforts (Salmon, Stanton, Walker, & Jenkins, 2005).	Nurses or electronic systems responsible for and involved in handoffs within the activity
Cognition	The mental act or process by which knowledge is acquired, including perception, intuition, and reasoning (Collins English Dictionary, 2017).	Data, information and knowledge shared between agents (person or electronic system) during the OR-to-PACU care handoff process.
Cognitive Task	The mental act or process by which knowledge is acquired, including perception, intuition, and reasoning required during a task.	Nurse identification of priority information needed for handoffs– and rationale for why the information is important.
Command	The person who has control over the situation (Salmon et al., 2005).	The nurse assigned to handoff the patient from the OR and the nurse assigned to receive the patient in the PACU.
Communication	The imparting or interchange of thoughts, opinions, or information by speech, writing, or signs (Collins English Dictionary, 2017).	The exchange of verbal, written, or electronic patient information between nurses responsible for the patient, from the OR to PACU.
Communication Information Continuum	A model or framework that aims to understand the specific task characteristics that are used to identify which form of communication (communication channel) is most appropriate for the task at hand (Coiera, 2000).	A list of the entire communication space tools (e.g., forms, checklists,) and methods used (i.e., phone, fax computers).
Data	Discrete terminology elements (codes) shared during handoffs (e.g., diagnoses, goals, observations, medications).	Discrete terminology elements (codes) shared during handoffs (e.g., diagnoses, orders, goals).

Distributed Cognition	To place data or knowledge on objects, individuals, and tools in our environment and subsequently share (distribute) through interaction between agents (Liu et al., 2008).	The data, information, and knowledge shared and acted upon through written, verbal, or electronic communication between nurses during the OR-to PACU handoff.
Distributed Collaboration	To work jointly with others or together especially in an intellectual endeavor (Random House Dictionary, 2010).	Nursing working with all members of the clinical team to complete an OR-to-PACU handoff as measured by two-way interactions with other team members.
Perioperative Nursing Data Set (PNDS)	An interface terminology recognized by the American Nurses Association as a data set or vocabulary used to document or facilitate patient care (Petersen, 2007).	An interface terminology used to facilitate perioperative nursing care and document nursing contributions to identified patient outcomes.
Knowledge	Acquaintance with facts, truths, or principles, as from study or investigation; general erudition (Random House Dictionary, 2010).	Facts regarding best practices or evidenced-based care shared during handoffs.
Knowledge Object	The specific description of the data or knowledge source (Walker et al., 2006).	The specific description of the data or knowledge source (Walker et al., 2006).
Nursing Diagnosis	A clinical judgment about individual, family, or community experiences and responses to actual or potential health problems and life processes (NANDA-I, n.d.).	Patient symptoms, problems, diagnosis in response to actual or potential health and life processes.
Nursing Goal	Defined target or measure to be achieved in the process of patient care. A typical goal is expressed as an observation scheduled for a time in the future with a particular value (HL7, 2016).	Defined target or measure to be achieved in the process of patient care. A typical goal is expressed as an observation scheduled for a time in the future with a particular value.

Wisdom	The moral responsibility of implementing specific actions in response to concrete situations based on intellectual virtues of practice (Matney, 2015; Staudinger & Glück, 2011).	The ethical and compassionate application of knowledge in practice demonstrated as nursing judgment in clinical reasoning.

Research Assumptions

The assumptions for this research are centered on the questions asked about phenomena that is not clearly understood. EHRs are expected to capture all important communications related to patient care. Data in the EHR is structured formatting with limited characters to represent broad and sometimes complex human conditions. While the literature is silent on the mount or quality of these types of communication, the study design will stimulate inquiry between what is relayed between clinicians and how best to represent it. The following assumptions are made:

- The transfer of responsibility and accountability for continuing postsurgical patient care represents a critical transition point in care continuity;
- It is assumed the long-tenured perioperative experience of the PI observing nurses within the context of their environment will not disrupt procedural routines and communication patterns;
- Nurses involved in perioperative handoff engage in patient care data and information sharing to promote continuity of care during the postsurgical period;
- The data and information shared between nurses includes the expected universal handoff data elements and individualized patient considerations;
- The qualitative data captured during perioperative handoff (observations, interviews) identifies all patient care information important to postsurgical care continuity;

- Data and information shared between nurses is distributed between verbal interactions and data gathered from the EHR; and
- Data from the EHR is structured using the designated national standardized clinical terminologies for EHR data capture (e.g., SNOMED®, Logical Observation Identifier Names and Codes [LOINC®]).

Study Design and Methods

Overview of Study Design

Describing the phenomena of perioperative transfer communications (i.e., handoff) during the transition between the OR and PACU, the KITF will guide the exploratory descriptive design for this study. The intent is to fully delineate the types of data, information and knowledge shared within the context of the environment as it occurs using contextual inquiry methodology. Clinical Inquiry methodology is a systematic approach to studying people, tasks, and procedures within the environment of practice and a modification of cognitive ethnography to precisely define contextual and observable knowledge for the design and development of medical solutions (Privitera, 2015; Mattelmäki, Brand & Vaajakallio, 2011). Clinical Inquiry methodology approaches knowledge discovery through immersion in context (the environment) and engagement as a participant or nonparticipant observer using qualitative approaches for interviewing. This process will elucidate rich descriptions of the relationships about the shared contextual elements determined critical for uninterrupted ongoing patient care. Clinical Inquiry methodology observation immersions and coordinated semi-structured participant interviews facilitate understanding of why selected patient care information is exchanged during handoff communications as the patient transitions from one care environment to another. The context for information transmission combined with interactions of engaged participants (agents) contributes

to understanding the importance of selected patient data shared.

Transfer of care communications and nurse participant interviews will be audibly recorded with data transcribed verbatim. Subsequent collection of patient data captured in manual and electronic documentation platforms during the study period will assist in understanding the types of data and knowledge shared, what elements are captured for ongoing patient care, and what contextual elements may need to be structured for inclusion in the EHR.

Sample and setting. A purposive sample was used for demographic homogeneity and to achieve phenomena variation (Sandelowski, 1995). The sample was identified from the daily surgical schedule of a large intercity hospital with a national reputation for quality of care. An initial sample of 10 surgical handoffs from the OR to the PACU was expanded until saturation of data was reached (Privitera, 2015; Sandelowski, 1995). The sample consisted of dyads of OR nurses and assigned patients over the age of 18 years scheduled for total joint arthroplasty, as identified from the surgical assignment schedule on each day of study activities. Patients scheduled for total joint arthroplasty were selected for the propensity of comorbidity and requirements for a higher degree of care coordination following surgery. PACU nurses were identified by the department staffing schedule and the normal rotation of patient acceptance from the OR to the PACU. Nurses were recruited through nomination by the nurse manager and by their expressed interest during face-to-face conversations about the study. Nurses with less than 24 months of perioperative patient care experience were excluded to mitigate for domain knowledge deficits. Adult patients over the age of 18 scheduled for total joint arthroplasty have a higher frequency of comorbidity and require a higher degree of care coordination following surgery. The sample characteristics included only English-speaking men and women who are registered nurses to ensure patient care information exchanged is not influenced by dialect

inferences and translation interpretations that may potentially skew the meaning of data collected. All nationalities and minorities of nurses were included. Children undergoing total joint arthroplasty were excluded based on complexity of medical necessity for the pediatric population.

Consenting of nurses followed permissions being obtained to conduct the study from the Institutional Review Board (IRB) at the healthcare delivery organization, and Loyola University. Consenting of OR and PACU nursing personnel occurred prior to study activities (e.g., up to one week before) based on the study dates and that day's staffing schedule. If assigned personnel were not onsite the day of recruitment, the principal investigator (PI) conducted a phone interview to review the study requirements and determine the nurse's intent to participate. The investigator followed up the day of study activities with the formal consent process to confirm phone agreement to engage in the study. A waver of consent was received from the for the target surgical patient population of adult over the age of 18 years scheduled for total joint arthroplasty as the study focused on the types of information shared during nursing transfer of care communications. Patient data extracted from the EHR occurred retrospectively from the date of surgery by the study PI. During the extraction process, a code was assigned to patient data matching the unique de-identifier assigned to the recorded handoff communication and face-to-face OR and PACU nurse interviews.

Human subjects. To maintain nurse and patient participant confidentiality and secure personal information, the PI completed and maintained the protection of human subjects' research education and certification process offered by Collaborative Institutional Training Initiative (CITI) before and after participating in the study. The research proposal was submitted to the IRB to evaluate if an ethical, psychological or physical threat to study participants or

individuals involved with any portion of the study protocol. As part of the study consent process, nurses were informed their personal information being reviewed to collect study data. Information was provided to participants on the processes used to secure their de-identified personal information in a locked environment located off-site. The database system underwent auditing and used encrypted backup software.

There were no direct physical risks or benefits for individuals participating in this study and compensation, financial or other, was not be offered. Perceived risks to employability, risk of reputation, and breach of confidentiality was disclosure during the consenting process. Participants were informed of the research objective to improve the electronic data capture to promote better care coordination and improved patient outcomes.

Data collection. Data collection followed the nurse-patient dyad through the entire postoperative handoff process beginning with the OR nurse and assigned patient's arrival into the PACU through the transfer of patient care responsibility to the PACU nurse. Data collection sources included:

1. Field notes from observations of nursing activities during the postoperative handoff period.
2. Recording of direct verbal exchanges between the OR nurse and the PACU nurse.
3. Recording of post-handoff interviews with the OR and PACU nurses involved in the postoperative handoff.
4. A brief follow up survey to nurses participating in handoff communication on their use of the EHR to access patient data.
5. Extraction of handoff patient data contained within the electronic documentation system.
6. Identification of communication methods (e.g., phone, face-to-face, electronic) used during the postoperative handoff process.

Variables. Variables are defined as follows:

Demographics. The following demographic information will be collected for each observed handoff: OR and PACU nurse participant identifier (deidentified by department worked) and number of practice years.

Handoff method and data. The variables for this study include the method of data communication (verbal or electronic data capture [i.e., handoff artifacts]), and the information transferred from the OR nurse to the PACU nurse during the patient care transition. Because the handoff process varies within each organization (Hilligoss & Cohen, 2013; Keenan et al., 2013; Ong & Coiera, 2011; Peterson, 2008; Staggers, Mowinski, & Jennings, 2009), the data elements identified from the healthcare organization's handoff tool and complimented by elements from the literature were used to determine the expected transfer of care information to be communicated to the next patient care team. The handoff tool, and subsequent data collection tool developed by the collective data elements, was inclusive of the following set of universal data elements:

- patient demographics (gender, age),
- vital signs,
- allergies,
- type of anesthesia and status (e.g., spinal anesthesia, level of sensation),
- key medical and surgical history for surgical intervention,
- preoperative diagnosis and surgical procedure performed, postoperative diagnosis,
- incision approach and dressings,
- fluid input and output including intraoperative blood loss and transfusions,
- intravenous fluids administered and infusing,

- medications administered during surgery and those pending administration,
- lines and invasive devices (e.g., urinary catheter, endotracheal tube/size, drain type and size, hemodynamic monitoring catheters),
- pending medical orders, and
- outstanding nursing concerns (e.g., tissue changes due to patient positioning).

Procedure. Access permissions from the research site was initiated within one month of starting development of the protocol instructions. Once all necessary permissions to conduct the study were obtained from the designated hospital, the CHIRB, and Loyola University, a visit to the study site was conducted to provide a brief overview of the study purpose for the clinical staff. The study overview raised staff awareness to the intent of the study, allowed acknowledgement of any experience gaps (potential confounder), and provided information for nursing staff to answer questions that may be raised by patients or patients' families.

All verbal handoff communications and participant interviews were recorded and transcribed verbatim by the PI. Transcripts from recorded handoff communications and participant interviews, were reviewed against respective audio recordings for accuracy prior to data analysis completion. Audio recordings for the transfer of care communications began as the consented OR nurse-patient dyad entered the assigned PACU bay. Initiation of the recording occurred after the patient was identified by the OR nurse. Initiating the recording at this point allowed for impromptu unstructured communications to be captured while minimizing interruptions to patient care workflow. The PI was a non-participatory observer simultaneously captured field notes on the data collection tool during the perioperative handoff process.

Participant interviews were conducted using a semi-structured interview process with consented nursing staff who participated in a handoff exchange. All interviews were audio

recorded. Interviews with OR nurses followed shortly after completion of the handoff process when required documentation was finished or when time allowed between patient assignments. PACU nurses were interviewed after the patient is deemed stable and patient care coverage was provided by another nurse or following discharge of the patient from the PACU stay. As part of the study protocol, arrangements will be made with department were conducted as needed and occurred outside of the patient care environment in a private space at a time convenient to the participating nurse.

Permission to record participants during interviews was obtained prior to initiation of face-to-face interviews. Field notes were taken simultaneously as the interview progressed. Initial questions (see Appendix B) were general in nature and included the previously identified demographic data for the description of the sample. As interviews progressed, questions guided by the semi-structured questions became more focused to encourage greater detail, while remaining somewhat flexible to generate new questions centered on the interviewee's perceptions of information requirements for continuing patient care documentation (Privitera, 2105; Rubin & Rubin, 2012). Participants were asked at the close of the interview for permission to be contacted should additional follow-up be required, or clarification of content needed.

Documented handoff data, inclusive of required data elements, operative report, and discharge summary, was extracted from the EHR retrospectively from the day of each recorded nurse-patient dyad handoff communication by the study PI. Extracted patient data was deidentified and coded to match the recorded handoff communication and corresponding interviews allowing for accurate evaluation of EHR data to audio recordings while protecting participant and patient privacy. Collection of patient care handoff related data from the electronic documentation platform assisted with understanding:

- the types of data and knowledge shared by nurses,
- what data elements are captured for ongoing patient care, and
- what contextual elements (i.e., personal knowledge of patient care) may need to be structured for inclusion in the EHR.

Data analysis. Verbal transfer of care communications and participant interviews were recorded and transcribed verbatim. Content analysis of verbal information identified data exchanged beyond the study site's handoff requirements. Types of data between the verbally shared information and the handoff data collection tool, developed from the study site's handoff tool and complimented by elements from the literature, are reported using descriptive statistics. Documented patient handoff data extracted retrospectively from the EHR will be evaluated for an exact semantic match, partial semantic match or no match with the data collection tool and recorded handoff communications. As study data were collected, coding occurred with integration into an electronic database and secured in a locked environment not located at the test site. Preliminary collation and preparation of the data for analysis began during the data collection period.

The data analysis strategy per research aim follows:

Aim 1: Determine what parameters of postoperative patient care (e.g., hospital handoff criteria) are exchanged between the OR and PACU nurses during handoff communications and are captured in the EHR.

1.1 What patient care information verbally exchanged between the OR and the PACU nurses during the handoff period is accurately captured in the EHR?

Analysis: Patient handoff data captured in the EHR was extracted and prepared by collating and logging data into the data dictionary. Once logged, a manual review was conducted

to evaluate data accuracy and fidelity. After all handoff criteria data were collected and reviewed, data were cataloged into a secure database. Scored percentages for each data element from the data collection tool are reported using a descriptive table. Agreement between the coded data and the data extracted from the EHR was evaluated for an exact semantic match, partial semantic match or no match. A mentor of the PI conducted a review of the data collection tool, method of data collection and semantic agreement, and approved the PI's work.

1.2 What contextual patient care information exchanged during postoperative handoff communication is necessary for uninterrupted continuity in ongoing patient care?

Analysis: The recorded verbal handoff exchanges between the OR nurse and the PACU nurse were transcribed verbatim. Verbal information was systematically analyzed through the data reduction process for thematic text and classified into categories representative of the exchanged patient care content. Identification of erroneous (i.e., unintended) data elements verbally exchanged and not identified on the handoff data collection tool were categorized separately. Data removed during the content analysis and not representative of the handoff variable will be weighted for significance for ongoing patient care as established by the literature and defined by the interviews with the nursing study participants. Field notes were evaluated through content analysis and each data element from the handoff tool verbally expressed or documented are represented as score percentages and reported through a descriptive table. A mentor of the PI validated the data reduction themes and categorical text and approved the process and results.

1.3 Do the hospital handoff tools routinely embedded within the health information system, facilitate the accuracy of transitional patient care information exchanged between the OR and PACU nurse?

Analysis: The verbatim transcriptions of verbal handoff interactions systematically analyzed through the data reduction process for thematic text and classified into categories representative of the exchanged patient care content, were evaluated for an exact semantic match, partial semantic match or no match with the data collection tool developed from the hospital's handoff tool. Scored percentage for each data element from the data collection tool and from the content analysis will be reported using a descriptive table. A mentor of the PI validated the evaluation between the content analysis findings and handoff tool and approved the process and results.

1.4 Does the Perioperative Nursing Data Set (PNDS) nursing terminology support the electronic capture of transfer of care communication for ongoing postoperative patient care?

Analysis: Nursing diagnoses, interventions and outcomes (i.e., goals) were manually extracted from the handoff artifacts and the patient EHR data files. The PNDS outcomes are equivalent nursing goals. Concepts within the PNDS are parsimonious without losing semantic meaning (Petersen, 2011) providing a mechanism to map synonyms between the PNDS, categories derived from the content analysis, and the handoff tool. Mapping consisted of identifying an exact semantic match, partial semantic match or no match and reported in a descriptive table. A mentor of the PI assessed the completed mappings with findings evaluated for interrater reliability with the novice PI's findings using a Cohen's Kappa statistic.

CHAPTER FOUR

RESULTS

This chapter presents the findings from the research methods used: intrahospital OR to PACU nursing handoff observations and recordings, participant interviews, chart abstraction and nursing terminology (i.e., PNDS) mappings to coded patient care themes. Data were collected over a six-week period from the OR to PACU handoff communications for 21 adult patients having total joint arthroplasty surgery. A total of 23 Registered Nurses (RN) were consented to participate in the study. The final sample for the observed handoffs communications consisted of nine OR RNs and 12 PACU RNs. Operating room RNs practiced between two and 18 years at the time of the study with a mean average of eight years' experience whereas PACU practice experience was 2-15 years with a mean average of seven years for RNs.

The sample of RNs who participated in the observed handoff communications and follow-up interviews involved seven OR RNs and nine PACU RNs. Of the observed handoff exchanges, three PACU RNs and two OR RNs elected not to participate in the follow-up interview. Of the total RNs participating in the study, 12 also responded to a short follow-up survey on the EHR record and patient handoff.

Patient surgeries included 15 total knee arthroplasty (TKA), five total hip arthroplasty (THA) and one total shoulder arthroplasty. To ensure the maximum amount of variance in the data for handoff communications, the PI elected to continue data collection until a minimum of five revision arthroplasties were observed inclusive of 2 THAs and 3 TKAs of the total observed

handoffs.

Data collection included observation, field notes, and recordings of the OR to PACU RN handoff communications (see Appendix A), interviews of RNs participating in the handoff process (questions, see Appendix B), a 9-question survey (see Appendix C) to participating RNs to understand how they accessed the EHR for patient data, and EHR data abstraction which was completed by the PI. Recordings were lost for three of the 21 recorded handoff exchanges and one of the PACU participant interviews due to equipment malfunctioning. Two PACU RNs involved in handoff exchanges declined participation in the follow up interviews. Data saturation occurred with 10 handoff observations, and, five OR RN and five PACU RN interviews. The data analysis will be discussed in alignment with the stated Research Primary Aim and associated questions:

Primary Aim

Determine what information for postoperative patient care (e.g., hospital handoff criteria) is exchanged between the OR and PACU RNs during handoff communications and is captured in the EHR.

1.1 What patient care information verbally exchanged between OR and the PACU RNs during the handoff period is accurately captured in the electronic health record?

1.2 What contextual patient care information exchanged during postoperative handoff communication is necessary for uninterrupted continuity in ongoing patient care?

1.3 Do the hospital handoff tools, routinely embedded within the electronic health record, facilitate the accuracy of transitional patient care information exchanged between the OR and PACU RN?

1.4 Does the Perioperative Nursing Data Set (PNDS) nursing terminology support the

electronic capture of perioperative transfer of care communication for ongoing postoperative patient care needs?

Primary Aim: Question 1.1

What patient care information verbally exchanged between OR and the PACU RNs during the handoff period is accurately captured in the electronic health record?

Data collection. Data were collected from the patient care information handoff by observing and recording the verbal exchanges with simultaneous filed notes being captured. Field notes were captured on the data collection tool (see Appendix A) using the primary data points from the study site's handoff tool (see Figure 5) and additional handoff elements identified from the literature (Hilligoss & Cohen, 2013; Keenan et al., 2013; Ong & Coiera, 2011; Peterson, 2008; Staggers et al., 2009) before the study began.

Figure 5. Study Site's Handoff Tool

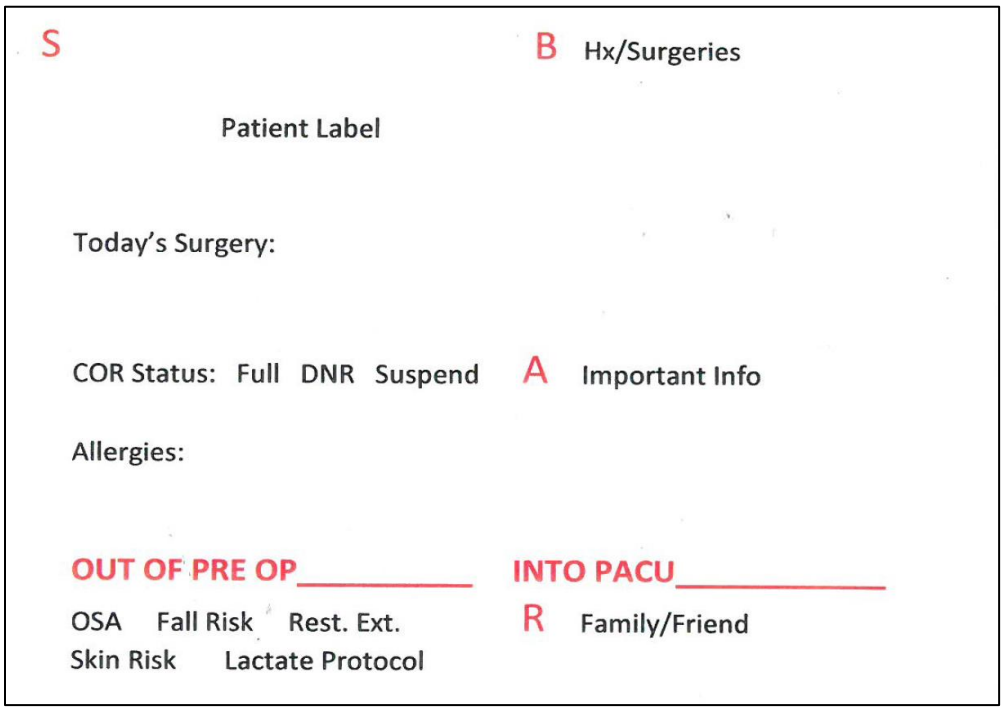

Figure 5. Sample handoff tool prior to data collection.

Recorded handoff exchanges. Recordings from the verbal handoff communications were manually transcribed verbatim by the PI. Transcription accuracy and fidelity was completed by performing a word-by-word review of the transcription against the recordings. Once all recorded data were accurately transcribed, data reduction proceeded with a systematic analysis to identify thematic text which was further classified and descriptively coded (Privitera, 2015) into categories representative of the exchanged patient care information. Privitera describes themes as the "dominant behavior, idea, or trend seen" (2015, p.123) during the study which gives rise to the codes to further define or categorize data. While Contextual Inquiry methodology divides coding into descriptive, emotional (i.e., study participant's response to an event or task), or sequential (i.e., progressive example), descriptive coding was the only approach applied to this study to identify the types of data exchanged between participants.

As descriptive codes were identified from the thematic text, a comparison to the data elements on the study handoff data collection tool (HDCT) was performed. Table 3 illustrates the subsequent themes, associated descriptive codes, and comparison to the data elements on the HDCT.

The descriptive codes surfacing from the data reduction process represent 64% of the data elements on the study handoff data collection tool (N=25). While the theme of "Nursing Interventions" is broadly discussed in the literature, coding demonstrated limited patient specific interventions deemed important by the reporting OR RN. These data are being captured under the ambiguous category of "Important Information" on the study site's handoff tool. "Patient Consideration" was not included on the data collection tool but coded data was articulated on 84% of the perioperative handoffs (N=19).

Table 3. Verbal Handoff (HO) Exchanged Categories

Theme	Descriptive Codes	On HDCT
Postoperative Status	Patient ID	Y
	Allergies	Y
	Procedure Performed	Y
	History -Surgical	Y
	History-Medical	Y
	Dressings	Y
	Drains	Y
	Urine output	Y
	IV fluids	Y
	Medications	Y
	OSA	Y
	Anesthesia type	Y
	Code Status	Y
Family/Support Access	Family	Y
Nursing Interventions		Y
	Tourniquet Time	N
	Cricothyroid Maneuver	N
	TED Hose placement	N
	Bladder Study	N
Patient Considerations		N
	Belongings	N
	Post PACU stay	N
	Home O_2*	Y
	Nickname*	Y

*Descriptive codes are a partial semantic match to a handoff tool data element. Y = Yes; N = No.

EHR data abstraction. Manual EHR data abstraction was performed by the PI. Data were abstracted for each patient involved in an OR to PACU handoff report (N=21) to determine what patient care information was being captured. Abstracted data aligned with the study site's handoff tool and the additional handoff data elements identified from the literature. Abstracted data included descriptive or quantitative details related to each data elements (see Table 4).

Table 4. Abstracted EHR Data and Data Type Examples

EHR Abstracted Data	Data Type Examples
Patient Demographics	Documented, Not Documented
Anesthesia Type	Spinal, General, Block
Surgical Procedure	Right total knee arthroplasty
Code Status	Advance Directives
Problems/Diagnosis	Bradycardia, Complex Regional Pain Syndrome
Allergies	Latex, Penicillin
Obstructive Sleep Apnea Risk	Negative, High Risk
Skin Risk	Documented, Not Documented
Medications	Documented, Not Documented
Surgical History	Colectomy, Knee Arthroscopy
Dressing	ABD Pad, Clear Dressing, Ice
Urine Output	Quantitative Volume
Drains	Quantitative Volume, Location
Intravenous Line	Solution Type, Placement
Blood	Documented Administration, Not Documented
Family / Friends Visitor	Identified and Documented, Not Documented
Preop Diagnosis	Osteoarthritis of (Laterality) Knee
Postop Diagnosis	Osteoarthritis of (Laterality) Knee
Vitals	Temperature, Pulse, Respiratory Rate, Oxygen Saturation, Pain Score
Fall Risk	Presence of Fall Risk Band
Restraints	Applicable, Non-applicable
Lactate Protocol	Implemented, Not Implemented
Incision	Documented, Not Documented
Estimated Blood Loss	Quantitative Volume
Tests/Pending	Type Documented, Not Documented
Nursing Interventions	Deep Vein Thrombosis Prevention

Note: Bolded text represents data elements from the facility handoff tool except for "Important Information."

Abstracted EHR data elements (N=26) were analyzed for an exact semantic match (ESM), a partial semantic match (PSM), or no match (NM) with the coded data (see Table 5). Semantic evaluation was applied to verify if the lexical representation is equivalent between the data types. Descriptive codes reflected an exact semantic matched of 58% (n=15) for abstracted data, no

Table 5. Coded Data to EHR Abstracted Data Semantic Match

Descriptive Code	EHR Abstracted Data	Match
Patient Name	Patient Name	ESM
Anesthesia type	Anesthesia Type	ESM
Procedure Performed	Surgical Procedure	ESM
Code Status	Code Status	ESM
History-Medical	Problems/Dx	PSM
Allergies	Allergies	ESM
Obstructive Sleep Apnea Score	OSA	PSM
Skin Risk	Skin Assessment	PSM
Medications	Medications	ESM
History -Surgical	Surgery / History	ESM
Dressings	Dressing	ESM
Urine output	Urine Output	ESM
Drains	Drains /Locations	ESM
IV fluids	IV/Blood	ESM
Family	Family / Friends visiting	ESM
	Preop Dx	NM
	Postop Dx	NM
	Vitals	NM
	Fall Risk	NM
	Restraint Extremity	NM
	Lactate Protocol	NM
	Important Information	NM
	Position/ Skin	NM
	Incision	NM
	EBL	NM
	Tests/Pending	NM
Nursing Interventions (defined)	Nursing Interventions (documented)	PSM
Bladder study		PSM
Tourniquet Time		PSM
TED hose placement		PSM
Cricothyroid Maneuver		NM

match for 42% (n=11) of the data, and one partial semantic match surfacing (4%). The partial match identified for “Nursing Interventions,” represents the requirement to communicate or

document the implementation of treatments and procedures performed. Four subcategories were identified for "Nursing Interventions," indicative of frequently performed interventions (e.g., Tourniquet Time, TED Hose placement) and periodic interventions not captured in formal documentation nursing (i.e., Bladder Study, Cricothyroid Maneuver). Representation of the "Bladder Study" in documentation was indicated as residual urine volume after scanning; the patient consent form was not included in the EHR. "Cricothyroid Maneuver," also known as Sellick's maneuver (Ovassapian & Salem, 2009), is performed by the OR RN at the request of the Anesthesia provider during endotracheal intubation to occlude the esophagus and reduce the risk of regurgitation. This action was not captured in nursing or anesthesia documentation.

Data capture. To determine what handoff data were accurately captured in the EHR, data elements from the study HDCT were semantically evaluated against the abstracted EHR data. Data presented in Table 6 displays the frequency of communicated data captured in the EHR but does not include the percentage of handoff data present in Anesthesia documentation. While communicated handoff data is present in the EHR, it is only documented if it bares significance to the patient's surgical encounter. For example, "Lactate Protocol" and "Restrained Extremity" were not communicated during the observed handoff exchanges nor were these items identified as interventions in the patient records.

Despite the limitations in what patient care data is communicated during the handoff exchange, responses to the follow-up survey question, "The EHR is inclusive of all necessary patient information to provide patient care," were favorable towards the data captured in the EHR for ongoing patient care needs. Approximately 83% (n=10) of the 12 respondents agreed with the statement while 17% (n=2) strongly agreed. Equally, nursing confidence in finding all needed patient information to make an appropriate clinical decision was similar with only one

respondent (8%) disagreeing, while 67% (n=8) agreed and 25% (n-3) strongly agreed. The survey findings also reflect responses during interviews. Both groups of RNs commented on needing to "…go into the chart history and into a progress note…" or "…dig in the chart…" for data to be fully prepared to care for the patient.

Table 6. Semantic Match Frequency of Communicated Data in EHR

Data Category	ESM	PSM	Not Communicated
Name/Age		71.4%	
Anesthesia		51.7%	
Surgical Procedure		23.5%	
Problems/Dx	4.8%	52.4%	9.5%
Surgery / Hx		6.8%	9.5'%
Code Status		23.5%	71.4%
Important Info.		38.1%	38.0%
Allergies		76.2%	
OSA		23.8%	66.7%
Vitals			85.1%
Fall Risk		4.8%	95.3%
Restrained Extremity			100.0%
Skin Risk		9.5%	90.5%
Lactate Protocol			100.0%
Meds		57.1%	4.8/%
Position/ Skin		14.3%	85.7%
Dressing		66.7%	11.0%
Incision		38.1%	61.9/%
EBL		19%	4.8%
Urine Output		66.7%	9.5%
Drains / Locations	4.8%	90.4%	4.8%
IV / Blood		23.8%	
Tests / Pending			95.2%
Family / Friend		90.5%	
Nursing. Interventions		14.3%	85.7%

Note: Figures do not reflect percentage of anesthesia documentation capturing data

Primary Aim: Question 1.2

What contextual patient care information exchanged during postoperative handoff communication is necessary for uninterrupted continuity in ongoing patient care?

Handoff data identification. Patient care data deemed important by the OR RN for the handoff exchange is identified at the initiation of the patient's surgical care experience in the Preoperative Care Unit (PrCU). While the patient is being prepared for surgery, the OR RN completes a review of the patient's EHR and manually adds notes to the facility handoff tool. The record review is followed-up with a preoperative patient assessment. Data gathered from the EHR or patient information that has been exchanged by the assigned PrCU RN, or the Internist providing preoperative orders, is clarified with the patient and amendments to the handoff tool are made prior to the start of the scheduled surgery. The handoff tool data continues to expand as the patient moves through the surgical care continuum.

Handoff environment. The OR to PACU handoffs occurs in rapidly changing and demanding environment. Multiple conversations, patient equipment alarms, and communications regarding incoming patient transfers permeate the space during each handoff sequence. Immediately before a patient is accepted into the PACU department, the PACU RN receives a brief report from the department Charge RN which initiates a series of activities by the assigned RN to prepare for the incoming patient. If time allows, a review of the patient's EHR is performed in addition to acquiring patient specific appliances or interventional equipment (e.g., bladder scanner), and ensuring the assigned bay is organized and stocked to receive the patient.

Following the scheduled surgical procedure, the patient is brought into the PACU by the Anesthesia provider and the OR RN. As the patient enters the PACU, the OR RN or Anesthesia provider identifies the patient's assigned bay from an assignment board above the nursing

station. Seeing the incoming patient, the PACU RN moves away from the bay computer where the incoming patient's EHR is reviewed (i.e., Summary, MAR, Anesthesia record) and moves toward the EKG monitor at the head of the bed (i.e., stretcher). The OR clinicians exchange greetings with the PACU RN while the patient stretcher is positioned into the bay. Immediately the PACU and OR RN on the opposite side of the stretcher begin attaching monitoring cables to the in-place EKG electrodes. In harmony the PACU RN, the Anesthesia provider, and OR RN face the monitor to check the patient's immediate postop heart rhythm. At the same time, the PACU RN reaches for the tympanic thermometer and takes the patient's temperature from the ear closest to his or her side of the stretcher. The temperature may be repeated on the opposite ear if the reading is questionable. Figure 6 diagrams the high-level process for the OR to PACU handoff exchange.

Figure 6. OR to PACU Handoff: High Level Process

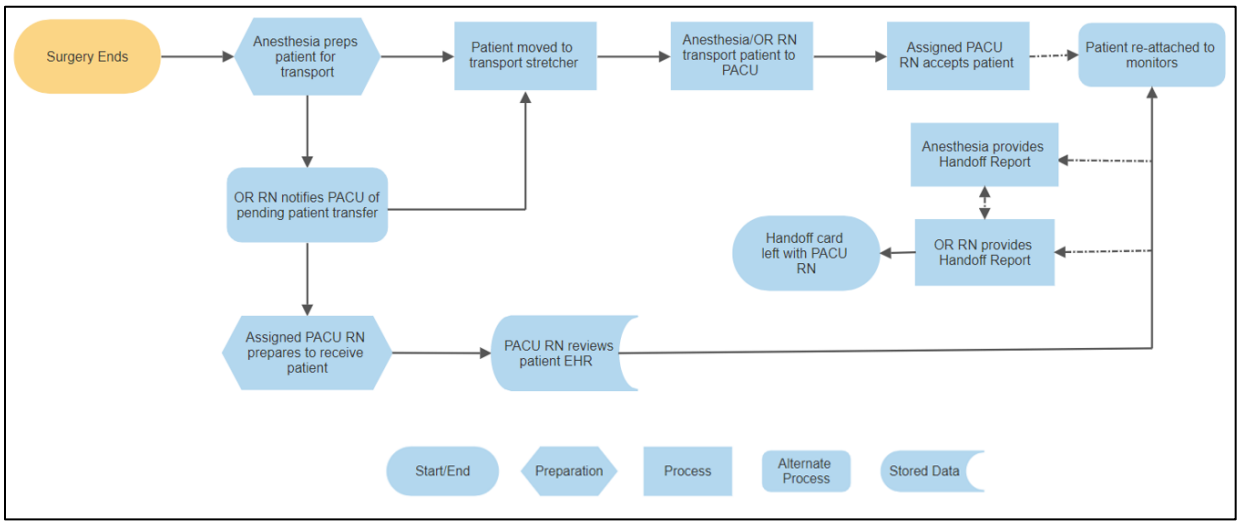

Figure 6. OR to PACU Handoff: High Level Process. The handoff process is initiated with the pending transfer of communication to the PACU and is completed with handoff reports of the Anesthesia clinician and OR RN.

There is a sense of urgency by the OR clinicians to begin the handoff process as soon as the patient is perceived "settled" into the PACU bay. This urgency is fueled by the compressed

time (i.e., ≤ 30 minutes) to prepare the operating room for the next surgical procedure and is demonstrated by the rapid movements to position the patient stretcher and engage in attaching the patient to monitoring equipment. One PACU RN (c-568) described this as the OR team needing to ". . . go off so quickly. . ." If the Anesthesia provider or the OR RN begins the handoff report before the patient's temperature or initial vital signs are obtained, the PACU RN will request additional time before allowing the speaker to proceed. The PACU RN, while concentrating on the activity in process (e.g., obtaining a temperature, adjusting EKG electrodes), will often state, "I need more time," "I'm not ready," or "Just a minute." In response to these comments, the Anesthesia provider or the OR RN will pause and wait for the activities of the PACU RN to be finished before confirming if the handoff report can begin.

After vital signs are obtained and communicated to the Anesthesia provider, the PACU RN will simultaneously begin to assess the patient, giving special attention at the dressing site. The PACU RN places an insulated bag of crushed ice, available in anticipation of receiving the patient, over the dressing site and continues to assess the patient's affected extremity for color, pulses, and sensation. At any point during this initial assessment, the PACU RN may ask clarifying questions or confirm relayed information. For example, during one OR RN handoff report, the procedure was identified as ". . . we did revision, where we did his cup (d-583)." The PACU RN responded with a query on what was meant by the statement. The OR RN replied, "It's the acetabular component instead of the whole thing (d-583)."

Patient information exchange. The handoff report is initiated by the Anesthesia provider or the OR RN. Who initiates the start of the report is dependent on the Anesthesia provider and the perceived pressure to return to the OR to prepare for the next surgical procedure. During the Anesthesia report the OR RN remains silent, sometimes reviewing written

notes or speaking quietly to orient or answer questions from the somnolent patient. The OR RN will listen to the Anesthesia report and offer details (e.g., estimated blood loss) if the provider does not have the data available. This practice also serves to tailor the content the OR RN relays and prevent redundancy in data and information communicated during his or her report. Post Anesthesia Care RNs exhibit extra attentiveness to the Anesthesia report and often confirm or repeat back medications administered, comparison of intraoperative vital signs to currently captured vital signs and clarifying any imminent concerns for the post anesthesia period (e.g., need for Intensive Care Unit bed). Anesthesia providers consistently ask the PACU RN if they have additional questions or needs for their assistance before returning to the OR. Anesthesia data and information relayed accounts for approximately 36% (n=9) of the data elements on the study HDCT (N =24). Data communicated by Anesthesia personnel is frequently repeated by the OR RN representing reinforcement of key information for continuity of patient care (see Table 7).

The OR RN may provide the handoff report from memory, reference information captured on the 4x4 inch handoff card (i.e., handoff tool) or use a combination of both while attempting to make eye contact with the PACU RN. A pause in the handoff occurs if questions are raised or assistance is need by the PACU RN. The pause to clarify or assist the PACU RN is an immediate response by the OR RN. This practice was unmistakable when OR RN (j-670) was describing placement of a patient's implanted spinal cord stimulator battery pack. In response to the PACU RN's subtle response, the OR RN instinctively reacted by physically pointing to the placement of the device. At the close of the handoff report, the OR RN will also confirm there are no unanswered questions and will wait for the PACU RN to acknowledge the question before returning to the OR.

Table 7. Frequency of Facility Handoff Tool Data Communicated

Data Category	Nurse	n	Anesthesia	n	Not Communicated	n
Name/Age	72.60%	16	23.80%	5		
Surgical Procedure	90.50%	19	28.60%	5		
Problems/ Dx	57.10%	12	33.30%	7	9.50%	2
Surgery / Hx	61.90%	13	28.60%	6	9.50%	2
Code Status	23.80%	5	4.80%	1	71.40%	15
Important Info.	38.10%	8	28.60%	6	38.10%	8
Allergies	76.20%	16	28.60%	6		
Obstructive Sleep Apnea	23.80%	5	9.50%	2	61.60%	14
Fall Risk	4.80%	1			95.20%	20
Restrained Ext.					100%	21
Skin Risk	9.50%	2			90.50%	19
Lactate Protocol					100%	21
Family/Friend	90.50%	19	9.50%	2		

Operating Room RNs relay patient care information based on practice standards established by AORN (Fearon & Spruce, 2018; Giarrizzo-Wilson, 2016b). Data elements included on the study HDCT identify the minimum information to be incorporated into perioperative handoff communications. Operating Room RNs also expressed the importance of "special" patient considerations that may impact their continuing care including psychosocial and physical determinants of health (HealthyPeople.gov, 11/5/19). Conditions considered "sensitive" were always communicated but were not documented (e.g., physical abuse). Table 8 illustrates the determinants of health communicated during these perioperative handoff

exchanges.

Table 8. Communicated Determinants of Health

Determinants of Health	Communicated	Documentation
Living Arrangements	Homelessness	Documented
	Special living conditions	Documented
Social Support	Who is with them	Documented
Transportation	Who is transporting home	Documented
Physical Barriers	CPAP	Documented
	Sensitivities (environmental, medications)	Documented
	Absent lung not identified	Documented
	Physical assessment findings (prosthetics, skin conditions)	Documented
Psychological Status	Difficult upbringing	Verbally communicated
	Post-Traumatic Stress Disorder	Verbally communicated
	Pain tolerance	Documented
Language barriers	interpretation services needed	Documented
Behavioral	combative emergence from anesthesia	Documented
	drug/alcohol abuse	Documented

Frequently, PACU RNs would return to the patient's EHR to document vital signs or reexamine additional patient information when the OR RN's report followed the Anesthesia report. This move to the computer, positioned next to the patient's stretcher, occurs while the OR RN is actively speaking. Alternately, the PACU RN will simultaneously monitor the patient while actively adjusting devices (e.g., monitoring equipment), intravenous lines, or securing

equipment in the immediate patient care area. The PACU RN may interject data and impressions from patient monitors while the report is in process. This multitasking conveys a lack of attentiveness to the OR RN during this portion of the handoff report. One OR RN expressed it as, "Sometimes, … a lot of times, I feel like they're not even paying attention . . . He's more focused on getting ice on him [the patient] and . . . getting him adjusted (G-421)." Another comment reflected the collective OR RNs' perceived sense of inattention, ". . . If they don't remember anything I've said, it's all charted, so they have that as a reinforcement. . . (H-811)."

Post Anesthesia Care Unit RNs rely on the OR RN's report to provide baseline information (e.g., patient name, surgeon name, and procedure), unusual patient history or an intraoperative event. Verbal exchanges are the preferred approach on heavily scheduled surgery days when time is limited to access the EHR versus when the time between patients permits a thorough review of the incoming patient's record. One PACU RN stated:

> . . . if I have a few minutes before the patient comes, I already know what the OR RN is telling me minus dressings. If I don't have any time, then everything I am telling you [the PI] is brand new information. So, if I've had time, they're probably not going to tell me anything new. If I don't have time, yeah, I might have to dig in the chart after (Q-187).

Primary Aim: Question 1.3

Do the hospital handoff tools, routinely embedded within the health information system, facilitate the accuracy of transitional patient care information?

Documentation of exchanged patient care information represents a combination of preoperative data collected by the OR RN from the patient's EHR and discussions held with the patient and family members during the interview immediately before the surgical procedure. The collected preoperative data is transferred to the 4x4 inch facility issued handoff tool (see Figure 7).

Figure 7. Preoperative Handoff Tool

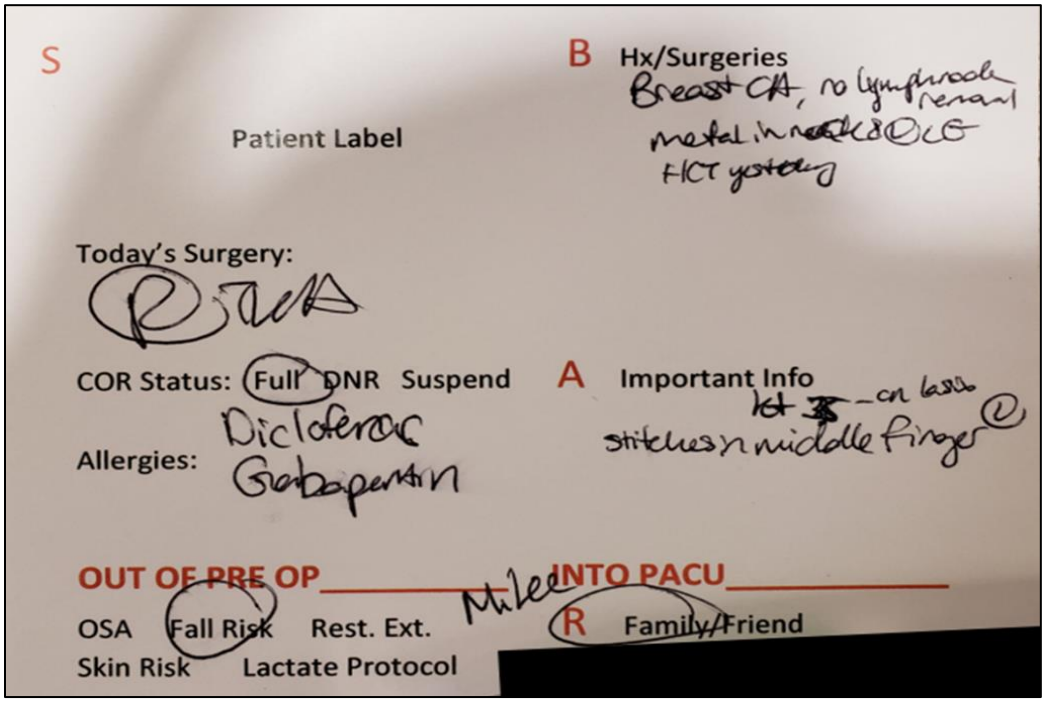

Figure 7. Preoperative Handoff Tool. Study site sample of the preoperative handoff tool with initial OR RN notations of patient data to be relayed during the PACU handoff period.

The handoff tool follows the patient from the preoperative unit through surgery and into PACU. Additional patient information is captured in the EHR as intraoperative nursing interventions are performed throughout the surgical procedure. These supplemental data are selectively added to the facility handoff tool (see Figure 8) or communicated from memory during the postoperative handoff by the OR RN. A subjective determination is made by the OR RN on what information is collected and communicated during the handoff report.

The category of "Important Info" is designated by the OR RNs for "special" patient information to pass on during the handoff communications. Data that may be included are patient preferences (e.g., nick name, tape sensitivity), unique patient care concerns (e.g., living situation, medical devices, participation in clinical study), unusual intraoperative events (e.g., excessive bleeding), and testing completed (e.g., presurgical blood glucose) in the Preoperative Care Unit.

Similar to not capturing “sensitive” patient considerations in the EHR, this data type is also not documented on the handoff tool and only communicated verbally with the PACU RN during the handoff information exchange.

Figure 8. Postoperative Handoff Tool

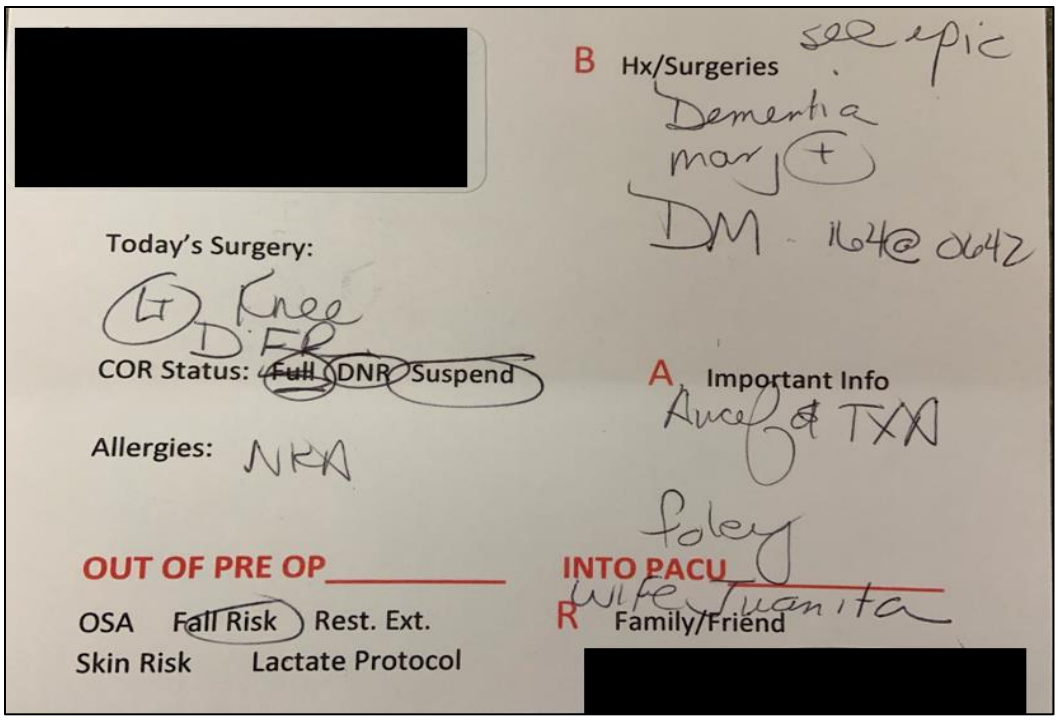

Figure 8. Postoperative Handoff Tool. Study site sample of the postoperative handoff tool with notation to “see epic” for additional patient care data.

The facility issued handoff tool does not reflect the complete list of data elements recommended in the literature or found on published handoff resources (AHRQ, 2019; IHI, 2013; TJC, 2017; WHO, 2008). The additional data elements added to study handoff data collection tool from the literature include:

- Anesthesia type
- Patient problems or diagnoses
- Vital signs
- Medications

- Patient positioning with skin integrity findings
- Dressings
- Incision location
- Estimated blood loss (frequently communicated by Anesthesia)
- Urine output
- Drains with location
- Intravenous fluids type and amount administered
- Blood products administered or available
- Testing completed or pending
- Nursing interventions completed or pending

During interviews, OR RNs who are employees of the hospital, expressed the categories on the handoff tool are sufficient to collect the patient information needed for the postoperative transfer to the PACU. Alternately, OR RNs contracted as travel nurses noted the handoff tool is deficient in providing the detailed information that should be shared during the handoff report. One contracted OR RN commented on the facility handoff tool and compared it with other organizational tools previously used:

> . . . some places there's a prefilled-out form instead of a little card where you fill things in, like a pretty detailed paper, you fill out the dressings spot. Our little card, there's no place for dressings, and drains or anything like that, that's called off [from] memory that I'm telling them [PACU RNs] . . . Even though it is in the computer, there's so many different tabs and so many different areas you've got to look to see all this information. It's nice to have it on an organized sheet of paper. . . if they [PACU] really . . . had a question and needed to find something out they could find it in the electronic record, but I think it's easier and less is missed if you have it [handoff sheet] right there in front of you (G-421).

Post Anesthesia Care Unit RNs also reported discrepancies between data on the facility handoff tool and what is documented in the EHR. Comments about ". . . often what they have on that

little card for history does not match what I have in the computer. . . (G-422)" and what is captured in the EHR ". . . is not filled out (j-671)" on the handoff card.

Primary Aim: Question 1.4

Does the Perioperative Nursing Data Set (PNDS) nursing terminology support the electronic capture of perioperative transfer of care communication for ongoing postoperative patient care needs?

The PNDS is an empirically validated standardized nursing language informing perioperative nursing's contributions toward surgical care outcomes (Petersen, 2007). The current version is a non-published 4th edition that is fully integrated into the automated standardized documentation framework, AORN Syntegrity® (AORN Syntegrity®, n.d.). The 4th edition of the PNDS association (i.e., mapping) tables are available to subscribed clients within the AORN Syntegrity® Online Companion Guide, a resource for the application and integration of the documentation solution into EHR vendor systems.

AORN Syntegrity®. The Syntegrity® platform incorporates the PNDS clinical workflow for the perioperative plan of care and maps the PNDS coded Assessments, Implementation, Evaluation and Outcomes to practices standards, evidence-based guidelines, and, regulatory and accreditation requirements. The PNDS documentation data elements are also mapped to federally recognized EHR clinical languages, SNOMED CT®, ICD-10PCS, CPT-HCPCS, Medicare Inpatient and ASC (Ambulatory Surgery Center) coding standards. Client feedback is incorporated into quarterly releases representing user engagement in maintaining product integrity (AORN Syntegrity® Q4 2019).

Within the Syntegrity® documentation framework (SDF), the coded PNDS elements are

mapped to the three phases of perioperative care: The Preoperative, Intraoperative, and Postoperative periods of a patient's surgical encounter. Each phase is broken down into the requisite documentation data for the relevant plan of care and the surgical Health Systems domain of operational, non-clinical resource allocation fields (e.g., patient acuity scores, productive/nonproductive time, anesthesia type). Documentation Data Sets (see Figure 9) are defined by categories and groupings of finite data fields supported by regulatory, accreditation and practice guidelines for perioperative care. The PNDS data elements, and other EHR clinical languages, are associated for each Primary Field documentation point with supporting regulations, accreditation, and practice guidelines detailed under the supplementing Clinical Information option (AORN Syntegrity® Q4 2019).

Figure 9. AORN Syntegrity® Documentation Categories

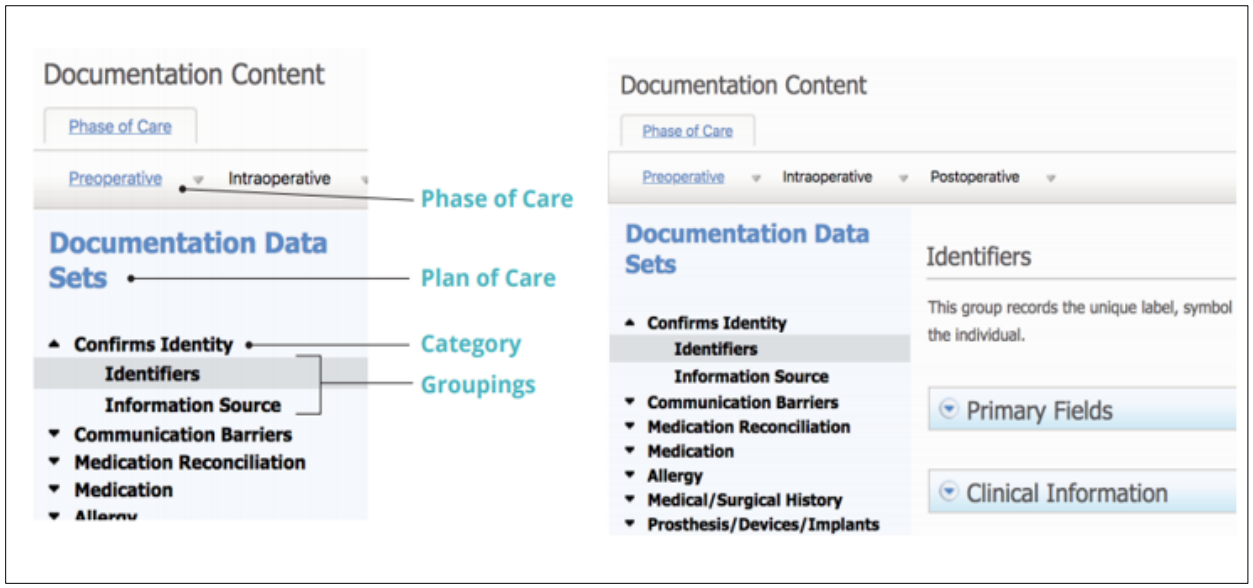

Figure 9. AORN Synegrity®Documentation Categories. Copyright AORN Syntegrity®. All rights reserved. Reprinted with permission.

PNDS mapping to handoff data elements. The handoff data collection tool (HDCT) and the verbally exchanged handoff themes (HT) were mapped to the PNDS coded Nursing

Problems, Assessments, Implementation, Evaluation and Outcomes in three steps. To understand how the PNDS was utilized for clinical documentation, mappings began with the SDF. Data elements from the HDCT and the HT were compared to each perioperative phase of care for related PNDS documentation elements. For example, the HDCT data category of "Name/Age" is aligned with the HT "Patient ID." These concepts are found in the SDF Health Systems Domain. The Syntegrity® platform maps the concept of "Patient ID" to the Health Systems Domain (H) and PNDS Assessment (A) coding (see Table 9).

Table 9. PNDS Mapping to Handoff Data Elements Example

Handoff Data Collection Tool Element	Handoff Theme: Patient Status	PNDS Codes	PNDS Code Label	Primary Fields [Documentation Point]
Name/Age	Patient ID	A.10	Confirms patient identity	Patient Identifiers
		H.905	Patient name	Patient Name
		H.910	Birthdate	Date of Birth

It became apparent while conducting this mapping, the SDF does not incorporate Nursing Problems (i.e., Nursing Diagnoses) as a documentation element and not all PNDS documentation groupings included an Outcome assignment. The PNDS Plans of Care were then considered for additional codes to map to the HDCT-HT data elements. This review did not provide insight into further PNDS data elements to use.

The third step taken to rectify coding variance employed the PNDS association tables that define the alpha-numeric codes, concepts, and definitions encompassed within the 4 domains of the Perioperative Patient-focused Model of Care which provides the foundation for the PNDS language (AORN Syntegrity®, n.d.). The PNDS tables are pre-coordinated (i.e., pre-

implementation) associations of the language from Assessment to Nursing Problems, Nursing Problems to Outcomes, Outcomes to Implementation and Implementation to Evaluation with the specific domain of the Patient-focused Model of Care identified for each data element.

Using the HDCT-HT mappings to the SDF, the PNDS tables were reviewed for Nursing Problems, Outcomes and additional Implementation coding to supplement the HDCT-HT mappings. When a HT did not have a matching concept to the HDCT, the HDCT data element was used to map to the PNDS tables. For each PNDS Outcome present in the HDCT-HT mappings, a corresponding and concept relevant Nursing Problem code(s) was assigned. The remaining HDCT-HT mappings to the SDF were compared to the PNDS tables for congurence with existng Assessment and Evaluation codes and to identify supplemental Implementation code to complete the mappings. Of the 28 HDCT-HT data elements, 11% (n=3) received an additional Assessment code assignment, 14% (n=4) an Implementation and Outcome assignments, and an additional 1 to 18 Nursing Problems were identified for all data elements. No HDCT-HT data elements required an Evaluation code. Three HDCT-HT data elements (i.e., Patient ID, Anesthesia Type, Surgical Procedure) incorporated a Health Systems Domain data element to represent operational information necessary for scheduling surgery. Table 10 identifies the HDCT-HT data elements receiving additional coding from the PNDS mapping tables. The final HDCT-HT mappings to the SDF and PNDS tables were reviewed by two members of the dissertation committee experienced in nursing terminology. Due to the inability for the committee members to access the proprietary SDF documentation content, the review was limited to the PNDS mapping tables. Discussions with the PI on the approach used and clinical significance of the mapped content were deemed appropriate though interrater reliability could not be determined. An additional review was completed by a mentor of the PI who had worked

with the periopaerative nursing language and SDF platform while employed with AORN. Following the second review, a Cohen's κ was run using SPSS v25 to determin interrater reliability for agreement between the PI's mappings and the mentor's knowledge of the PNDS associations and application into the SDF. An almost perfect agreement was obtained, $\kappa = 1.000$, $p < .0001$. Findings from the collective mappings demonstrate the PNDS supports the minimum electronic capture of perioperative transfer communications.

Table 10. Additional PNDS Cods Mapped to HDCT-HT Data Elements

HDCT-HT Data Element	Assessment	Implementation	Outcome	Nursing Problem
Medical History	6	12		18
Allergies			2	3
Fall Risk		1		3
Extremity Restraint	1			1
Skin Risk				1
Surgical Hx			12	13
IV Fluids/Blood	1			2

Note: All HDCT-HT data elements received Nursing Problem assignments.

CHAPTER FIVE

DISCUSSION

Dissertation Purpose

The purpose of this dissertation was to explore the human communication process during postsurgical patient care transitions to determine what information is exchanged during the transition in care to the PACU, the data elements necessary for continuity in postsurgical care and if the data are present in the EHR to support transitioning postsurgical patient care needs. A discussion of the study findings and insights gained from the data analysis and the implications for nursing informatics, perioperative practice, education, and policy follows.

Data for Ongoing Care

Transfer Communications

Findings from this study suggest the information exchanged between all perioperative nurses is important to the continuing care of the postsurgical patient. While OR RNs focus on data required for intraoperative care and safe patient outcomes, recurring themes in the PACU RN data center on the immediate patient status inclusive of the anesthesia type. Post Anesthesia Care Unit RNs emphasis on anesthesia is suggestive of a conscious knowledge (Nibbelink, & Carrington, 2019) of the patient's condition from the biological effects of anesthetic agents. Consistent with the literature (Reine, Ræder, Manser, Småstuen & Rustøen, 2019a), Post Anesthesia Care Unit RNs expressed information seeking behaviors as developing awareness of the patient's status and to coordinate a progressive surgical recovery plan of care. Desired information to be shared by the OR RN reinforces existing acquired knowledge and was often

identified as “the basics” (e.g., name, procedure, wake up history, family present). Of least significance was the specific details of the surgical dressing. Operating Room nurses are taught to report dressing materials should it need to be changed, reinforced or to pass dressing components to the next nursing care unit. All but one PACU RN noted the dressing was an optional piece of information and was presented as an assertion for needing immediate patient status indicators (e.g., vital signs, medication history) during the time-limited interactions during handoff.

Patient data shared during the immediate postoperative period represent a tight subset of what is identified in the literature and perioperative practice guidelines and recommendations (AORN 2019; AHRQ, 2013; IHI, 2013; TJC, 2017, 2020; WHO, 2008). Data and information obtained during the preoperative patient interview, and the EHR, inform the OR RN of patient-specific intraoperative interventions needed to achieve identified interim outcomes during the surgical encounter. These data and any untoward intraoperative events are relayed during the PACU handoff period. Participation in the comprehensive collection and documentation of patient data is vital to informing and promoting interdisciplinary collaboration in care delivery (ANA, 2016). OR RNs capture patient information in a written (e.g., handoff tool) or electronic format to facilitate data accuracy and reduce the reliance on memory to retain vital details (Jefferies et al., 2012).

“Sensitive” patient considerations, such as behavioral health issues, are verbally communicated but not documented on the handoff tool. Though sensitive patient conditions were captured in each patient’s EHR, the absence from the handoff tool presents a point for information decay heightened in the presence of a time-constrained environment (Jensen et al., 2014; Holly & Poletick, 2013). Time-limits for face-to-face handoffs add to abridged

communications with the understanding that patient information is captured in the EHR (IOM, 2012). Information seeking by PACU RNs is also limited to the timeframe allotted before patient arrival. Reliance on the face-to-face interaction to convey important patient considerations without a written cue, increases the cognitive burden to retain this information in the working memory. While not identified during this research process, variation in clinical practice can contribute to the loss of similar patient information should the data not be captured in the EHR or integrated into the ongoing plan of care (Jefferies et al., 2012; Borofsky et al., 2017).

Consideration must be given to the handoff process when the assigned OR RN does not accompany the patient to PACU. During one day of study activities, a patient was brought into the PACU by an Anesthesia provider and a relief OR RN. The relief RN only communicated the patient's name, surgeon and procedure performed. When asked for clarifying information on the patient's history by the PACU RN, the relief RN stated she was the "relief nurse" and "did not work with the patient." The handoff tool held by the relief RN was incomplete. In this instance the PACU RN did not have sufficient time between patients to review the incoming patient's EHR. The Anesthesia provider also did not have the information requested. The quality of the verbal handoff was hindered by the circumstances of an uninformed relief person. Intraoperatively, a thorough handoff, including pertinent care concerns, should occur with the relief personnel to promote care continuity (AORN, 2019; Fearon & Spruce, 2018; TJC, 2017).

Adequacy of the Handoff Tool

The facility handoff tool is designed in an SBAR format, a nationally accepted format for handoff communications, to enable the capture of individual patient care data necessary for the safe delivery of intraoperative and postoperative phases of the surgical care continuum. As noted in the literature (Braff, Riley & Manias, 2015; Collins, Stein, Vawdrey, Stetson, &

Bakken, 2011; Rattray et al., 2018; Weir et al., 2011), the OR to PACU handoff is completed as a collaborative interdisciplinary activity with each interaction demonstrating shared responsibility in the patient's care. Comments during interviews substantiated the collaborative approach helps to mitigate loss of patient care information as gaps in patient data are covered by the alternate OR clinician during his or her report. This process of collaborative information coverage to ensure information gaps were closed additionally helps to reinforce PACU RNs newly formed knowledge from reviewing the patient's EHR. During times when PACU RNs did not have time to review an incoming patient EHR, the collaborative process provided a framework for the generation of new knowledge for individualized care delivery.

While this collaborative process is replicated with each occurring handoff, opposing views on the effectiveness of the facility handoff tool were conveyed during the study. Operating Room RNs act as gatekeepers of patient information (Holly & Poletick, 2013) by completing the handoff tool to provide a concise and relevant transfer communication with the intent of ensuring the correct information for continuity of care while acting as a cognitive artifact for the transitory communication process. Consideration is given to patient data determined to have significant clinical implications (e.g., test results, unusual intraoperative events) or importance to the patient's welfare (e.g., ride home, psychosocial issues). Conversely, participating PACU RNs prefer EHR data and the Anesthesia handoff communication. This expressed preference reflects the need to concentrate on information necessary for immediate care activities of the post anesthesia patient (Lillibridge, Botti, Wood & Redley, 2017; Reine et al, 2019a). Only when time was restricted between patient arrivals, did PACU RNs afford more attention to the OR RN communications. This was displayed frequently as direct eye contact or clarification of information relayed.

Often, PACU RNs did not retain the handoff tool at the closure of the transfer report. Operating Room RNs noted the handoff tool provides a "quick reference" since the handoff report occurs simultaneously to patient assessment and monitoring activities. Consistent with the current literature (Holly & Poletick, 2013; Rattray et al., 2018; Reine et al., 2019a; Reine, Rustøen, Ræder, & Aase, 2019b), PACU participants identified conflicting data between the EHR and the handoff tool and data not being documented or "passed along" further influencing the perceived value of the handoff tool. Though an SBAR format is provided on the handoff tool, the limited visual data cues allow subjectivity in determining what should be included for transfer communications. The limited data cues require some OR RNs to rely on memory for provided patient care. This suggests the current format of the handoff tool emphasizes the gatekeeper role, increasing the potential for incomplete information transfer and the PACU RNs' dependence on information seeking from within the EHR (Holly & Poletick, 2013; Reine et al., 2019a).

Important information. Data captured as "important information" sporadically mirrored nursing interventions such as urinary catheter insertion or application of antiembolism stockings. Verbal recognition of nursing interventions was limited during the study period regardless of national practice standards identified in the literature (ANA, 2016; Giarrizzo-Wilson, 2016b) requiring their inclusion. Participants from the OR spoke of nursing interventions completed during interviews but frequently did not acknowledge their actions during handoff. Alternately, PACU participants consistently expressed their desire to be informed about outcomes from OR RN interventions (e.g., assessment findings, treatments completed). The possibility exists the ambiguity in the category of "important information" does not provide the supporting visual signal to include pertinent nursing intervention data.

The theme of "patient considerations" was also noted under the "important information" category. Four distinct data types emerged during data analysis: belongings, post PACU stay, home oxygen use and patient nickname. Naming these data elements suggest the OR RNs' conscious knowledge (Nibbelink & Carrington, 2019) of the patient's care continuum and the personal significance for the patient. Post Anesthesia Care Unit RNs would affirm the mention of this information and clarify specific details when needed. An additional item that was not included under patient considerations, but should be considered, is the patient's primary language (AHRQ, 2013; ANA, 2016; Giarrizzo-Wilson, 2016b). During the study period, one patient used English as a second language, noted when the patient responded to the PACU nurse in English but with a substantial accent. The OR RN did not share the primary language nor did the PACU RN request more information.

EHR Capture of Transitional Care Communications

Influence of the Electronic Heath Record (EHR)

Contrary to what has been documented in the literature (Brattheim et al., 2011; Wisner, Lyndon & Chesla, 2019), findings indicate the study site's EHR is a dependable cognitive tool for promoting intraprofessional collaboration and care delivery. The empirical representation of data in the EHR permits necessary interpretation and synthesis of patient care information. Study participants identified the current EHR, one year in use, "more reliable" with improved access to patients' longitudinal care history as opposed to the previous version. The current EHR offers a fully functional platform for user interface to support clinical judgment and communication (Kossman et al., 2013). Similar to other EHR systems, the user designed displays of the current system do not provide the flexibility to view multiple screens simultaneously requiring additional navigation to obtain a complete rendering of the patient's status.

Collective participant comments suggest the EHR is a comprehensive representation of patient care information (IOM, 2012), citing the "Summary" document as a main data source. Often, OR participants stated PACU RNs could refer to the EHR for handoff content as needed. Post Anesthesia Care Unit RNs routinely accessed clinically meaningful information (Wisner et al., 2019) from the "Summary" and "Anesthesia" documents prior to the patient's arrival. These routines of accessing the EHR to facilitate patient care and to initiate interdisciplinary communication offered opposing perspectives during the research period. While PACU RNs obtain the greatest portion of patient care information from the Summary and Anesthesia documents, they do not review or find value in the intraoperative nursing record for potential ongoing patient care needs. Instances occurred when PACU participants were unable to locate specific patient data (Staggers et al., 2011), inclusive of past medical and surgical histories (e.g., cardiac diagnosis, hernia repair) identified during the handoff process and made a point to call this out during interviews. Operating Room RNs spoke of individual patient concerns not captured in the EHR (e.g., allergies, location of personal belongings in a security locker) and intraoperative interventions (e.g., cricothyroid maneuver) not entered by Anesthesia or Nursing. These omissions of patient information, valuable to ongoing patient care, combined with the frequency of non-communicated data in the EHR (see Table 6) bares consideration as a patient safety indicator for transfer communication practices.

Cognitive Impact

Postoperative patients are a highly vulnerable patient population as metabolic functions return to baseline from anesthesia administration and stabilize from the intraoperative intervention. Handoff exchanges during this period of transition from one level of care to another are a significant point of cognitive complexity and organizational priority (Bonifacio et al., 2013;

Reine et al., 2019a). Communications during care transitions include the provision of critical patient information with the physical transfer of supportive technologies (e.g., monitors, invasive lines) to facilitate subsequent healthcare interventions (Petrovic et al., 2015). What is communicated and how it is structured can facilitate the individualized care continuum or introduce a measure of disparity in the delivery process. The significance of the care environment where the transition occurs, and the tools employed to relay patient information further influence the direction of clinician engagement and information sharing. For nursing, ongoing care requirements are strongly associated with patient outcomes. The availability of needed patient information for decision making can be hampered by the requirements to locate data within the EHR (Lillibridge et al., 2017; Roman, Ancker, Johnson, & Senathirajah, 2017; Wisner et al., 2019) thereby increasing cognitive workload from navigation challenges presented by digitally fragmented displays (IOM, 2012; Roman, et al., 2017).

EHR navigation. Establishing and sustaining the common ground for information sharing evolves through the exchange of data and the tools used. The complexities inherent within the handoff process are amplified with intrahospital transitions in care and by the environment necessitating a rapid creation of the shared mental model (Collins et al., 2011; Hardiker, Dowding, Dykes, & Sermeus, 2019; Weir et al., 2011; Wisner et al., 2019). Coupled with an increased effort to navigate the EHR, the user stores more information from previously viewed screens in the working memory (Roman et al., 2017). With increased cognitive load, nursing judgment is diminished from the inability to retain the new knowledge generated without viewing the same display of patient information (Birmingham et al., 2015; Roman et al., 2017; Wisner et al., 2019).

Findings from this study identified similar usability concerns and the impact on

knowledge development from both groups of participating nurses. Comments on the processes to identify patient information in patient EHRs were more difficult under constrained timeframes. Frequent references to "If I have time. . ." or having to ". . . start digging in [the EHR]. . ." by PACU RNs indicated the importance of having a foundation of knowledge about the patient before his or her arrival to the unit (Reine et al., 2019a). Participating OR RNs expressed this as missing preoperative information that is ". . . not there [in EHR] right away" or was "different" than the information received during the preoperative assessment. Time spent navigating through the EHR when the "Summary" page was incomplete increased notations on the handoff tool by OR RNs to decrease reliance on memorization (Staggers et al., 2011; Staggers, Clark, Blaz, & Kapsandoy, 2012). Post Anesthesia Care Unit participants focused on specific surgical data (e.g., vital signs, medications) from the "Anesthesia Record" or "Summary" page for baseline patient information and background, consequently establishing a foundation for a shared mental model of the patient's condition. Few PACU RNs captured notes on paper when reviewing the EHR. Both OR and PACU participants accessed contextualized information to aid in the delivery and receiving of handoff information (Collins et al., 2011; Reine et al., 2019b). Despite the enhancements and improvement in portions of cognitive work with the current EHR system, overall cognitive load increased with navigation challenges (Coiera, 2009; Brattheim et al., 2011; Roman et al., 2017; Weir et al., 2011; Wisner et al., 2019). Information and knowledge loss were noted when PACU RNs sought clarification on handoff data or questioned the purpose of the surgical intervention performed.

Perioperative Nursing Data Set (PNDS)

Strengths. The PNDS is an interface terminology providing a complete representation of the perioperative nursing domain's knowledge (Cimino, 1998; Rosenbloom, Miller, Johnson,

Elkin, & Brown, 2006). Receiving ANA recognition in 1999 as a "data set useful in the practice of nursing" (Petersen, 2011, p. 407), the PNDS has evolved to maintain currency with perioperative nursing practice, accreditation requirements and regulatory edicts. While interface terminologies facilitate integration and aggregation of clinical data in EHR systems (Rosenbloom et al., 2006), they should also be integrated into reference terminologies (e.g., SNOMED CT®) to support synonymy and compositionality (McDonald, Chute, Ogren, Wahner-Roedler, & Elkin, 1999; Rosenbloom et al., 2006) and allow for improved interoperability of clinical data. The PNDS was mapped to the SNOMED CT® in July 2003 to support the exchange of perioperative nursing data across health information technology (health IT) and promote continuity in care and safe patient outcomes (Westra, Bauman, Delaney, Lundberg, & Petersen, 2008). The PNDS was also mapped into the International Classification for Nursing Practice (2010), registered with Health Level Seven (2009), and the National Library of Medicine (2010) (Petersen & Kleiner, 2010).

With the 2009 automation of the PNDS into the AORN Syntegrity® documentation framework (SDF) (Giarrizzo-Wilson, Maxwell-Downing, & Bowman-Hayes, 2011) came the opportunity to aggregate and quantify perioperative nursing knowledge presented by the documentation mappings of the language representing perioperative nursing influence on patient outcomes (Petersen & Kleiner, 2010). The current digital edition of the PNDS, integrated into the study site's EHR system, has eliminated implementation ambiguity, and standardizes the application of the perioperative nursing process in clinical documentation. As no new data elements for ongoing care emerged during the study to be incorporated into the EHR, the question arose, what is the role of nursing terminology to the ongoing care for post-surgical patients?

As the findings identified, the PNDS supports the minimum electronic capture of perioperative transfer communications. The discovery process to identify PNDS codes for nursing diagnosis, interventions (i.e., Assessment, Implementation, Evaluation), and outcomes for handoff data elements validated the terminology symbolizes the perioperative plan of care clinical workflow (see Figure 10) (Petersen & Kleiner, 2010) and nursing knowledge characteristic of transitional care communications. Past literature (Junttila, Salanterä & Hupli, 2005; Killen. Kleinbeck, Golar, Takahasi Schuchardt & Uebele, 1997) identified perioperative

Figure 10. Perioperative Plan of Care Clinical Workflow

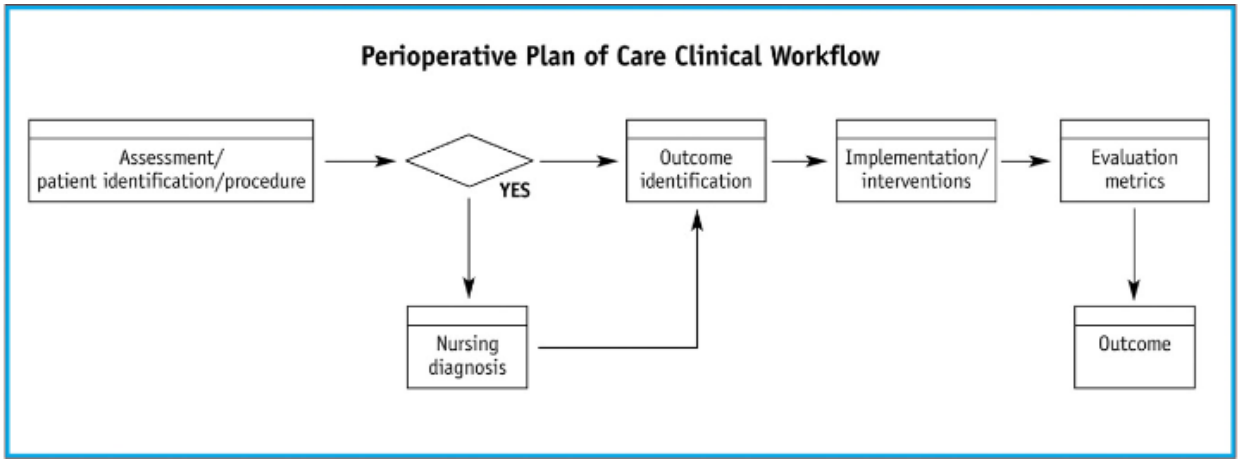

Figure 10.Perioperative Plan of Care Clinical Workflow. Kleiner, C. & Petersen, C. (2010). *Evolution and revision of the Perioperative Nursing Data Set. AORN Journal, 93*(1), 6. https://doi.org/10.1016/j.aorn.2010.07.015. Copyright John Wiley and Sons Publishers. Reprinted with permission.

nurses' resistance to using the nursing process to develop individualized patient plans of care. At the time these studies were conducted the PNDS was manually integrated into paper or electronic documentation platforms. The introduction of the AORN Syntegrity® platform alleviates the PNDS documentation burden with a consistent and reliable representation of clinical relationships to nurse-sensitive outcomes and demonstration of perioperative nursing care judgments. The relevance of the PNDS to ongoing care outside of the OR has not been established (Lamberg, Salanterä & Juntilla, 2013) and no studies were found in PubMed on the

SDF's contributions to ongoing patient care. This study is the first, to the author's knowledge, to examine the automation of the PNDS in the AORN Syntegrity® platform for transitional care communications.

Weaknesses. While the automation of the PNDS language facilitates the clinical documentation process, weaknesses in the automation were identified during the mapping process for perioperative handoff data elements. The SDF closely aligns selective PNDS data elements to supporting federal regulations, healthcare accreditation, and clinical practice guidelines. This alignment extends to the Syntegrity® Primary Fields and ensures the necessary data are captured as part of the patient's longitudinal health record. The Primary Fields identify levels of data to collect which are mapped to the PNDS coded elements.

The analysis of the PNDS in the SDF concluded an omission of Nursing Problems exists in addition to some Assessment, Implementation and Outcome coding that could be incorporated to expand the representation of perioperative nursing knowledge and nurse-sensitive outcomes. Though the literature acknowledges nursing problems are unnecessary due to perioperative nursing clinical judgment being focused on patient safety and prevention of harm (Junttila et al., 2005; Killen et al., 1997; Petersen, 2011), the inclusion of nursing problems included in the documented plan of care is indicative of the enumerated relationships within the language and each concept's orientation (Cimino, 1998; Petersen, 2011). Interface terminologies developed with pre-coordination (i.e., enumeration) have a precise concept definition (e.g. patient name), to avoid context-sensitive ambiguity by maintaining semantic coherence through alignment of concept intention (Cimino, 1998). Terminologies using post-coordinated concepts are unique in data granularity allowing for concept groupings to create meaning (e.g., first name + middle name + last name) (Goss et al., 2013). This discussion of pre-versus post-coordination of a

terminology's concepts becomes important when examining the automation of an interface terminology, like the PNDS. The absence of mapped PNDS nursing problems to the SDF Primary Fields permits instability of the hierarchical relationships within the language. An example of this instability noted during the PNDS mapping process for the handoff tool data element "Belongings," is displayed in Table 11. The Outcome O.700 is found in the SDF document category of "Psychosocial" and the subcategory of "Patient Property." Without a nursing problem mapped to the SDF Outcome the relationship appears logical. Mapping the associated PNDS Nursing Problems identified in the PNDS Association Tables, the relationship becomes questionable with concept ambiguity introduced and increases opportunities for missed care or adverse events (Roman et al., 2017).

Table 11. Example of PNDS Hierarchical Relationship Instability

Handoff Tool Data Element	PNDS Outcome	PNDS Nursing Problem	Primary Fields
Belongings	O.700 Participates in decision affecting the patient's perioperative plan of care	NP.505 At risk of conflict between religious belief and healthcare recommendation NP.506 Decisional Conflict	Patient Belongings

It is not within the scope of this study to complete a comprehensive examination of the PNDS structure within the SDF, but it is noteworthy to consider the ramifications on the language's stability going forward. The methodology to maintain and expand the language must differentiate between creating additional concepts to precisely represent nursing knowledge versus attempting to accommodate the exact representations of required documentation actions (McDonald et al., 1999; Cimino, 1998). The current digital version of the PNDS has been

expanded to accommodate precise clinical conditions (i.e., nursing actions). For example, the 3rd edition of the PNDS intervention code Im.220 Administers prescribed medications, included four child codes to accommodate immunizations, electrolyte therapy, antibiotic administration, and medications for blood gas results. The digital 4th edition added three additional codes corresponding to medication administration based on pain assessment, laboratory/point-of-care results, and prophylactic antiemetics. Additionally, the electrolyte therapy code was reassigned to fall under Im.205 Manages fluid and electrolytes while keeping the conceptual meaning for electrolyte therapy medication administration unchanged. The reassignment was presumably to reduce redundancy between it and medications for blood gas results. Without a statement of user consensus or detailed descriptions regarding concept movement or expansion (Cimino, 1998) it is unknown if the changes were deemed clinically necessary, in response to supporting healthcare agency documents, or a perceived gap in the language that could not be accommodated with the existing structure. Maintenance of the language must evolve with care delivery advancements and as patient care requirements change. Interface terminologies like the PNDS offer a mechanism to represent domain phenomena but need to mature without hindering or overburdening the representation of practice.

Kennedy Integrated Theoretical Framework (Updated)

The Kennedy Integrated Theoretical Framework (KITF), Figure 11, established the theoretical foundation to guide the study in the exploration of the human communication process during patient transitions from the OR to the PACU to identify what data are necessary for ongoing patient care and if existing data in the EHR supports transitioning postsurgical patient care needs. The KITF identified the relationships in the patterns of knowledge (Kennedy, 2012; Phenix, 1964) in handoff content that used communication channels of phone notifications, EHR

information seeking, face-to-face interactions, and the facility issued handoff tool. The functional information patterns of cognitive artifacts promoted situational awareness of the patient condition and reinforced working memory patterns for study participants. Consistent with distributed cognition theory (Liu et al., 2008; McLane et al., 2010), findings noted the emergence of team collaboration (i.e. distributed collaboration) through the movement of information and data shared across human interaction and artifacts within the clinical communication space (Brattheim et al., 2011; Coiera, 2000; Kuziemsky & Varpio, 2010). As handoff exchanges progressed, common ground shaped through situational awareness generated new knowledge about the patient's condition as data was shared and interpreted (Coiera, 2000; Liu et al., 2008).

Figure 11. Kennedy Integrated Theoretical Framework

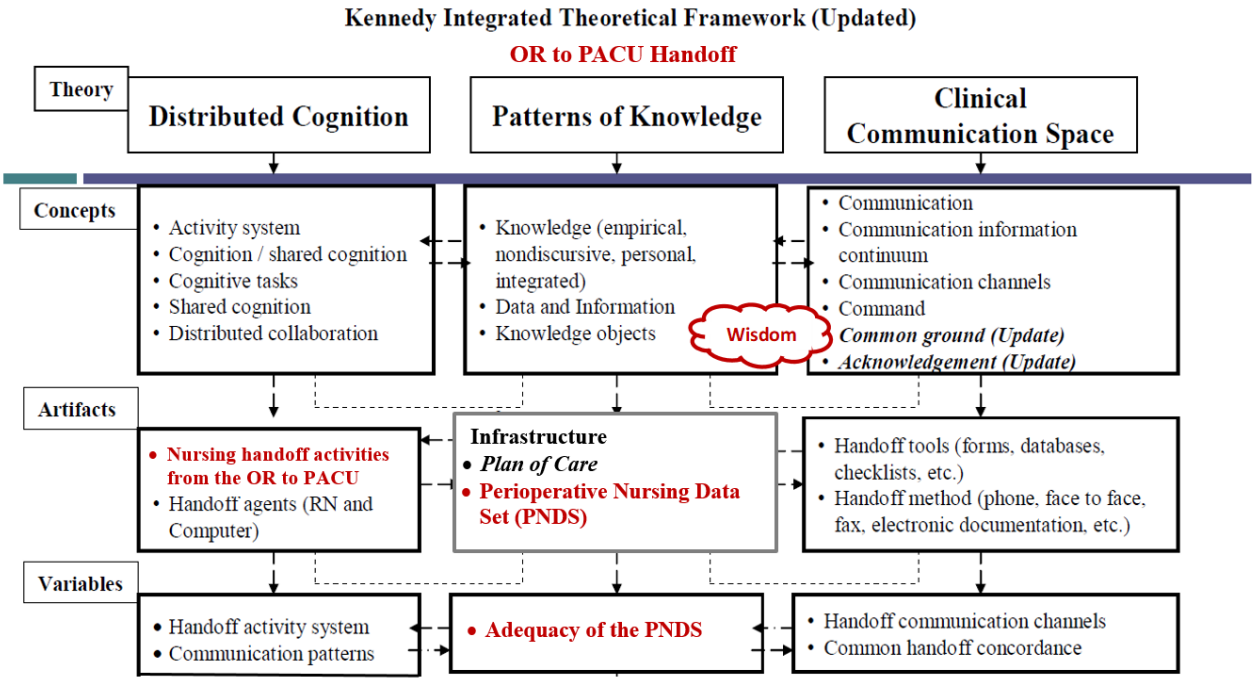

Figure 11. Kennedy Integrated Theoretical Framework. Modifications to the Kennedy Integrated Theoretical Framework completed with permission from the author.

Communication and Information Continuum

Patterns in contextual exchanges. Distributed collaboration utilizes functional

information patterns (i.e., representational states) as information is exchanged between the OR and PACU agents (see Figure 12). The propagation of representational states moved patient specific data between agents and the EHR by way of cognitive artifacts (static or electronic cues) designed to facilitate the handoff process and complete the transfer of patient information

Figure 12. Distributed Collaboration: Agents and Artifacts

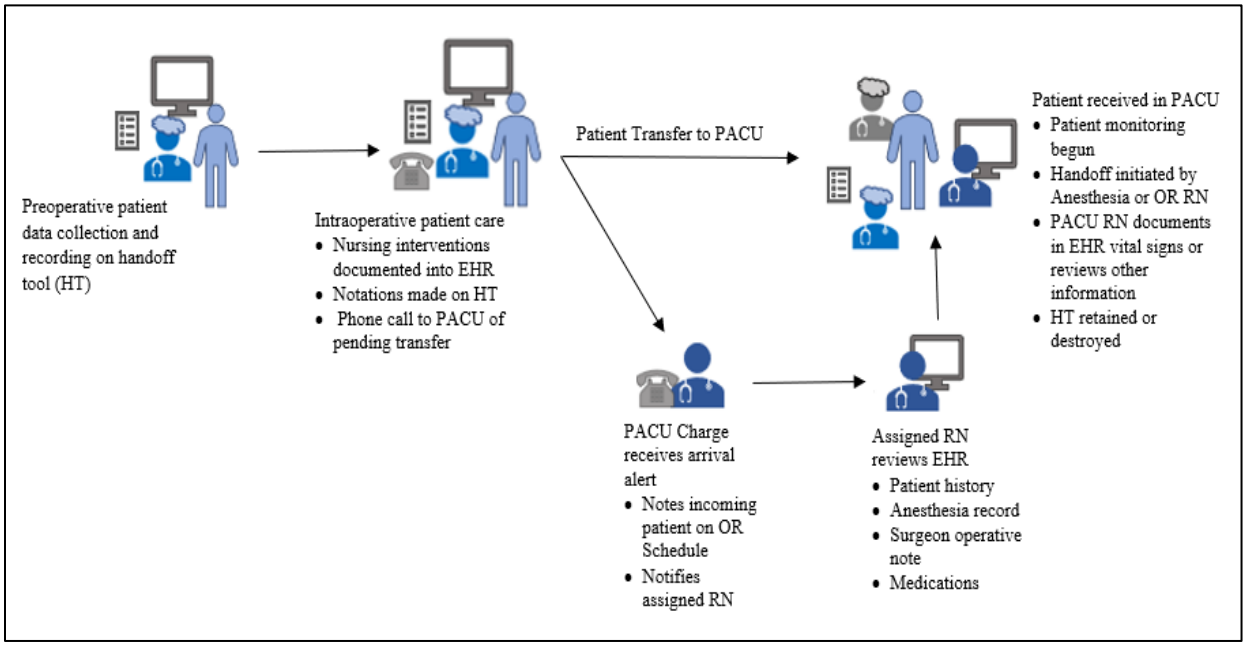

Figure 12. Distributed Collaboration: Agents and Artifacts. The transmission of representational states moving patient data between perioperative agents and the EHR using cognitive artifacts.

(Hazlehurst et al., 2008; McLane et al., 2010; Patel & Currie, 2005). The cognitive artifacts employed during transfer communication also increased coordination of activities by augmenting agent tacit knowledge through non-verbal communication patterns (Xiao, 2004) as seen with agent body language displayed and interpreted as a cue for more information or assistance in immediate patient care activities. Non-verbal physical cues are representative of the interactive process of information movement between parties in a less structured communication path within the space of shared common ground (Coiera, 2000). The concept of non-verbal communication patterns exist within the clinical communication space of the KITF. A recommendation to further

modify the framework is made for the inclusion of this concept to bring heightened attention to the dynamic nature of patterns in contextual exchanges in the clinical communication space.

Prioritization of data, information, and knowledge to be shared between agents (i.e., person or EHR) for handoff communications are scripted according to an SBAR format on the handoff tool. Data aggregation initiating with the preoperative visit and ending with the patient's arrival in the PACU could theoretically continue to follow the patient to postoperative placement and help inform the next team of patient care clinicians without navigating through the EHR. The promotion of a common handoff concordance throughout the patient's healthcare continuum could help to reduce cognitive load and encourage improved patient outcomes (Galatzan & Carrington, 2018)

Wisdom. Study Findings identified "Wisdom" in the KITF as the implementation of specific actions in response to tacit knowledge or clinical reasoning in a situation (Edmonson et al., 2009; Matney et al., 2015). The development of tacit knowledge occurs as common ground is shaped through situational awareness (Coiera, 2000) with the synthesis of information shared between agents and formalized in the working memory to allow the execution of judgments for appropriate care delivery interventions (Englebardt & Nelson, 2002; Matney et al., 2010).

Displays of wisdom were infrequent during postoperative patient transfer and amounted to spontaneous actions to assist with settling patients in the PACU bay, physically indicating where an implanted device was on one patient, and gathering additional supplies based on information obtained from the EHR. Spoken interventions by participating OR RNs were limited to routine surgical care activities (e.g., urinary catheter insertion) during their patient's encounter. Conversely during interviews, contextual data referenced multiple clinical actions as participants spoke of intuitive-base judgments and interventions. Examples included

coordination of postoperative services for an indigent patient, implementation of behavioral health interventions, and specialized patient positioning interventions for anatomically challenged patients. Though additional research is warranted, this study validates the presence of wisdom evolving from the distribution of cognition emanating from the shared information and data across human interaction and artifacts within the clinical communication space.

Implications of Findings

Implications for Informatics

EHR usability. While this study was not focused on usability issues, concerns regarding the human-technology interface surfaced. The findings from this study validated EHRs with a fully functional user interface, supports clinical judgment and team communication (Kossman et al., 2013), user designed displays requiring navigation through multiple screens increases cognitive load as more information is stored in the working memory (Roman et al., 2017). All study participants acknowledged improved accessibility with the current EHR over the previous system. Comments also discussed usability problems to search for needed patient information that was not intuitively available. The ability to locate patient information effortlessly facilitates the delivery of care and promotes effective team communications. Design features with displays to view multiple screens simultaneously (Roman et al., 2017) will reduce time sensitive activates and navigation requirements (Jensen et al., 2014; Wisner et al., 2019). Reengineering cognitive aids (e.g., handoff tools) and incorporating clinical decision support platforms that compute patient-specific data to infer handoff information prior to patient arrival to the PACU can facilitate transitional care delivery (HealthIT.gov, n.d.). The use of mobile communication (e.g., tablets, cellular phones) could simultaneously identify missing data elements important to ongoing care and reduce the need to navigate fragmented EHR data displays while promoting

active engagement during handoff communications. Integration of adaptive processes into existing tools (e.g., interoperable infusion pumps) within the time constrained transitional care environment would further improve the intrahospital OR to PACU handoff procedure.

Interface terminologies. Electronic Health Records that integrate interface terminologies representing a clinical domain have a vehicle to aggregate the knowledge of practice and contribute to new understanding in care delivery (Cimino, 1998; McDonald et al., 1999; Rosenbloom et al., 2006). The tension between domain knowledge and clinical usability with interface terminologies (Rosenbloom et al., 2006) needs to be balanced. As found in the PNDS mappings, efforts to accommodate the multiple requirements for capturing health information in the EHR without retaining relationships for concept intention can create ambiguity in the language.

The current representation of the AORN perioperative nursing language, the PNDS, in the electronic documentation framework has been adopted by multiple EHR vendors (AORN Syntegrity®, n.d.). Demonstrated by the study site's EHR, the language facilitates the capture of recommended perioperative handoff data and information. A more significant consideration is how the domain representation of the interface terminology influences the synthesis of information into tacit or explicit knowledge. This impact on the codification of knowledge is a contributing factor in patient safety (Turner et al., 2014). The codification and sharing of a domain's knowledge are further shaped by the conditions of sharing knowledge (Asrar-ul-Haq & Anwar, 2016). If ambiguity exists in the embedded interface terminology, is there consistent interpretation of meaning by users? Further study on how automation effects the PNDS and other interface terminologies will help determine whether all concept relationships need to remain intact to be sufficient in representing domain phenomena. Additional analysis is also necessary to

assess the impact on patient outcomes and how the interface terminology moves data to information for clinical decision support and knowledge generation for nursing judgment.

Implications for Perioperative Nursing Practice

Handoff tool. During the handoff process, the information communicated regarding the patient status contributes to the individualized plan of care involving an interdisciplinary care team with the goal of increasing the safety of care delivery by the receiving healthcare professional (Cohen et al., 2012; Cohen & Hilligross, 2010). Patient information may be conveyed using paper or electronic records, and with or without exchanges of personal clinician insights of the patient care experience.

The study site adopted national patient safety recommendations to use a standardized handoff tool. The handoff tool utilizes the frequently cited Situation-Background-Assessment-Recommendation (SBAR) format to improve team communications (Abraham et al., 2013; AHRQ, n.d.; AORN, 2016; IOM, 2013). The handoff tool is scripted with data-type cues aligned to the SBAR layout to assist population of content to provide during the postoperative transfer communications. Employed participants from the OR described the tool as an effective artifact to collect data for the handoff report while contracted OR participants stated the tool is incomplete for a comprehensive report and required an increased reliance on recall for omitted data cues during handoff. The life of the handoff tool terminated in PACU where the tool is devalued due to discrepancies between it and the EHR.

The incongruities between the perceived inadequacies of the tool and the EHR creates a weak link at this vulnerable transition point for ongoing patient care. Lost data adds to the cycle of information decay and is compounded by the working memory's ability to manage and manipulate data for immediate patient care activities (Jensen et al., 2014). Furthermore, the

SBAR format, though a well-documented tool for delivering critical patient information, has failed to demonstrate effectiveness in co-creating a shared mental model during handoff to promote beneficial clinical outcomes (Cohen et al., 2012). The importance of data and information transfer during care transitions and the influence of the practice environment on the effectiveness of communications cannot be underestimated. An immediate need for the study site is to use an evidence-based strategy to evaluate the current handoff tool. This would be best facilitated with a workgroup representing all stakeholders (i.e., OR, PACU, Anesthesia, Clinical Leadership, Quality/Risk Management, Education) to specify the desired and critical data to support ongoing care of the postsurgical patient. A digital report could also be developed that aggregates and populates the specific data for handoff as the patient moves through the surgical care continuum. The report should include functionality to print at any point in the care process and could also follow the patient to the postoperative care environment (e.g., clinical floor, rehab unit) as a comprehensive care summary individualized to the patient. The enhancements to the handoff tool and the potential care summary report could stimulate more interaction during the transfer communications as both groups of perioperative RNs would have the same information on one screen or document thereby decreasing cognitive load and information sharing.

Implications for Education

Guidelines for nursing curriculums incorporate content on transferring patient care and the importance of the interprofessional communication process (AHRQ, n.d.; American Association of Colleges of Nursing, 2020). The growing adoption of health IT in clinical practice is changing how these communications occur by acting as an intermediary for information transfer. Human interaction is still needed to confirm the accuracy of data and information and to deliver the tacit knowledge that may not be capture in documentation platforms. Nursing

programs, clinical education, and training offerings need to incorporate the role of situational awareness in co-creating shared mental models and how this progression of mutual understanding shapes collaborative engagement for ongoing patient care requirements.

As clinicians increasingly rely on the collective health IT ecosystem (e.g., EHR, mobile communications, applications) to retrieve transitional patient care information, there is a need for educational programs to provide instruction on the types of data to review for ongoing care. Findings from this study identified the importance of receiving immediate patient care data by the PACU RNs. Their information seeking behaviors are consistent with their domain knowledge requirements, but this can be an information limiting factor without the collaborative insights from the OR RNs. Transitions in perioperative patient care require a comprehensive representation of patient status inclusive of interventions provided by the perioperative nurses. Incorporating the knowledge and actions of the OR RNs into their awareness of the patient condition can help to inform clinical wisdom and decision making that is infrequently captured in clinical documentation (Kossman et al., 2013; Mckie et al., 2012; Yee et al., 2013).

Implications for Policy

One of the six priorities of the National Quality Strategy for Quality Improvement in Healthcare is the focus on effectiveness of communication and care coordination (AHRQ, 2017). In concert with the National Quality Strategy, the Office of the National Coordinator (ONC) established *The Federal Health IT Strategic Plan 2020-2025* to improve the nation's health IT infrastructure within a framework incorporating advancing person centered health, transforming health care delivery, and fostering research and innovation (ONC, 2020). Since the start of this study, the ONC is revising specification requirements for electronic clinical quality measures (eCQM). Oversight to identify and commission development of eCQMs is provided by CMS.

CMS coordinates quality measurement efforts to address the National Quality Strategy six priories (CMS, 2020). Transitional care measures for discharge planning from acute to home or long-term care are currently in development (CMS.gov, 2019, November 20). Currently there are no measures addressing intrahospital care transitions. As more interest is garnered in the area of patient care transitions between clinical units and the quality of data communicated for ongoing care, continuing research in this domain will drive improvements in the functionality of health IT for care coordination, supporting clinical judgment, and expand the requirements for electronic specification of quality measurement.

Study Strengths and Limitation

Study Strengths

This study advances the knowledge on effective transitional care communications in the perioperative care environment. The research established an understanding of the types of data and information exchanged during postoperative patient transitions to the PACU to support ongoing patient care and if the data captured in the EHR supports transitioning patient care needs. Findings identified the EHR is a central artifact in the preparation to provide ongoing care for perioperative transitions and when patient data is omitted, or a discrepancy exists between the information relayed during handoff, patient safety is at risk (Bloomrosen et al., 2011; ONC, 2019).

The KITF was the supporting theoretical framework for transfer communications for postsurgical patients. The findings confirmed the theoretical constructs of distributed cognition, patterns of knowledge and the clinical communication space are transferable to intrahospital care transitions. The perioperative nursing language, the PNDS, provides the plan of care within the framework, although, as the language is currently mapped within the Syntegrity® documentation

framework, concept ambiguity skews the translation of the perioperative plan of care. Findings also validated the concept of wisdom is present within the framework, but further research is needed to fully explore the concept.

This study is the first, to the researcher's knowledge, to examine the automation of the PNDS in the AORN Syntegrity® platform for transitional care communications. While not a comprehensive examination of the language automation, the findings suggest additional research is needed to fully examine how automation affects interface terminologies to determine if all concept relationships need to remain intact to be sufficient in representing domain phenomenon.

Study Limitations

The most significant limitation for this research project was the single study site. Despite having a robust surgical orthopedic volume, the study site is biased by regional influences. The hospital is in close proximity to the Association of periOperative Registered Nurses (AORN), a national driver for establishing perioperative nursing standards of care. This point positively skewed some study findings (e.g., use of SBAR on handoff tool). This limitation did not influence data collection as discrepancies were noted during handoff communication process. The study used a convenience sample of limited size, based on study aims and the research methodology to define detailed contextual and observable knowledge through immersion in context, the sample size was appropriate. The OR RN sample also introduced some bias as the study site used service line teams (e.g., orthopedic, spine, cardiac). To diminish the impact of repeated RNs providing handoff reports, study days were adjusted to involve as many of the orthopedic RN team as possible to reduce the frequency of reoccurring team member participants. Since data saturation was quickly reached, additional study days were added to include revision total joint arthroplasty, a more complex procedure. No supplementary concepts

were identified with the additional observations.

Novice PI bias was mitigated by having an experienced researcher and mentor of the PI completed evaluations of the data reduction process and mapping processes. Interrater reliability for the PNDS mapping was evaluated using a Cohen's Kappa statistic to determine agreement between findings of the novice PI and the research mentor who was involved with the language through automation while employed at AORN.

To minimize threats to external validity by the Hawthorne Effect, the PI was on site at the study hospital in the Surgical Services department a month before the research was begun to provide education on the background of the study and the PI's perioperative experience. During study activities, a portion of the handoff observations were conducted at random (i.e., avoiding sequential observations for any one PACU nurse participant) (Yee et al., 2013). The recording device was discreetly placed in the clinical environment to permit audio capture without being intrusive to participants and interviews were conducted in a quiet, secure area away from clinical routines.

Direction for Further Research.

Identifying gaps in structured EHR data is necessary for transitional care to better inform nurses regarding the data and information to be communicated to the next patient care provider and contribute to new requirements to improve the safety of health information technology in perioperative clinical practice. Improving the accuracy of EHR transfer of care data elements supports improvements in the safety and efficiency of ongoing patient care. While study findings did not identify specificity in data elements to add to the EHR, the findings confirmed over 50% of the minimum data stipulated in practice and accreditation guidelines for transfer communications was present in the EHR with full lexical representation with the study site's

handoff tool. The homogeneity of the patient population in the study who are classified as "elective" surgical patients may have contributed to this finding. Replicating the study on other scheduled but similarly complex patients with a higher care acuity (e.g., spine, cardiac) may contribute new knowledge for data elements representing required ongoing care. Broadening the scope of the study, Anesthesia providers will be included to explore the contributions of this clinician group to ongoing care requirements that overlap with nursing and determine new dimensions for the perioperative collaborative care model.

Additional considerations for expanding this research center on the PNDS and the KITF. The remaining component of mapping the PNDS to the Quality Data Model (QDM) will complete the replication of the KITF. The QDM is the template utilized for the development of national eCQMs for healthcare reporting and incentive payments. Mapping the digital 4th edition of the PNDS Association tables to the QDM will offer perioperative nursing practice an additional level of representation that can be measured and quantified through process and outcome measures. Implications for how the language is currently mapped within the AORN Syntegrity® documentation framework EHR may be impacted by the results of the mappings to the QDM. Performing a comprehensive study on the structure of the PNDS within the documentation framework may help establish a baseline for further research on interface terminology stability and whether the current mappings are feasible for data extraction for eCQMs.

Complimenting afore mentioned considerations is the continuing research need to explore the role of wisdom in the KITF. The current study noted the limited demonstrations of wisdom during perioperative patient transfers and the frequency of expressed wisdom during interviews. Approaching the exploration of wisdom in the KITF may require replication of the study premise

by following the included patient population through the entire perioperative continuum. Following handoff communications throughout the patient's surgical experience will expand findings through Clinical Inquiry methodology elucidating the intersection of wisdom within the framework.

Conclusion

This dissertation is a first step in understating the types of data and information exchanged during postoperative patient transitions to the PACU to support ongoing patient care and the relationship of the data captured in the EHR to supporting transitioning patient care requirements. The study revealed complexity in the human communication process and the importance of establishing shared awareness to facilitate common ground and information transfer. The design of handoff artifacts (e.g., paper, electronic) significantly impact the value of information received. Incomplete handoff tools or EHR data adds to the cycle of information decay while contributing to an increased cognitive load and decreasing the ability of the working memory to manage and manipulate data for immediate patient care activities.

The patient's condition and the circumstances of the handoff environment greatly influences the quality and completeness of transfer communication. With compressed timeframes to provide the handoff exchange, PACU RNs initiate information seeking in the EHR before the patient's arrival. The records reviewed provide domain knowledge and immediate patient status awareness but do not include the intraoperative nursing record of care. The OR RN coordinates with Anesthesia to relay data and information that validates the PACU RN's newly acquired knowledge and fills in gaps occurring during handoff. The findings confirmed over 50% of the minimum data required for transfer communications were present in the EHR, though no additional data elements were identified for inclusion in perioperative handoff exchanges.

As a central artifact in the preparation to provide ongoing care for perioperative transitions, the EHR can contribute to unanticipated patient safety events if an omission or discrepancy exists with the information relayed during and handoff. When interface terminologies are incorporated into the EHR, they become a mechanism to represent and measure domain knowledge. Terminologies must evolve and change with clinical phenomena but without impacting the representation of practice.

The recommendations from the data analysis discussion will contribute to improving the quality of transitional communications at the study site and expand representation of perioperative practice in electronic documentation frameworks.

APPENDIX A

HANDOFF DATA COLLECTION TOOL AND FIELD NOTES TEMPLATE

	Date:		Handoff		S												B	A										R	Comment	
Count	Nurse	Code	Method	Format	Demographics	Anesthesia	Surgical Procedure	Code Status	Problems/Dx	Allergies	Vitals	OSA	Fall Risk	Skin Risk	Lactate Procol	Meds	Rest. Ext.	Surgery / Hx	Important Info.	Position/Skin	Dressing	Incision	EBL	Urine Output	Drains / Locations	IV / Blood	Tests / Pending	Family / Friend	Nsg. Interventions	
1	Dyad																													
	PACU																													
2	Dyad																													
	PACU																													
3	Dyad																													
	PACU																													
4	Dyad																													
	PACU																													
5	Dyad																													
	PACU																													
6	Dyad																													
	PACU																													
7	Dyad																													
	PACU																													
8	Dyad																													
	PACU																													

General Notes:

APPENDIX B

INITIAL INTERVIEW QUESTIONS

OR RN Questions

1. Please provide your name, age, department, number of years practicing as a perioperative RN, and your highest degree earned.
2. When you prepare for handoff, what types of information are you collecting about the patient?
3. When you receive your patient assignment how do you gather the information about that patient?
4. As you are working through the surgery, what type of information do you normally collect, pull together, for the PACU handoff?
5. What type of information do you feel the PACU nurse might need that wasn't asked about or is not on the [handoff] card?
6. Can you tell me about a time the PACU nurse ask for information?
7. What type of information is critical for the PACU nurse to know about the patient that would be important for continuing care in the hospital or a rehab unit?
8. Tell me about an experience when the PACU nurse asked you for information after you've given them everything that you have on the [Handoff] card?
9. What might make the handoff better or more streamlined?

PACU RN Questions

1. Please provide your name, age, department, number of years practicing as a PACU RN, and your highest degree earned.
2. How do you prepare for accepting the patient into the recovery room?
3. When you prepare for a patient that's coming in, what type of information do you look for in Epic [EHR] to help prepare?

4. What type of information are you anticipating or would like to get from the OR nurse?
5. What type of information do you look at on the intraoperative record?
6. Do you receive any handoff information by phone, or by a text from the [OR] nurses?
7. What do you document for your handoff?
8. Tell me about a time when you didn't feel you were getting enough information from the OR nurse.
9. Is there anything else that you would like to mention related to handoff or concerns related to handoff that might impact the patient going forward?

APPENDIX C

THE ELECTRONIC HEALTH RECORD AND PATIENT HANDOFF SURVEY RESULTS

1. I am confident that I can find all needed patient information in the electronic health record (EHR) to make appropriate clinical decisions.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	8.33%	1
Agree	66.67%	8
Strongly agree	25.00%	3
TOTAL		12

2. The EHR is inclusive of all necessary patient information to provide ongoing patient care.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	0.00%	0
Agree	83.33%	10
Strongly agree	16.67%	2
TOTAL		12

3. The encounter summary page provides all patient information needed to prepare for patient handoff.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	0.00%	0
Agree	83.33%	10
Strongly agree	16.67%	2
TOTAL		12

4. I review the EHR for patient problems to prepare for patient handoff.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	0.00%	0
Agree	75.00%	9
Strongly agree	25.00%	3
TOTAL		12

5. I access test results to prepare for patient handoff.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	0.00%	0
Agree	83.33%	10
Strongly agree	16.67%	2
TOTAL		12

6. I review intraoperative care interventions (e.g., blood transfusions, patient positioning) to prepare for patient handoff.

ANSWER CHOICES	RESPONSES	
Strongly disagree	8.33%	1
Disagree	8.33%	1
Agree	66.67%	8
Strongly agree	16.67%	2
TOTAL		12

7. I review postoperative orders to prepare for patient handoff.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	25.00%	3
Agree	41.67%	5
Strongly agree	33.33%	4
TOTAL		12

8. I rely on electronic communications between the healthcare team to prepare for patient handoff.

ANSWER CHOICES	RESPONSES	
Strongly disagree	0.00%	0
Disagree	8.33%	1
Agree	50.00%	6
Strongly agree	41.67%	5
TOTAL		12

9. What other areas of the EHR do you access to prepare for patient handoff? Free text, collective responses:

    - Patient History and Physical,
    - Anesthesia Records,
    - Labs, Imaging,
    - "Notes,"
    - Home Medications

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VITA

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