A Team Approach to Inter-Unit Handovers of Care

Ruth J. Browne

Charlottesville, VA

BSN, Olivet Nazarene University, 2005

MSN, University of Virginia, 2017

A Scholarly Practice Project presented to the Graduate Faculty

of the University of Virginia in Candidacy for the Degree of

Doctor of Nursing Practice

School of Nursing

University of Virginia

May, 2018

Beth Quatrara DNP, RN, CMSRN, ACNS-BC

Julie Haizlip, MD, MAPP, FAAP

Beth Hundt Ph.D., RN, NP-C, ACNS-BC

Ivora Hinton, Ph.D.

Nicole Chiota-McCollum, MD

Abstract

Handovers of patients between hospital units, such as those that take place on admission of stroke patients from the emergency department to the neurosciences intensive care unit, are especially critical times, with significant potential for missed information, communication errors and interprofessional tensions. A quality improvement (QI) initiative aimed at standardizing team approaches to handovers was developed and implemented. To determine if this QI initiative affected clinician perceptions regarding interprofessional collaboration and handover quality in the emergency department and neurosciences intensive care unit of a rural academic medical center, a convenience sample of clinical nurses (RN) and licensed independent providers (LIP) caring for stroke patients were surveyed pre and post-implementation. Utilizing the Interprofessional Collaboration Scale and Handover Quality Rating Form to compare views surrounding handover of care and interprofessional collaboration between professions and units, this evaluation of the QI project demonstrated overall increased perceptions of teamwork (Mean difference 1.664, $p = .029$). LIP's demonstrated a significant decrease in perceived isolation post-implementation (MD 3.700, $p = .002$), and RN's reported increases in teamwork (MD 2.056, $p = .020$) and accommodation (MD 3.069, $p = .035$). Highly complex handover cases demonstrated significantly increased teamwork (MD 2.733, $p = .019$) and decreased perceptions of time pressure (MD -3.133, $p = .002$) post-implementation. These findings suggest that increased exposure to other professions through meaningful patient care interactions increases teamwork.

Keywords: Handover, Handoff, Interprofessional, Collaboration, Emergency Department, Stroke

Table of Contents

A Team Approach to Inter-Unit Handovers of Stroke Patients

Handovers have a significant role in healthcare, with elements of education, socialization, error detection and team cohesion present in each patient transfer (Horwitz et al., 2009). A handover occurs when one provider (or provider team) transfers "responsibility and/or accountability for patient care" to another (Chaboyer et al., 2009, p. 136). Handovers occur throughout health care, with nurse change of shift reports, physician transfer of 'on-call' status, transfer from operating room to post-operative unit, and admission from the emergency department (ED) to inpatient units being only a few examples of handovers (Patterson, Roth, Woods, Chow, & Gomes, 2004).

Handovers have been identified as a time of increased vulnerability and risk (Patterson et al., 2004). Errors in handover are associated with increased adverse events, increased length of stay and poor outcomes in stroke patients (Holloway, Tuttle, Baird, & Skelton, 2007). The transfer of patients from the emergency department to the intensive care unit is often associated with "a significant loss of important clinical information" (Zakrison et al., 2015, p. 935).

The need for inter-unit transfers (or admissions) is associated with a change in patient status (requiring increased levels of care) and can reflect a high-risk state. The transfers from the ED are especially risk-laden, as one report indicates 29% of physicians (5 ED, 27 internal medicine, 8 hospitalists) reported their patients "experienced (or almost experienced) an adverse event because of inadequate communication between the ED and admitting physician" (Horwitz et al., 2009, p. 702). The strongest indicator of an adverse event is the failure of clinicians to review the most recent patient vital signs (Horwitz et al., 2009).

According to the American Heart Association (AHA), stroke affects around 795,000 people annually in the United States, and is the 5th leading cause of death, with an age-adjusted

death rate of 36.5 per 100,000 related to stroke. Approximately 87% of those strokes are ischemic in nature (Benjamin et al., 2017). Intravenous recombinant tissue plasminogen activator (IV rtPA) has become the standard of care for ischemic strokes (Prabhakaran, Ruff, & Bernstein, 2015). Recommendations from the manufacturer include monitoring vital signs and conducting neurologic assessments using the abbreviated National Institutes of Health Stroke Scale (aNIHSS) at set intervals after the administration of IV rtPA. Monitoring should begin immediately following IV administration of rtPA and continue every 15 minutes for 2 hours, then every 30 minutes for 6 hours to every hour until the 24 hour period after the initial bolus is completed (Genentech USA, Inc., 2017). Frequent assessment is necessary because up to 6.4% of these patients can develop symptomatic intracranial bleeding (Prabhakaran, Ruff, & Bernstein, 2015). In addition to the risks associated with thrombolysis (hemorrhage), stroke patients are inherently at risk for cerebral or cerebellar edema and seizures based on the location and impact of infarct (Powers et al., 2018). The 2018 American Heart Association/American Stroke Association (AHA/ASA) guidelines include blood pressure and blood glucose control, as well as close clinical monitoring for stroke patients (Powers et al., 2018).

Holloway, Tuttle, Baird, and Skelton (2007) analyze a series of reported adverse events that occurred after a patient experienced a stroke (ischemic stroke and intracerebral hemorrhage), concluding that problems with communication or handover between providers were involved in 10% of preventable adverse events. The authors find a lower rate of adverse events in stroke patients (12%) compared to community-acquired pneumonia (CAP) or congestive heart failure (CHF) patients and other current literature (up to 75%). However, upon further analysis, they conclude that this low occurrence is related to the increased early mortality associated with stroke pathology compared to CHF or CAP (Holloway, Tuttle, Baird, & Skelton, 2007).

Interventions to reduce adverse events due to miscommunication and problematic transfer of care include standardization of handover content, interprofessional collaboration and in-person communication (Horwitz et al., 2009). Poletick and Holly (2010), report approximately 70% of sentinel events result from defects in communication, and ineffective handovers contribute to "wrong treatment, delays in diagnosis, severe adverse events, patient complaints, increased cost and longer lengths of stay"(p.123). One suggested method to meet the National Patient Safety goal of uniformity in handover communication is to conduct handover at the patient's bedside, which has the potential to decrease miscommunication (Mardis et al., 2016). Bedside handovers could contribute to improved patient outcomes, but the evidence is sparse (Mardis et al., 2016).

Qualitative literature indicates that nursing handovers reflect a hierarchy surrounding information dissemination, and that in-person handover would humanize staff members of opposite shifts and positively affect team building (Holly & Poletick, 2013). Utilization of a standard tool during nursing handover is recommended to improve recall (Holly & Poletick, 2013; Poltick & Holly, 2010). Bedside nursing handover results in increased nurse accountability, an improved ability to communicate with physicians about patients' status immediately after shift change (Maxson, Derby, Wrobleski, & Foss, 2012), and reports of improved communication, increased patient satisfaction, and improved prioritization of shift duties (Taylor, 2015). Implications for post-stroke care suggest that implementation of a standardized, in-person bedside report could increase teamwork between units, as well as create a shared image of the patient between care team members.

Interprofessional care is marked by individuals from multiple professional backgrounds working together, involving "the integration of perspectives, concepts, theories and methods

from two or more disciplines or fields to address the focal problem" (Hall, Vogel, Stipelman, Stokols, Morgan & Gehlert, 2012, p. 416). Application of this approach has the potential to improve care for the stroke patient. AHA/ASA guidelines for 2018 includes the use of multidisciplinary collaboration to promote quality improvement measures (Powers et al., 2018).

A previous quality improvement (QI) project initiating standardized, bedside nursing handovers was undertaken at a rural academic medical center. This scholarly practice project implements and evaluates a follow-on QI initiative regarding the effectiveness of a structured team approach to the handover of stroke patients between the ED and the neurosciences intensive care unit (NEUROICU) by collecting clinician perspectives on handover quality and interprofessional collaboration (IPC), pre and post-implementation of the QI initiative. This scholarly practice project evaluates whether a team approach to handovers of care occurring on admission from the ED to the NEUROICU improves perceptions of teamwork between the ED and NEUROICU units and between professions.

Theoretical Framework

Lewin's Three-Stage change theory (Unfreeze, Change, Refreeze) was founded in the social sciences and evaluates the group's progress through change (Cummings, Bridgman, & Brown, 2016; Lewin, 1947). It is identified by many as foundational to approaching change (Cummings, Bridgman, & Brown, 2016; Wojciechowski, Pearsall, Murphy, & French, 2016) and is often used in efforts to improve bedside care (Wojciechowski et al., 2016).

Lewin's theory describes an approach to change utilizing three stages. The first stage consists of unfreezing the current state by creating knowledge regarding the problem or need to change. Concepts or processes involved in this stage include education, communication, and presenting reasons for change. Once members are aware of the need for change, the second

stage is the implementation of the change which includes the process of examining alternative methods and decreasing inhibitors which can include the training, implementation and role modeling of the change. The third stage is re-freezing the new behaviors in place, establishing a new equilibrium. This focuses on sustaining the implemented change, such as retraining, communication, monitoring, and cost realization (Wojciechowski et al., 2016).

Lewin's Three-Stage theory is often utilized in the literature surrounding handovers of care (Bradley & Mott, 2012; Bradley & Mott, 2013; Chaboyer et al., 2009; McMurray, Chaboyer, Wallis, & Fetherston, 2009), indicating it is suitable to address this topic for change.

Criticisms of Lewin's Three-Stage Theory include the assertions that it fails to consider the fluid nature of current healthcare delivery (Wojciechowski et al., 2016). However, the level of usage in the literature establishes its relevance to the behaviors surrounding handovers of care.

The application of the Three Stage Theory in this scholarly project places this project within the cycle of change of the larger organization. The unfreezing phase commenced with the findings of an expert consultant (in preparation for Comprehensive Stroke Center designation) indicating that bedside handover of care was best practice. This resulted in the implementation of a new standard work between the ED, stroke team and NEUROICU regarding nursing bedside handovers of care in post-rtPA and thrombectomy patients. This expanded into nursing bedside handovers of care across multiple units on the neurosciences service line, reflecting the change and re-freezing aspects of the three stage theory. This project continues the refreezing momentum by expanding the scope of bedside handover to include licensed independent provider team members. Through concrete feedback about the team method, re-freezing will be strengthened. It will also require unfreezing of the current practices of provider handover, change to the pilot program, and refreezing as indicated by survey results (see Fig. 1).

Scholarly Practice Project Question

How do clinician perceptions of interprofessional collaboration and handover quality change as a result of a structured team approach to bedside handover of care for stroke patients admitted to the neurosciences intensive care unit from the emergency department?

Definitions

Interprofessional collaboration (IPC) takes place when individual members of separate health professions communicate and make patient health care decisions out of their shared skills and knowledge (Kenaszchuk, Reeves, Nicholas & Zwarenstein, 2010).

Team, defined by Manser, quoting Salas, Dickinson, Converse, and Tannenbaum (1992), is a "distinguishable set of two or more people who interact dynamically interdependently, and adaptively toward a common and valued goal… who have a limited lifespan of membership" (Manser, Foster, Flin, & Patey, 2013, p. 139).

Handover, as defined by Robertson, (citing the British Medical Association) is "the transfer of professional responsibility and accountability for some or all aspects of care for a patient… to another person, or professional group on a temporary or permanent basis" (Robertson, Morgan, Bird, Catchpole & McCulloch, 2014, p. 600). The critical elements of a handover include continuity of care and the "transfer of professional responsibility for the patient" (Smeulers, Lucas & Vermeulen, 2014, p. 3).

Standardized work (SW), defined by Graban (2012), a foundational concept in Lean methodology, is the "current one best way to safely complete an activity with the proper outcome and highest quality using the fewest resources" (Graban, 2012, p. 67). In the institution assessed, it also indicates a formalized document describing the process by which the unit members conduct daily activities. The roles, responsibilities, and triggers for action are laid out in an

organized fashion for clinicians. For the processes in place at the onset of this project addressing the nursing bedside handover, see Appendix A. For the final standard work (SW) process developed during the implementation portion of this QI initiative, and evaluated post-implementation see Appendix B.

Stroke team at this facility is composed of a junior resident (PGY2), a team leader (fellow or attending physician), and an intern that respond to each stroke alert in the ED. The stroke alert process is initiated when a patient presents with symptoms of stroke within the window to receive treatment with intravenous tPA or mechanical thrombectomy. The stroke team informs the NEUROICU team of the incoming patient and files a note in the electronic medical record.

Review of the Literature

The purpose of this review is to assess the published literature regarding bedside team approaches to handovers (transfer) of care between the ED and the NEUROICU for stroke patients. For this review, any controlled trial, including those with pre and post design, which produced new data regarding inpatient bedside team (or interprofessional) handovers of care between units was included. Database search began with a search of PubMed for "(Bedside OR Clinical) AND (Handoffs or Handovers) AND (Team or Interprofessional)" with the limits of English language, human subjects, available full-text and abstract published in the past ten years (2007-2017), which produced 247 articles. The same search in OVID, with the same limitations, resulted in 219 articles. Searches of CINAHL and Cochrane produced 7 and 13 articles respectively. This resulted in a total of 225 articles after duplicates were removed (414 initial articles). Title and abstract review reduced this number to 25. After full text review, eight articles met inclusion criteria. (See Figure 2). A summary of each study follows.

Fabila et al. (2016) evaluate the effects of re-organizing the handover between the operating room (OR) and the pediatric cardiac intensive care unit (CICU) from the perspective of the receiving unit (the CICU) using a pre-post interventional study. Eight pediatric intensivists (PI) and 44 nurses completed a self-administered questionnaire (5-point and 4-point Likert scales) created by the research team. Results reveal no change in perceived length of handover. The CICU nurses reported increased perception of sufficiency of information transfer (31.8 to 95.5%, $p < .0001$), and that the "information conveyed was concise and clear" (70% difference, $p < .0001$), the “standout” presence of a leader (36.4% difference, $p < .0001$). The nurses also reported decreased rates of undesirable situations such as “having to look elsewhere for information” (38.6% difference; 95% CI [23.8%, 54.9%]; $p < .0001$) or “having no opportunity to ask questions” (29.5% difference; 95% CI [28.3%, 61.4%]; $p < .001$). No difference was noted in the receiving PI's perceptions pre and post-intervention, except for decreased reports of "errors of omission" occurring "sometimes" (87.5% difference, 95% CI [40.1%, 99.3], $p = .001$). "Looking elsewhere for information" went from no PI reports of "rarely" to 62.5% reported “rarely” after intervention (95% CI [38.7, 108.0%; $p = .026$) (Fabila et al., 2016). This study indicates that a standardized approach to handovers results in decreased work searching for information by nurses and physicians, without increased time committed to the handover process.

Petrovic et al. (2012), report on a pre-post pilot study implementing a standard protocol in operating room (OR) handovers to a 15-bed cardiac surgical intensive care unit (CSICU) to evaluate the effects on provider satisfaction, information sharing and the number of technical defects. Baseline practices were evaluated (n = 30 handoffs) indicating that OR surgeons had higher satisfaction with handovers than the ICU nurses (98% and 62% respectively, $p < .001$).

Post-intervention observations (n = 30) and surveys (n = 138) indicate that the length of time for handovers increased from 11 to 12 minutes (defined as time from ICU arrival to OR team departure, $p = .395$), and the rates of all team members being present at the bedside increased (0% to 68%, $p < .001$). The mean number of parallel conversations per handover decreased (11.3 to 3.5, $p < .001$). The percentage of nurses stating they heard all of the content increased (45% to 78%, $p = .023$), and information sharing overall increased (78% to 84%, $p = .01$) (Petrovic et al., 2012). This study suggests that a standardized approach to handovers increases information sharing and communication, but at the cost of increased handover duration. It implies that the increased number of nurses hearing content, decreased parallel conversations and increased attendance rates are evidences of increased team behaviors and respect.

An additional prospective, unblended cross-sectional study by Petrovic et al. (2014) evaluates the effects of implementing a standard handover protocol, compared to usual handover methods, for transitions between the OR and the peri-anesthesia care unit (PACU) at a tertiary care facility. Observations of OR to PACU handovers (n = 53 pre-intervention, n = 50 post-intervention) indicated an increased mean length of the handover period (9.0 to 11.0, minutes, $p = .01$) with a decreased time from PACU arrival to the start of handover (mean 4.4 minutes), increased participation by surgery personnel (21% to 83%, $p < .01$), mean incidence of defects per handover decreased (9.92 to 3.68, $p < .01$), mean missed information fields in anesthesia and surgery reports decreased (7.57 to 1.2, $p < 0.01$), and mean missed information per handover decreased (2.02 to 0.94, $p < 0.01$) significantly (Petrovic et al., 2014). This study of handovers suggests that a standardized process decreases wasted time by decreasing the time from arrival in the unit to the time of handover commencement, and increased information availability.

Robinson (2016) conducted and evaluated a quality improvement project between the OR and the PACU to “demonstrate how a structured hand-off tool and standardized process could increase effective perioperative communication of essential elements of care and assist in the timely recognition of patients at risk” (Robinson, 2016, p. 245) Observation audits of 50 handovers conducted before and after implementation resulted in increased "yes" responses to audit questions asking if the patient identification was verified, essential patient information such as medical history reviewed, and if intraoperative positioning was presented during the handover. Results also report confusion surrounding the delay in waiting for the PACU nurse to complete patient care tasks (perceived as theirs), by the OR staff waiting to give handover. A significant portion of the intervention surrounded the completion of tasks prior to the handover to decrease distractions during information transfer, yet final results indicate that more occurrences of simultaneous care tasks and handover occurred after initiation of the protocol (Robinson, 2016). The increased simultaneous care after standardization of the handover process suggests teamwork was affected and improved.

Segall et al. (2016) develop and evaluate a human-centered design approach to the handover process between the OR and the surgical intensive care unit (SICU). After the initiation of the new handover protocol, which included a rollout call before departure from the OR, and a structured interprofessional bedside handover between providers upon arrival in the SICU. Compliance analysis indicated that task performance by assigned individuals increased from 53.6% to 78.2% (one-tailed $t[95]=1.66$; $p < .001$). An evaluation of 49 handovers and interviews of 32 providers were conducted using the NASA Task Load Index (TLX) team behavior scores, information transfer score and length of handover. Results reveal no significant change in the length of the handover, the information transfer score, or the number of

interruptions during the handover. However, increased mean team behavior scores (one-tailed $t[96] = 1.66$; 61.14 - 82.75; $p < .001$), decreased workload (TLX score) (34.75 - 28.38, one-tailed $t[96] = 3.18$, $p < .001$), and increased satisfaction with new process (one-tailed t[55],= 7.91, $p < .0001$) were noted (Segall et al., 2016). This procedure differs from Robinson (2016) in that both sending and receiving team members completed patient care tasks such as transferring monitors and ventilators, instead of just the receiving unit. A survey conducted three years after implementation of the new process indicates increased staff satisfaction with the new handover method over the original handover (one-tailed $t[55] = 7.91$; $p < .0001$) (Segall et al., 2016). This study suggests that the application of a human-centered design created structured handover process increases team behaviors and increases staff satisfaction with handovers of care.

Sheth et al. (2016) evaluates a standardized handover process between the ICU to the acute care unit, in which an interprofessional team, including acute care and ICU attending physicians, and both clinical nurses met at the patient bedside for verbal handover with the family. They evaluated 278 patient transfers for efficiency, the AHRQ culture of safety and conducted convenience audits (47%) on adherence to bundle measures. Adherence to the bundle occurred in 93.4% of transfers after implementation. Transfer latency (time delay after handover, before transfer) decreased 84% (mean 378 (± 167min) pre-intervention to 24 (±21 min) post-intervention. The percentage of positive National Culture of Safety scores increased in the areas of "things fall through the cracks" (15.2% to 39.80%; $p = .005$) and "problems often occur in the exchange of information across hospital units" (19.6% to 38.8%; $p = .031$). Increased family satisfaction was reported with shared information (41% - 70%, $p = .02$) and chances to ask questions (46% to 74%, $p < .01$). Increased provider satisfaction with the volume of information given (34% to 41%, $p = .03$), time to transfer (5% to 34%, $p < .01$), and overall

process to transfer the patient (3% to 24%, $p < .01$). No changes in readmission rates, rapid response team activations, or in-hospital mortality were noted (Sheth et al., 2016, p. 6). This study suggests that involvement of patients or family (such as occurs with bedside handovers) with a standardized process improves information transfer and decreases the probability of problems occurring related to information exchange.

Vergales et al. (2015), determine the feasibility of a "comprehensive, primarily face-to-face handoff process… utilize(*ing*) formal process steps surrounding essential providers across multiple disciplines" between the OR and the pediatric intensive care unit (PICU) in patients that had undergone congenital heart surgery. The evaluation of 79 consecutive handovers with electronic surveys to the stakeholders report that the new handover procedure improved patient quality of care (20% to 94%). Provider surveys also indicated increased perceptions of process efficiency (58% to 69%) and increased comfort asking questions (53% to 75%). In this model, the PICU nurse traveled to the OR to pick up the patient, and verbal handover began after patient care tasks were completed in the PICU, the mean length of handover was 8.7 minutes. The conclusions support the feasibility of this handover method at the studied location (Vergales et al., 2015). This study indicates that a standardized handover process that begins before departure to the destination unit, and occurs in-person, could increase efficiency and improve care.

Yang & Zhang (2016) conduct a pre and post analysis of OR to neurology ICU handovers evaluating a new handover procedure, including a standardized process, surgeon attendance, face-to-face handover, multi-disciplinary and a ventilator weaning process. Participants included 77 nurses, 20 residents, 10 intensivists, 2 respiratory therapists, 34 neuro-surgeons and 13 anesthetists over a spread of 56 patient cases (total of 168, pre- post- and follow-up cases). Baseline handover practices included the anesthetist and OR nurse

transporting the patient to the ICU for handover to the ICU clinical nurse. This practice did not change during the intervention. Instead, the surgeon began to attend the bedside handover. Results included increased surgeon presence (77-95%, $p = .007$), increased pre-admit preparation tasks completion (81%-96%), increased median teamwork score (3-5, $p < .001$), and decreased duration of mechanical ventilation per patient (5.1 to 3.3 hours, $p = .001$) (Yang & Zhang, 2015). While this study presents changes as a result of standardizing handovers, the addition of a surgeon increases the interprofessional aspect and improves information exchange.

The time required to complete the standardized handover increased in two studies (Petrovic et al., 2012; Petrovic et al., 2014), with others demonstrating decreased transfer latency (the time between handover and transfer) (Sheth et al., 2016) and decreased time to onset of handover after transfer from the OR (Petrovic et al., 2014).

Results of interprofessional bedside handovers of care result in assorted increased teamwork metrics, including team behaviors (Segall et al., 2016), increased perception of the number of disciplines involved (Vergales et al., 2015), and increased teamwork scores (Yang & Zhang, 2015). Increased team presence during handover was reported after standardization, (Petrovic et al., 2012; Segall et al., 2016) with an emphasis on the presence of the surgeon (Yang & Zhang, 2015).

Common process metrics include adherence with handover procedures (Sheth et al., 2016), and defects of information transfer (Petrovic et al., 2014). The discussion surrounding care tasks varied, with one focused on completion before the start of verbal handover (Robinson, 2016), and another conducting verbal handover to the side with a core group and care tasks by other team members (Segall et al., 2016). Sheth et al. (2016) report increased information transfer using AHRQ metrics and increased provider and patient satisfaction (Sheth et al., 2016).

Quality of patient care was measured by provider's perceptions of care quality, rates of 6-hour ventilator weaning, and duration of mechanical ventilation (Vergales et al., 2015).

In summary, the majority of articles review the handovers from the OR to the ICU (Fabila et al., 2016; Petrovic et al., 2012; Segall et al., 2016; Vergales et al., 2015; Yang & Zhang, 2015), with others evaluating the transfer from the OR to the PACU (Petrovic et al., 2014; Robinson, 2016), or the ICU to the acute care unit (ACU) (Sheth et al., 2016). The interprofessional and bedside approach is intuitive in this population due to the critical nature of their illness (Petrovic et al., 2014; Segall et al., 2016). The most common intervention is standardization of the handover process (Fabila et al., 2016; Petrovic et al., 2012; Petrovic et al., 2014; Robinson, 2016), and use of an instrument to facilitate communication (Fabila et al., 2016; Segall et al., 2016; Sheth et al., 2016). The most frequently used instrument to facilitate a uniform process was the SBAR (Q) (Fabila et al., 2016; Segall et al., 2016) or the I-PASS (Sheth et al., 2016). Several other studies utilize a checklist to guide the handover process (Vergales et al., 2015; Yang & Zhang, 2015).

Methods

Introduction

This scholarly practice project implemented and assessed a quality improvement project targeting handover between ED, stroke team and NEUROICU clinicians featuring an enhanced team approach to the admission of patients with a suspected stroke diagnosis. Evaluation of the quality improvement project included assessment of perceived interprofessional collaboration and handover quality among the nurses and licensed independent providers of the ED, stroke team and NEUROICU. This scholarly practice project evaluates the handover that occurs when responsibility for a stroke patient is transferred from the ED to the NEUROICU.

Scholarly Practice Project Design

This scholarly practice project incorporated a pre-post comparison design.

Sample Selection

The target sample included all nurses and physicians (including trainees) that care for stroke patients in the ED and the NEUROICU. This included the stroke team that responds to the initial stroke alert in the ED, the ED nurse providing clinical care, the admitting NEUROICU provider, and the NEUROICU clinical nurse. Staff members were assigned according to schedules determined by program chief residents and unit level needs (nurses), and could be any member of the entire population of ED nurses, NEUROICU nurses, neurology (adult or pediatric), neurosurgery or anesthesia residents or attending physicians, and licensed independent providers staffing the NEUROICU. The sample population included residents, licensed independent practitioners, and nurses who cared for stroke patients admitted to the NEUROICU directly from the ED. Recruitment relied on a convenience sample, as the admission of stroke patients was unpredictable and occurred at all hours.

Setting

This quality improvement project was conducted in the NEUROICU and ED of a 600-bed rural academic medical center designated as a Comprehensive Stroke Center (CSC), with an average daily census of 462 that admits approximately 27,000 patients a year. The 41-bed ED sees approximately 61,000 visits per year. The NEUROICU is a 12-bed unit that includes patients admitted to the neurosurgery, neurology, or neuroradiology services.

Protection of Human Subjects

Pre-implementation, emails were sent to all ED and NEUROICU clinical nurses, the stroke team, and NEUROICU licensed independent providers containing an individual link to the

questionnaire. Email addresses and system generated user identifiers were purged from data before analysis.

Post-implementation, a paragraph summarizing data usage and collection was attached to the survey for participants to read. The text included: "No individual information will be shared with unit leadership. Results will only be presented in aggregate form. Completion of this survey indicates consent to data use. All responses are voluntary and confidential."

Surveys were deposited into an opaque locked box after completion by participants. All data was stored at a secure location (a locked drop box in the unit) and secured during the analysis period in a locked office on a designated shelf within a designated binder and using secured cloud-based storage.

Procedures

The pre-implementation phase consisted of the administration of an online survey including both the Handover Quality Rating Form (HQRF) and Interprofessional Collaboration Scale (ICS) to staff members who admitted stroke patients. A box check was included at the top of the survey with directions to select if the respondent was a nurse, physician or nurse practitioner. A second question asked if the respondent primarily worked in the ED, the NEUROICU or on the stroke team for the handover under evaluation. At the end of the survey was an optional free-text area. Participants were instructed not to include PHI in the comments. Project staff distributed surveys to staff using existing email lists and a secure online survey platform (Qualtrics®). Staff had two weeks to complete surveys, with one follow-up email sent to participants who had not yet completed the survey based on anonymized participant ID's (kept by Qualtrics®). All participant ID's and email addresses were purged from data before analysis.

The QI Project

Project staff worked with clinicians through the iterative process of developing a pilot standard work (SW) for handovers and incorporating staff input over a time of 4 weeks.

Project staff met with resident physicians, nurse practitioners and RN's to discuss the goal of an interprofessional handover of care for stroke patients and to ascertain clinician needs and values regarding handovers of care. Using the current SW utilized by the target unit, project staff developed a draft SW and distributed it to stakeholders for review and feedback. The SW utilized a standardized, organizational-specific format for handover content, and the utilization of a "rollout call" from the ED to the NEURICU, followed by a page to providers alerting them of the patients estimated arrival time in the NEUROICU. After review and feedback from clinicians, the SW was trialed between the ED and NEUROICU with project staff to facilitate the process. Handovers of stroke patients during this time were monitored, and staff informally questioned about barriers and ease of the new SW. The final SW incorporated these results and was disseminated to the provider and nursing teams, consisting of a combination of in-person presentations, handouts, tools such as badge buddies and flip cards, and posting of the final SW for team handovers in the ED and NEUROICU. For the process outlined in the baseline SW and the implementation standard work documents, see Appendix A and B.

Post-implementation

After development and implementation, an evaluation resource box was labeled and located at a central location on the nurse's station in the NEUROICU to store survey responses. Clinicians who participated in handovers for stroke patients in the following six weeks were asked to complete a pen and paper survey consisting of the HQRF and ICS and a brief

demographic paragraph. Participants placed responses in the locked portion of the box through a designated opening.

Completed surveys were collected by primary investigators every few days with reminders to staff on the importance of survey completion. Data was entered into an electronic spreadsheet and stored on secure cloud-based storage. Analysis took place on secured computers. See Figure 3 for the survey instrument.

Measures

The selected instruments were the Handover Quality Rating Form (HQRF) and the Interprofessional Collaboration Scale (ICS) (for approval letters see Figures 4 and 5). The HQRF is a 21-item survey, on a 4-point Likert scale, assessing the individual's perception of the handover of care (Manser, Foster, Gisin., Jaekel, & Ummenhofer, 2010). The HQRF was developed targeting handovers between multiple professions including pre-hospital, emergency department, anesthesia, general wards and post-anesthesia care clinicians. As the HQRF focuses on handovers involving a variety of clinical professionals focused on a single patient (Manser, Foster, Gisin., Jaekel, & Ummenhofer, 2010), it is uniquely suited to this setting. HQRF evaluates three elements of handovers: information transfer, shared understanding, and working atmosphere; and was designed for the participants to conduct self-assessment in addition to a component for observation. Multiple regression analysis of correlation of the three themes revealed that information transfer ($r=0.54$, $p\leq0.001$) was most closely correlated with perceived quality of the handover, followed by shared understanding ($r=0.40$, $p\leq0.001$) and working atmosphere ($r=0.19$, $p\leq0.001$) (Manser, Foster, Gisin., Jaekel, & Ummenhofer, 2010). The HQRF also evaluates the presence of 4 control items: time pressure on the sending (or receiving) unit, case uncertainty and case complexity (Manser, Foster, Flin, & Patey, 2013).

The Interprofessional Collaboration Scale (ICS) is a 13-item survey evaluating the themes of communication, accommodation, and isolation on a 4-point Likert scale (Kenaszchuk, Reeves, Nicholas, & Zwarenstein, 2010). The ICS has been validated across professions including RN, MD, and other health professions. Reliability and validity measures were compared to the Nursing Work Index (Nurse-Physician Relations Subscale) (NWI-NPRS). Overall reliability for nurses evaluating physicians, in the three factors of communication, accommodation, and isolation, *p* values (Raykov's composite reliability statistic) were 0.76, 0.85, and 0.76, compared to the NWI-NPRS (0.92), and *p* values for physicians evaluating nurses were 0.80, 0.86, and 0.71 across the same factors. Validity was measured using factor correlations, with scores ranging from 0.66 to 0.85. The primary limitation of the ICS emanates from the development of the instrument from a nursing perspective, and the limited model fit with other health professionals (excluding MD's) (not assessed in this scholarly project) (Kenaszchuk, Reeves, Nicholas, & Zwarenstein, 2010).

For further analysis, demographic data collected at the top of the instrument included the option to select if the respondent was a nurse, physician or nurse practitioner. A second question determined if the respondent primarily worked on the ED, stroke team, or NEUROICU, during the handover under evaluation.

Data Analysis

Data was analyzed using UNICOM SPSS® version 24. Descriptive statistics were used to report the sample composition pre and post-implementation and were reported by unit and profession. Responses to the survey were assigned a value of 1 to 4 along the Likert scale to enable calculation of measures of central tendency and totals of subgroups based on unit and profession. Negatively worded questions were recoded according to psychometric properties

listed in the author's guidelines so that a higher HQRF or ICS score indicated a more positive response. The HQRF score was the sum of the values reported on the Likert scale, with 1 being "No" and 4 being "Yes," and a total maximum score of 68. The HQRF Score was calculated by totaling the values of individual responses for each participant. Sub-scale analysis of the HQRF domains (handover conduct, quality, and teamwork) was completed based on the total score of question groups. The HQRF also contained four control items evaluating the handover circumstances. The four control variables from the HQRF were divided into two sections: case complexity and HQRF time pressure. An increased score in the HQRF control variables of time pressure or case complexity indicates an increased clinician perception of those components within the handover. Responses with a score ≥ 5 were categorized as handovers with high complexity or time pressure. A score less than 5 was recorded as low complexity or time pressure. Scores from control variables are reported as means to evaluate the grade of complexity with the low and high categorizations used for comparisons.

The ICS score was obtained by calculating the sum of the 13-item Likert scale values with 1 being "Strongly Disagree" and 4 being "Strongly Agree," with a maximum score of 52. Sub-scale analysis of the ICS factors (accommodation, isolation, and communication) was conducted by calculating the sum of responses to questions within factor groups.

Participants who submitted an incomplete overall survey (and thus had no HQRF or ICS Score calculated) had sub-scores included if all questions were completed within an HQRF or ICS sub-scale.

Individual ICS and HQRF question scores were compared, and means/medians calculated. Data was aggregated and analyzed by unit and profession. Due to the small sample size, inter-group comparisons were invalid. The Mann-Whitney U test was used to determine

significance. A *p* value of .05 or less was considered significant. Pre and post-implementation mean scores were compared across units, professions, and as aggregate measures using mean differences (MD). Relationships between units, professions and control variables were evaluated pre and post-implementation.

Results

Analysis was conducted using UNICOM SPSS® version 24. Due to the small sample size, reporting results by or "RN, nurse practitioner or physician" could compromise confidentiality, so profession categories are aggregated into RN or licensed independent provider (LIP). Similarly, responses of "ED, NEUROICU, or stroke team" were aggregated according to the unit role at the time of handover, sending or receiving.

Pre-implementation.

Forty-nine responses were received. Eleven responses were excluded for answering "no" to the question "Have you ever been involved in the transfer of a stroke patient from the ED to the NEUROICU?" Nine entries were excluded for partial completion (set at a 50% instrument completion rate). Results indicated 37.9% were reported as LIPs and 62.1% reported as RNs. The reported roles in the handover were 58.6% in the sending unit, and 41.4% on the receiving unit.

Sub-scale analysis of HQRF and ICS results included surveys that had incomplete results, as long as the respondent completed the entire sub-scale section. The Mann-Whitney U test was used as the samples were un-paired due to the unpredictable nature of stroke admissions and staffing which prevented the same staff members from participating in each (pre and post-implementation) handover of care.

Mann-Whitney U of the HQRF and ICS scores by profession category (RN or LIP) indicated no significant differences in mean HQRF score (SD) of 50.82 (7.6) for LIPs, and 50.47 (8.240) for RNs, (p = .911). Pre-implementation sub-score analysis indicated no significant difference between professions across the sub-scores of quality, conduct, and teamwork. Differences in the HQRF control variable of time pressure were significant between LIP's and RN's (MD 1.62, p = .025). ICS scores demonstrated significance between RNs mean score of 40.50 (3.951) and providers 35.22 (SD 5.071) (p = .006). ICS sub-scale results demonstrated significance in the accommodation, (MD 2.34, p = .016), and isolation, (MD 2.7, $p \leq .001$) domains.

By unit, pre-implementation Mann-Whitney U tests revealed no significant difference in mean HQRF scores between the sending and receiving units (MD 5.292, p = .100). Sub-scale HQRF analysis showed significant difference in time pressure, (MD 1.63, p = .015) but did not demonstrate statistical significance in the quality, (p = .073) or conduct, (p = .059), sub-scores. Mean and sub-scale ICS scores between the sending and receiving units were not significant.

At baseline, no significant differences were noted between cases reported as high complexity or low complexity. For complete results see Figures 4 through 10.

Post-implementation

Thirteen surveys met overall inclusion criteria, with 30.8% LIP's, and 61.5% receiving unit. The difference of mean HQRF scores (9 valid responses) between sending and receiving unit did not approach statistical significance (MD 9.50). HQRF control variables of time pressure, (MD 2.00, p = .045,) and case complexity, (MD 2.975, p = .006,) were significant between units. Mean HQRF scores between LIPs and RNs were not significant (MD 5.14, p = .500). Sub-scale analysis indicated all other sub-scores and control variables were insignificant.

Mean and sub-scale ICS scores (n = 12) demonstrated no significant difference post-implementation between sending and receiving units. HQRF control variables of case complexity (MD 2.975, $p = .006$) and time pressure (MD 2.00, $p = .045$) were significant post-implementation. No significance was noted in mean ICS scores comparing LIP's (n = 4) and RN's (n = 8), nor was there significant difference in sub-scale analysis.

Clinicians that reported high HQRF complexity cases post-implementation had significantly increased mean HQRF conduct sub-score (mean difference 7.5, $p = .008$), compared to low complexity cases. Low complexity cases had significantly higher mean HQRF time pressure scores, (MD 2.98, $p = .003$).

Comparison of pre-implementation and post-implementation means

Overall responses revealed significant increases in the mean HQRF teamwork (MD 1.664, $p = .029$). The increase in mean ICS accommodation sub-score approached significance (MD 2.024, $p = .065$).

According to profession, RN's had a significant increase in the HQRF teamwork sub-score (MD 2.056, $p = .02$) and the ICS accommodation sub-score (MD 3.069, $p = .035$). RN's also reported decreased HQRF case complexity (MD -1.425, $p = .066$) compared to pre-implementation handovers. LIP responses demonstrated significant increases in the ICS isolation sub-score means (MD 3.700, $p = .002$) post-implementation.

The sending unit reported a significant decrease in HQRF time pressure (MD -2.625, $p = 0.008$) post-implementation. The receiving unit demonstrated a significant decrease in case complexity (MD -1.542, $p = .031$) and an increased ICS accommodation sub-score (MD 3.125, $p = .020$). The increase in the receiving unit's mean ICS score approached significance (MD

4.042, $p = 0.069$). All other mean differences were not significant between professions or unit roles.

Handovers identified as having high time pressure demonstrated a significant increase in ICS communication (MD 2.143, $p = .047$) and isolation (MD 3.232, $p = .001$) sub-scores. Mean ICS scores (MD 4.045, $p = .055$) approached significance. However, HQRF case complexity (MD -2.429, $p = .001$) and conduct sub-scores (mean difference -3.765, $p = .028$) decreased significantly in high pressure cases.

Significant increases were noted in the HQRF score (MD 8.083, $p = .027$) and the teamwork sub-score (MD 2.733, $p = .019$) in handovers identified as having high case complexity. A significant decrease in HQRF time pressure (MD -3.133, $p = .002$) was noted in highly complex cases. Cases marked with low complexity as demonstrated a significant decrease in HQRF conduct sub-scores (MD -4.038, $p = .037$).

In the pre-implementation population, the Cronbach's alpha for the HQRF was 0.796, the ICS/RN was 0.814 and ICS/MD 0.681. Post-implementation the Cronbach's alpha for the HQRF was 0.886 (without including the control variables; 0.842 including the four control variables), the ICS RN was 0.661, and the ICS MD was 0.859. Since many significance tests were performed, it is possible that one or more may be significant due to chance alone.

Qualitative Data

Qualitative analysis of responses entered in the free text area pre-implementation revealed themes ranging from indifference to frustration and disunity. While one comment remarked that a particular handover was "better than usual" because the nurses conducted a shared aNIHSS, another comment addressed the difficulty communicating with other professions. One noted strong bonds between some professions. Other comments addressed

perceptions of accommodation and teamwork, especially regarding tasks of handover and information transfer.

In the post-implementation phase, an increased number of respondents replied using the free text area. Several documented lapses within the process, mostly with the difficulty of providers arriving at the bedside. The other major theme noted was the completeness of documentation, with incomplete documentation cited frequently. A handover including the entire team approach was highlighted as being "very thorough."

Discussion

This evaluation of a quality improvement project applied the concepts of a structured bedside team handover of care with demonstrated effectiveness in the OR to the ICU (or acute care), or OR to PACU areas (Fabila et al., 2016; Petrovic et al., 2012; Petrovic et al., 2014; Robinson, 2016; Sheth et al., 2016; Vergales et al., 2015) to handovers occurring between the ED and the NEUROICU. Expanding the existing parallel structure of nurse-to-nurse and provider-to-provider handover to a structured, bedside, interprofessional process resulted in improved perceptions of team performance and accommodation between units. However, perceptions of the handover process were not significantly affected. The difference between pre and post-implementation could reflect the effect of either the structured process or the in-person, interprofessional component of the handover or some combination of the two. The bedside component will be included with the in-person component for this discussion.

The interprofessional, in-person portion of the handover process perhaps demonstrated the most impact with the increased HQRF teamwork sub-score, which suggests that staff perceived decreased tensions between team members, member handover questions were answered, and the team agreed when the handover was completed. These elements are included

in the structured nature of the handover, with the time for questions at the end of the organization specific handover format used in this QI initiative. The standardized information transfer of the handover also includes the conclusion of the handover, which gives the team a shared image of handover, including how to end the encounter.

The ICS accommodation sub-scale asks questions regarding the perception of the disciplines' coordinating and cooperating with patient care and practice delivery and the consideration of other disciplines when planning work processes. The increased overall ICS accommodation sub-score, while statistically insignificant, could suggest that staff perceive each other as more willing to collaborate in patient care. However, the significance of the increase in the RN ICS accommodation sub-score is likely to have weighted the overall value, as the change in mean providers ICS accommodation sub-score post-implementation was insignificant. It also suggests that the bedside and the in-person component of the handover resulted in a consistent mental image of the patient between professions.

Comparison of pre and post-implementation HQRF quality and conduct sub-scores, while statistically insignificant, could operationally suggest that RN's perception of handover quality decreased. It is also noted that a difference in perceptions of what constitutes sufficient documentation could be contributing to these scores as the process of documenting the aNIHSS was also undergoing review in these units. Interestingly, the mean score increased in the HQRF teamwork sub-score, suggesting RN's witnessed greater teamwork in the post-implementation phase. While the increase in mean RN ICS scores lacked statistical significance, it could reflect operational significance.

Providers had increased mean HQRF quality sub-scores post-implementation. This could be related to the addition of the in-person component of handover to their workflow. Notably the

provider's mean ICS isolation sub-score nearly doubled post-implementation. This, coupled with the significant differences ($p \leq .001$) between LIPs and RNs baseline ICS isolation sub-scores, strongly suggests that the involvement of multiple professions in single events of patient care decreases perceptions of isolation. This supports the in-person component of the handover process. Providers also had an increase in ICS communication sub-scores that, while insignificant, could demonstrate operational importance, suggesting that the in-person component, the new change for most of their handover process, resulted in increased perceptions of effective communication.

At baseline, the units had differing HQRF conduct sub-scores, which suggests the senders and recipients of information held disparate views of what constituted a "good" handover. The sending unit had higher scores in all three sub-scores, suggesting that the sending unit was more comfortable with the baseline handover process than the receiving unit. The sending unit also had significantly higher perceptions of time pressure than the receiving unit. As the sending unit transported the patients to the receiving unit, staff may have experienced increased pressure to return to other work. However, post-implementation, the perceptions of time pressure shifted, so that while the difference between units was still significant, the receiving unit became more aware of time constraints (MD 1.00, $p = .157$) and the sending unit reported decreased time pressure post-implementation. This could be a result of the in-person component of the handover, as clinicians on both units became aware of the needs and priorities of others and teamwork improved.

In the post-implementation phase, HQRF case complexity was perceived differently by the two units, with the sending unit significantly rating patients as more complex or uncertain than the receiving unit, which could reflect the level of comfort with stroke patients and the

benefit of a dedicated neurosciences intensive care unit. The receiving unit reported decreased perceptions of case complexity post-implementation, which may be a contributing factor to the increased ICS score, as the decreased urgency allows for increased time to focus on interprofessional collaboration. The receiving unit had a significant increase in ICS accommodation sub-score which suggests that the bedside component, located on the receiving unit, and the standardized processes increased perceptions of others considering their convenience and their shared ideas on patient treatment and care practices.

This QI process added an additional workload to the standard procedures performed by clinicians which could have decreased the value placed on the process due to the increased complexity required in coordinating the arrival of the team, coming from multiple locations, in the NEUROICU patient room. This is particularly interesting in light of the significant decrease in mean HQRF conduct scores post-implementation noted in handovers rated as exhibiting high time pressure. Since the HQRF conduct sub-scale focuses on information transfer, communication of assessment findings, documentation completion, interruptions, and potential complications, this could reflect the sacrifices made in communication due to the pressure on team members to complete the handover quickly. The handovers rated as having low time pressure had an increase in the ICS accommodation sub-score (MD 1.982), while statistically insignificant, operationally suggests that when time pressure is removed, team members have fewer restraints on cooperation and consideration.

The overall view of teamwork increased, which could reflect the increased exposure to other disciplines and the collaborative nature of QI. The corresponding increase in ICS accommodation also suggests that this interprofessional awareness improved perceptions of consideration. As the process involved bringing LIPs to the bedside (into a more traditional

nursing space) this handover method may have contributed to the RN's perceptions of being more accommodated by LIPs. The structured component of the handover also built in time for questions, encouraging inter-professional dialogue surrounding patient care practices.

The unchanged HQRF scores (in all but the teamwork sub-score) shows that the changed handover process most likely did not result in team perceptions of a more efficient process, but the exposure to professionals from other units may have affected team behaviors. The act of gathering multiple professions together increased perceptions of teamwork and decreased perceptions of isolation. Further evaluation of the process is warranted to determine the most effective method to incorporate interprofessional collaboration into the handover process in this facility.

The literature focuses on bedside team handovers between OR and ICU- both examples of clinical teams focused on a single patient at a time. These teams are often located in areas central to care delivery. The addition of a circulating admission team (working out of an office on another unit) to the evaluated handover process increased complexity that may not have contributed to overall clinician workflow. Also, the duty to respond to each stroke alert in the ED creates an active stroke team with multiple demands for time across several locations. The ED is a flexible environment, with nurses often responsible for multiple patients, so the additional time away from their unit to participate in handover could be a factor contributing to the increased time pressure.

Further scientific evaluation is warranted to evaluate the long-term effects of a structured team handover on inter-unit relationships and teamwork on a larger scale.

Strengths and Limitations

Limiting the process to only the patients admitted to the NEUROICU from the ED on the stroke service resulted in a small number of patients, limiting the number of handovers in the post-implementation phase. This resulted in a small post-implementation sample size. Given the small post-implementation sample size and the decision to not collect identifying information, it is likely that the survey captured different clinician populations' pre and post-implementation based on staffing and scheduling. As a result, unpaired analyses were conducted. However, due to the small size of the resident cohort, it is also probable that survey groups overlapped. Interpersonal effects may have created an unmeasurable source of bias. A significant limitation is the lack of observed handovers and the reliance on self-report.

Strengths include the use of the same resident cohort for pre and post-testing and the use of valid, reliable instruments to evaluate the handover. The involvement of interprofessional clinicians in SW development can increase sustainability and buy-in for this process. Additionally, the prospective analysis approach increased the statistical strength of results. Recall bias was decreased by having participants completing the post-implementation questionnaires soon after their involvement in the handover process.

Nursing Practice Implications

An interprofessional approach to handover has the potential to enhance bedside handover practices and demonstrates increased commitment to providing high-quality stroke care. The increased teamwork that results from an interprofessional approach has the potential to increase the recognition of adverse reactions or alterations in mental status as clinicians operate with a shared vision of the patient. Vital in this area is the shared neurological assessment that sets the baseline patient status in this patient population.

These findings provide insights into alternative methods of conducting inter-unit handovers which may direct new approaches to care at this facility. The development of an interprofessional handover of care in this setting could affect other areas as clinicians develop relationships across units and professions. Promoting increased exposure to other professions through additional shared patient care activities could potentiate this effect. These results may verify findings by other researchers supporting structured interprofessional handovers.

Products of the Scholarly Practice Project

This scholarly project provided a new standard work for team-based bedside handovers. The findings of the project will be shared within the institution to guide new approaches to handover. Furthermore, an abstract or poster will be created and submitted for a national conference as well as a manuscript for publication.

References

Benjamin, E., Blaha, M., Chiuve, S., Cushman, M., Das, S., Deo, R., . . . Muntner, P. (2017). Heart Disease and Stroke Statistics-2017 Update: A Report From the American Heart Association. *Circulation, 135*, 146-603. Retrieved from http://circ.ahajournals.org Accessed July 19th, 2017

Bradley, S., & Mott, S. (2012). Handover: Faster and Safer? *Australian Journal of Advanced Nursing, 30*(1), 23-32.

Bradley, S., & Mott, S. (2013). Adopting a Patient-Centred Approach: An Investigation into the Introduction of Bedside Handover to Three Rural Hospitals. *Journal of Clinical Nursing, 23*, 1927-1936.

Chaboyer, W., McMurray, A., Johnson, J., Hardy, L., Wallis, M., & Chu, F. (2009). Bedside Handover: Quality Improvement Strategy to "Transform Care at the Bedside". *Journal of Nursing Care Quality, 24*(2), 136-142.

Cummings, S., Bridgman, T., & Brown, K. (2016). Unfreezing Change as Three Steps: Rethinking Kurt Lewin's Legacy for Change Management. *Human Relations, 69*(1), 33-60.

Fabila, T., Hee, H., Sultana, R., Assam, P., Kiew, A., & Chan, Y. (2016). Improving Postoperative Handover from Anaesthetists to Non-Anaesthetists in a Children's Intensive Care Unit: The Receiver's Perception. *Singapore Medical Journal, 57*(5), 242-253.

Genentech USA, Inc. (2017). *Post-Activase (t-PA) Care Sheet.* Retrieved from Prescribing Information: Resources: https://www.activase.com/content/dam/gene/activase/PDFs/Activase-Posttreatment-Monitoring/Post-Activase-Care-Sheet.pdf Retrieved 23 May 2017

Graban, M. (2012). *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement* (2nd ed.). Boca Raton, Florida: CRC Press.

Hall, K., Vogel, A., Stipelman, B., Stokols, D., Morgan, G., & Gehlert, S. (2012). A Four-Phase Model of Transdisciplinary Team-Based Research: Goals, Team Processes, and Strategies. *Translational Behavioral Medicine*, 415- 430.

Holloway, R., Tuttle, D., Baird, T., & Skelton, W. (2007). The Safety of Hospital Stroke Care. *Neurology, 68*, 550-555.

Holly, C., & Poletick, E. (2013). A Systematic Review on the Transfer of Information During Nurse Transitions in Care. *Journal of Clinical Nursing*, 2387-2396.

Horwitz, L., Meredith, T., Schuur, J., Shah, N., Kulkarni, R., & Jenq, G. (2009). Dropping the Baton: A Qualitative Analysis of Failures During the Transition From Emergency Department to Inpatient Care. *Annals of Emergency Medicine, 53*(6), 701-710.

Kenaszchuk, C., Reeves, S., Nicholas, D., & Zwarenstein, M. (2010). Validity and Reliability of a Multiple-Group Measurement Scale for Interprofessional Collaboration. *BMC Health Services Research, 10*(1), 1-16.

Lewin, K. (1947). Frontiers in Group Dynamics: Concept, Method and Reality in Social Science; Social Equilibria and Social Change. *Human Relations, 1*, 5-41.

Manser, T., Foster, S., Flin, R., & Patey, R. (2013). Team Communication During Patient Handover From the Operating Room: More Than Facts and Figures. *Human Factors, 55*(1), 138-156.

Manser, T., Foster, S., Gisin., Jaekel, D., & Ummenhofer, W. (2010). Assessing the Quality of Patient Handoffs at Care Transitions. *Quality and Safety in Health Care, 19*, 1-5.

Mardis, T., Mards, M., Davis, J., Justice, E., Holdinsky, S., Donnelly, J., . . . Riesenberg, L. (2016). Bedside Shift-to-Shift Handoffs: A Systematic Review of the Literature. *Journal of Nursing Care Quality, 31*(1), 54-60.

Maxson, P., Derby, K., Wrobleski, D., & Foss, D. (2012). Bedside Nurse-to-Nurse Handoff Promotes Patient Safety. *MEDSURG Nursing, 21*(3), 140-144.

McMurray, A., Chaboyer, W., Wallis, M., & Fetherston, C. (2009). Implementing Bedside Handover: Strategies for Change Management. *Journal of Clinical Nursing, 19*, 2580-2589.

Patterson, E., Roth, E., Woods, D., Chow, R., & Gomes, J. (2004). Handoff Strategies in Settings with High Consequences for Failure: Lessons for Health Care Operations. *International Journal for Quality in Health Care, 16*(2), 125-132.

Petrovic, M., Aboumatar, H., Baumgartner, W., Ulatowski, J., Moyer, J., Chang, T., . . . Martinez, E. (2012). Pilot Implementation of a Perioperative Protocol to Guide Operating Room-to-Intensive Care Unit Patient Handoffs. *Journal of Cardiothoracic and Vascular Anesthesia, 26*(1), 11-16.

Petrovic, M., Aboumatar, H., Scholl, A., Gill, R., Krenzischek, D., Camp, M., . . . Martinez, E. (2014). The Perioperative Handoff Protocol: Evaluating Impacts on Handoff Defects and Provider Satisfaction in Adult Perianesthesia Care Units. *Journal of Clinical Anesthesia, 27*, 111-119.

Poltick, E., & Holly, C. (2010). A Systematic Review of Nurses Inter-Shift Handoff Reports in Acute Care Hospitals. *JBI Library of Systematic Reviews, 8*(4), 121-172.

Powers, W., Rabistein, A., Ackerson, T., Adeoye, O., Bambakidis, N., Becker, K., & ... Tirschwell, D. (2018, January 24). 2008 Guidelines for the Early Management of Patients

with Acute Ischemic Stroke: A Guideline for Healthcare Profesionals From the American Heart Association/American Stroke Association. *Stroke*, e1-e345.

Prabhakaran, S., Ruff, I., & Bernstein, R. (2015). Acute Stroke Intervention: A Systematic Review. *Journal of the American Medical Association, 313*(14), 1451-1462.

Robertson, E. R., Morgan, L., Bird, S., Catchpole, K., & McCulloch, P. (2014). Interventions Employed to Improve Intrahosptial Handover: A Systematic Review. *BMJ Quality and Safety, 23*, 600-607.

Robinson, N. (2016). Promoting Patient Safety With Perioperative Hand-off Communication. *Journal of PeriAnesthesia Nursing, 31*(3), 245-253.

Segall, N., Bonifacio, A., Barbeito, A., Schroeder, R., Perfect, S., Wright, M., . . . Mark, J. (2016). Operating Room-to-ICU Patient Handovers: A Multidisciplinary Human-Centered Design Approach. *The Joint Commission Journal on Quality and Patient Safety, 42*(9), 400-409.

Sheth, S., McCarthy, E., Kipps, A., Wood, M., Roth, S., Sharek, P., & Shin, A. (2016). Changes in Efficiency and Safety Culture After Integration of an I-PASS-Supported Handoff Process. *Pediatrics, 137*(2), 1-9.

Smeulers, M., Lucas, C., & Vermeulen, H. (2014). Effectiveness of Different Nursing Handover Styles for Ensuring Continuity of Information in Hospitalized Patients. *Cochrane Database of Systematic Reviews*(6), 1-17.

Taylor, J. (2015). Improving Patient Safety and Satisfaction With Standardized Bedside Handoff and Walking Rounds. *Clinical Journal of Oncology Nursing, 19*(4), 414-416.

Vergales, J., Addison, N., Vendittelli, A., Nicholson, E., Carver, D., Stemland, C., . . . Gangemi, J. (2015). Face-to-Face Handoff: Improving Transfer to the Pediatric Intensive Care Unit After Cardiac Surgery. *American Journal of Medical Quality, 30*(2), 119-125.

Wojciechowski, E., Pearsall, T., Murphy, P., & French, E. (2016). A Case Review: Integrating Lewin's Theory with Lean's System Approach for Change. *Online Journal of Issues in Nursing, 21*(2).

Yang, J., & Zhang, J. (2015). Improving the Postoperative Handover Process in the Intensive Care Unit of a Tertiary Teaching Hospital. *Journal of Clinical Nursing, 25*, 1062-1072.

Zakrison, T., Rosenbloom, B., McFarlan, A., Jovicic, A., Soklaridis, S., Allen, C., . . . Rizoli, S. (2015). Lost Information During the Handover of Critically Injured Trauma Patients: A Mixed-Methods Study. *BMJ Quality and Safety*, 929-936.

Figure 1.

Lewin's Three-Stage Model of Change

Unfreezing	Change	Re-Freezing
Observation by Consultant	Implementation of Standard Work	Spread of Standard Work
Pre-QI project data gathering	Implementation of QI project	Data collection
Educational sessions	3-week educational initiative	Results presentation
Break room poster	Just in time education	

Figure 2.
PRISMA Flow Diagram of Literature Review Results

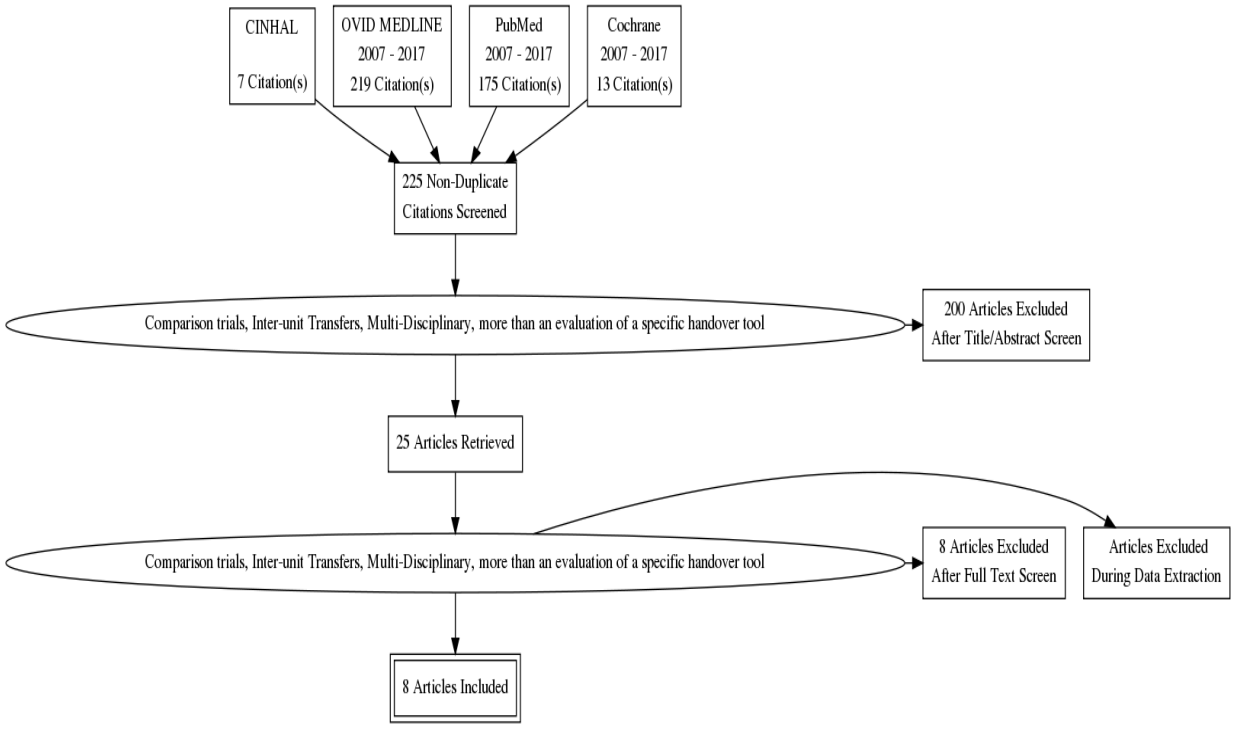


Figure 3.
Questionnaire

No individual information will be shared with unit leadership. Results will only be presented in aggregate form. Completion of this survey indicates consent to data use. All responses are voluntary and confidential. *Please check the appropriate boxes below, and mark the response that most accurately represents your impressions of the team and the handover recently completed*. Thank you.

Please check all that apply:			
Profession		**Unit**	
PHYSICIAN		NEUROICU	
RN		ED	
NP		STROKE TEAM	

Use this survey if you are a physician or nurse practitioner.

	Choose your response from the range of numbers →	Strongly Disagree	Disagree	Agree	Strongly Agree	Factors
1	Doctors/NPs have a good understanding with the nurses about our respective responsibilities.	1	2	3	4	Communication
2	Nurses are usually willing to take into account the convenience of doctors/NPs when planning their work.	1	2	3	4	Accommodation
3 R	I feel that patient treatment and care are not adequately discussed between doctors/NPs and nurses.	1	2	3	4	Communication
4	Medical staff and nurses share similar ideas about how to treat patients.	1	2	3	4	Accommodation
5	Nurses are willing to discuss medicine issues.	1	2	3	4	Accommodation
6	Nurses cooperate in the way we organize medical care.	1	2	3	4	Accommodation
7	Nursing staff would be willing to cooperate with new medical care practices.	1	2	3	4	Accommodation
8 R	The nurses do not usually ask for medical staff's opinions.	1	2	3	4	Isolation
9	Nursing staff anticipate when doctors/NPs will need their help	1	2	3	4	Communication
10	Important information is always passed on from doctors/NPs to nurses.	1	2	3	4	Communication
11 R	Disagreements with nurses often remain unresolved.	1	2	3	4	Communication
12 R	Nurses think their work is more important that the work of medical staff.	1	2	3	4	Isolation
13 R	Nurses would not be willing to discuss their new practices with doctors/NPs.	1	2	3	4	Isolation

Continued on next page.

Complete this survey if you are a nurse.

	Choose your response from the range of numbers →	Strongly Disagree	Disagree	Agree	Strongly Agree	Factors
1	Nurses have a good understating with the doctors/NPs about our respective responsibilities.	1	2	3	4	Communication
2	Doctors/NPs are usually willing to take into account the convenience of the nurses when planning their work.	1	2	3	4	Accommodation
3R	I feel that patient treatment and care are not adequately discussed between nurses and doctors/NPs.	1	2	3	4	Communication
4	Nurses and medical staff share similar ideas about how to treat patients.	1	2	3	4	Accommodation
5	Doctors/NPs are willing to discuss nursing issues.	1	2	3	4	Accommodation
6	Medical staff cooperate with the way we organize nursing.	1	2	3	4	Accommodation
7	Medical staff would be willing to cooperate with new nursing practices.	1	2	3	4	Accommodation
8R	The medical staff do not usually ask for nurses' opinions.	1	2	3	4	Isolation
9	Medical staff anticipate when nurses will need their help.	1	2	3	4	Communication
10	Important information is always passed on between nurses and doctors/NPs.	1	2	3	4	Communication
11 R	Disagreements with doctors/NPs often remain unresolved.	1	2	3	4	Communication
12 R	The doctors/NPs think their work is more important than the work of nurses.	1	2	3	4	Isolation
13 R	Doctors/NPs would not be willing to discuss their new practices with nurses.	1	2	3	4	Isolation

Adapted from: Kenaszchuk, C., Reeves, S., Nicholas, D., & Zwarenstein, M., (2010). Validity and reliability of a multiple group measurement scale of interprofessional collaboration. *BMC Health Services Research,* 10:83.

Continued on next page.

Handover Quality Rating Form

	Yes	Rather Yes	Rather No	No	**Circumstances of the handover**
Control Variables	4	3	2	1	The person handing over the patient was under time pressure
	4	3	2	1	The person taking on responsibility for the patient was under time pressure
	4	3	2	1	The case that was handed over was of high complexity
	4	3	2	1	The case that was handed over involves high uncertainty
					Conduct of the handover
1	4	3	2	1	The handover followed a logical structure
2	4	3	2	1	The person handing over the patient continuously used the available documentation (patient chart, etc.) to structure the handover
3R	4	3	2	1	Not enough time was allowed for the handover
4	4	3	2	1	In case of interruptions during handover, attempts were made to minimize them
5	4	3	2	1	All relevant information was selected and communicated
6	4	3	2	1	Priorities for further treatment were addressed
7	4	3	2	1	The person handing over the patient communicated her/his assessment of the patient clearly
8	4	3	2	1	Possible risks and complications were discussed
					Teamwork
9	4	3	2	1	It was easy to establish good contact at the beginning of the handover
10R	4	3	2	1	There were tensions within the team during handover
11	4	3	2	1	Questions and ambiguities were resolved (active inquiry by the person taking on responsibility for the patient)
12	4	3	2	1	The team jointly assured that the handover was complete
					Handover quality
13	4	3	2	1	Documentation was complete
14	4	3	2	1	There was too much information given
15	4	3	2	1	Too much information was asked for
16	4	3	2	1	The patients experience was considered carefully during handover (respect)
17	4	3	2	1	Overall the quality of this handover was very high

Comments on the handover:

_____

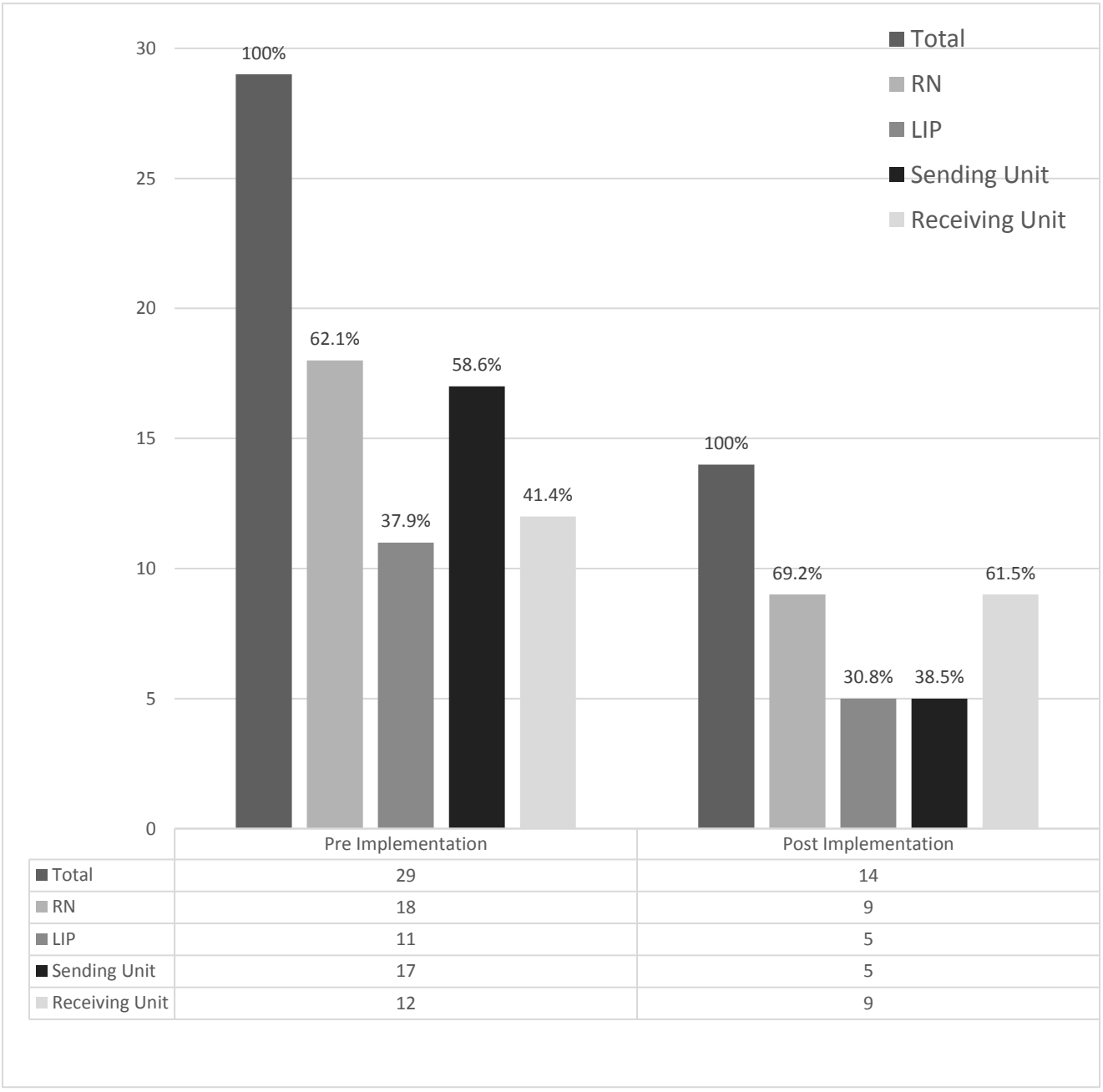
_____

_____

_____Adapted from: Manser, T., Foster, S., Gisin., Jaekel, D., & Ummenhofer, W. (2010). Assessing the Quality of Patient Handoffs at Care Transitions. *Quality and Safety in Health Care, 19,* 1-5.

Figure 4.

Sample Characteristics



	Pre Implementation	Post Implementation
Total	29	14
RN	18	9
LIP	11	5
Sending Unit	17	5
Receiving Unit	12	9

Figure 5.

Overall Mean Differences Pre and Post-Implementation

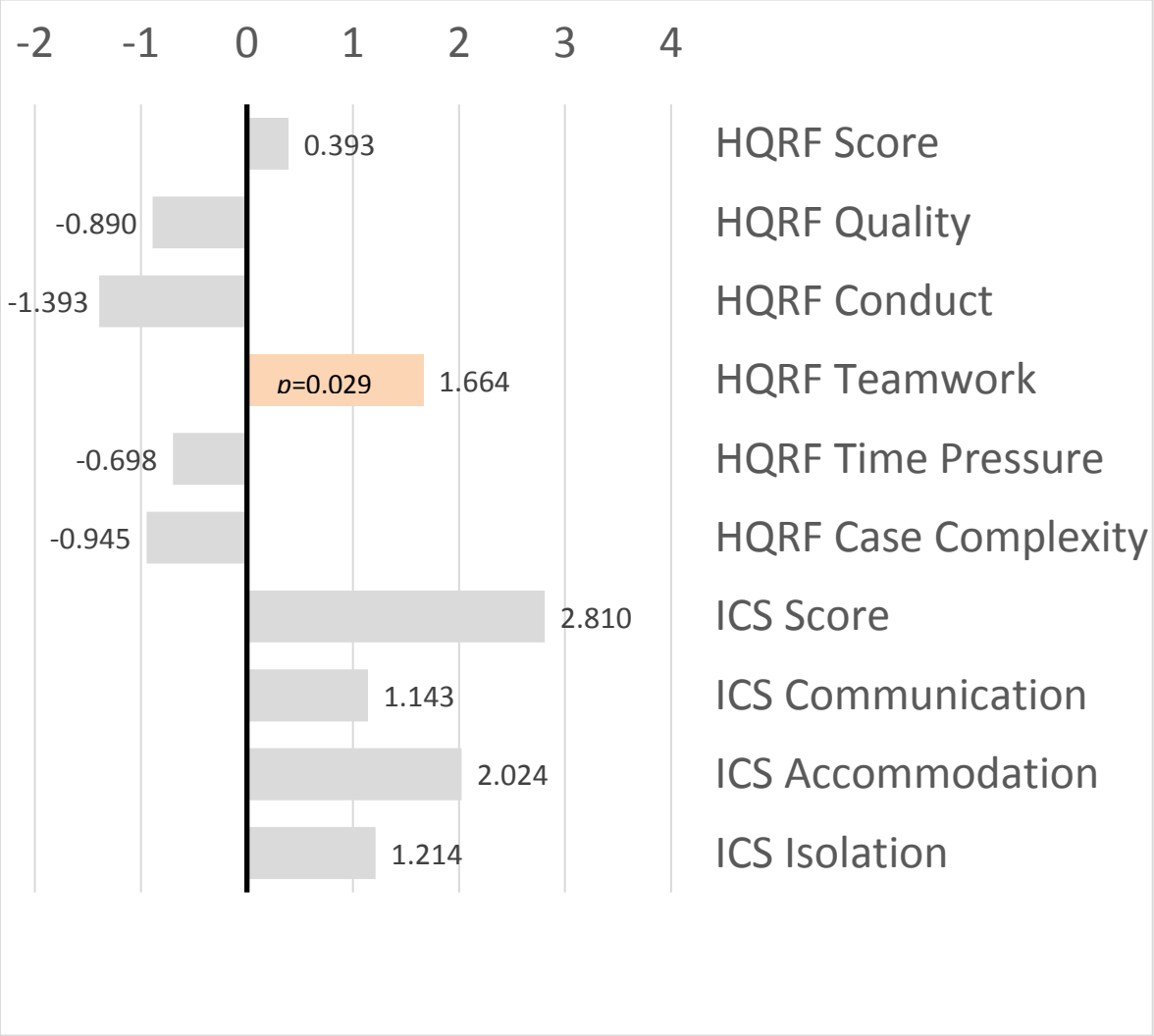


Figure 6.

Sending Unit Mean Differences Post-Implementation

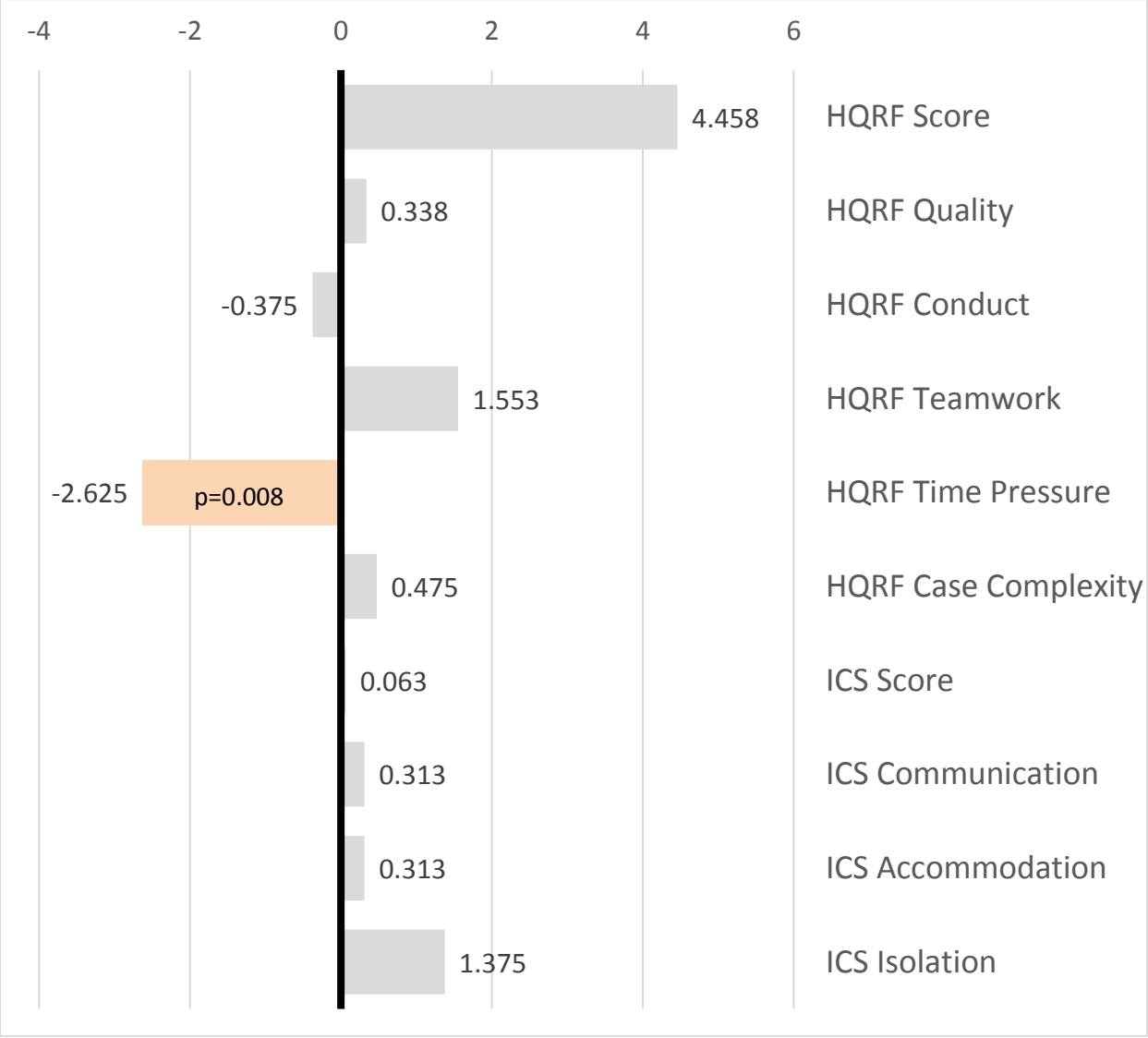


Figure 7.
Receiving Unit Mean Differences Post-Implementation

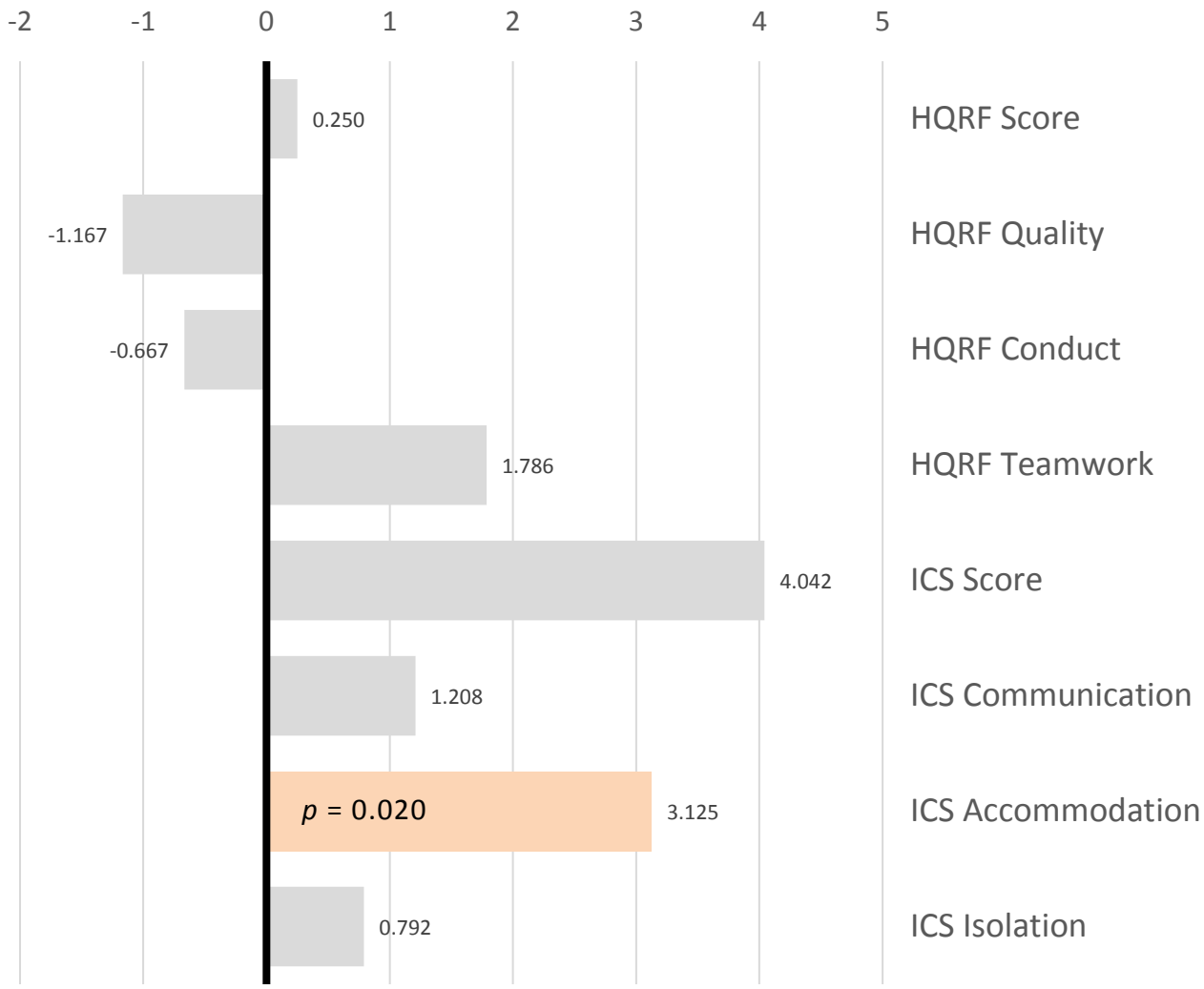


Figure 8.

Mean Difference Scores of LIP's Pre and Post-Implementation

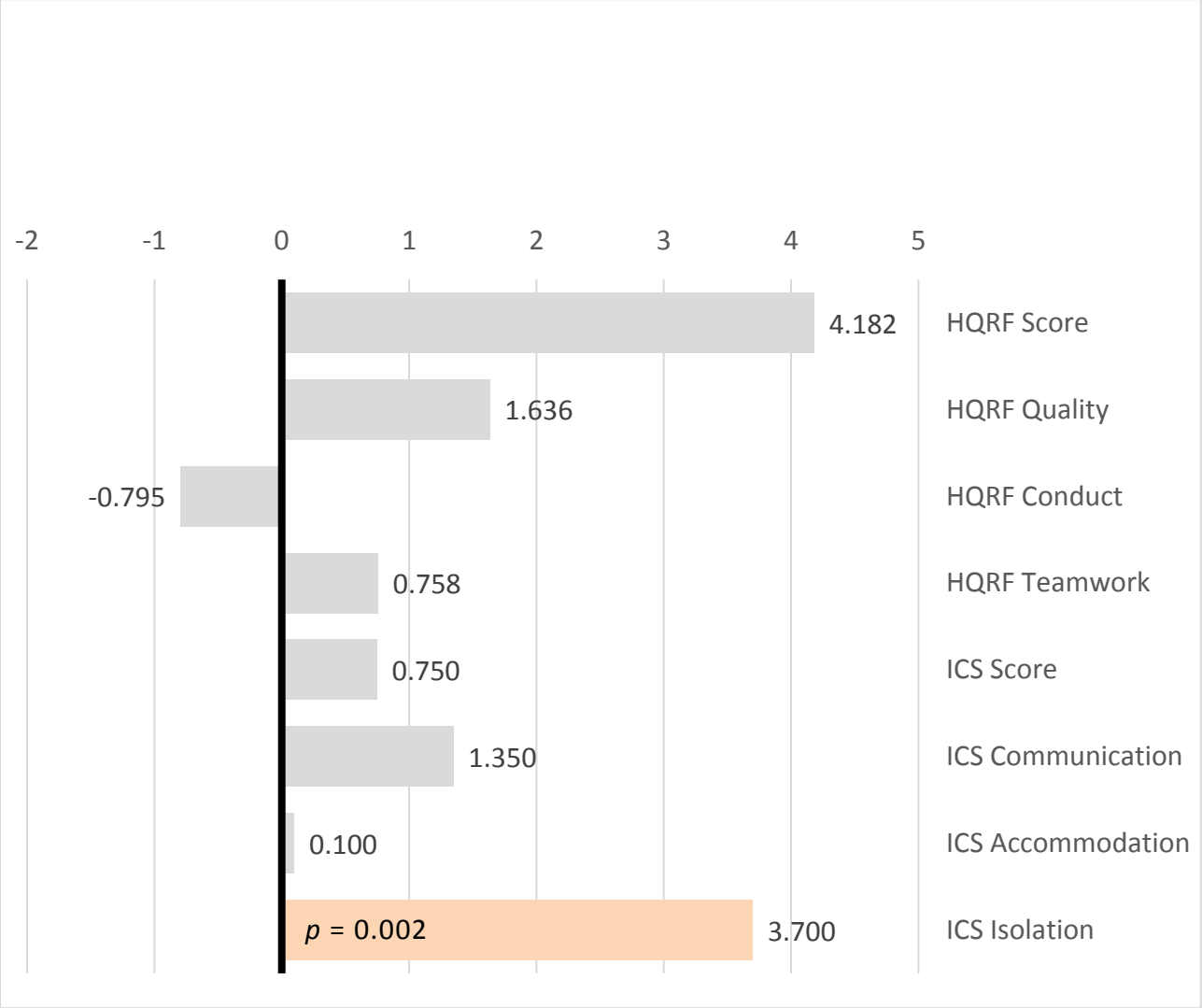


Figure 9.

Mean Difference in Nurse Scores Pre and Post -Implementation

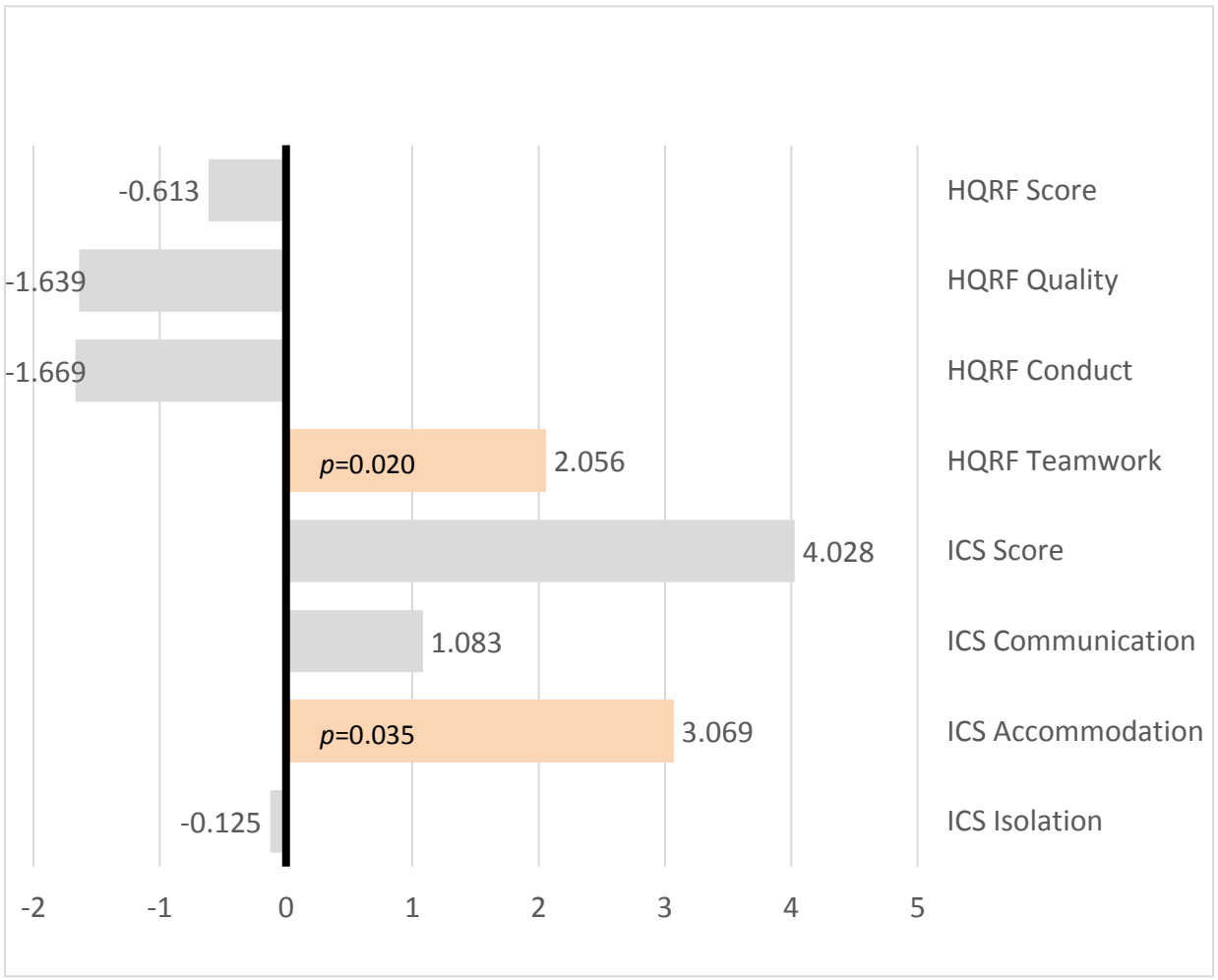
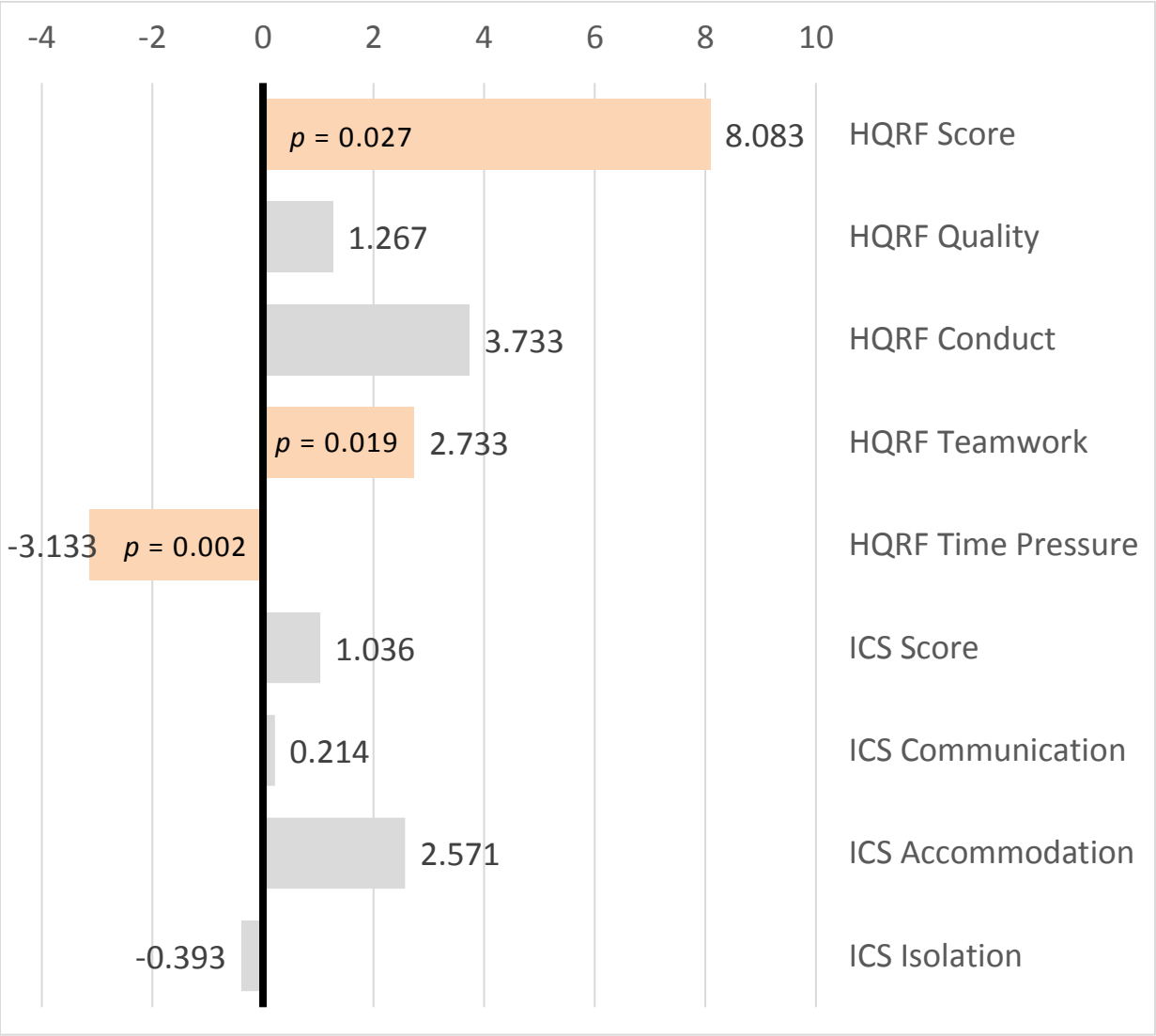


Figure 10.

Mean Differences in Highly Complex Cases Pre and Post-Implementation



Appendix A.

Baseline Standard Work for Post-tPA patient transfers from the ED to NEUROICU

Work performed by: (When)	**Major Step**	**Details**
ED Primary Nurse (as aware of pending admission to NEUROICU)	Calls brief report to NEUROICU shift manager Communicates with ED shift manager RN coverage for ED Stroke RN's other patients as needed	Provide synopsis of patient, including 1. airway status 2. vasopressor use 3. if anticipate thrombectomy 4. current abbreviated NIH stroke scale (aNIHSS) 5. estimated time of departure from ED NEUROICU shift manager verifies: 1. bed status/cleanliness 2. if need to leave IV pumps 3. barriers to immediate transport *if it will be <5 minutes until patient departure from the ED, no "rollout call" is needed.
NEUROICU shift manager	Arrange staffing	1. Assign Acute Stroke RN and Buddy RN. 2. Assign PCA/T to assist.
ED Stroke RN* (before departure from ED) *Primary RN in ED assigned to care for the stroke patient	Prepare for report to NEUROICU	Ensure have all patient information at hand including: 1. patient history 2. last known well time 3. time of tPA dose (including amount remaining to infuse) 4. changes in neurologic status
Acute Stroke RN* (on receipt of initial call) *primary RN to receive stroke patient in NEUROICU	Review EHR patient information.	Open patient's chart in EHR for review.
ED Stroke RN (before departure from ED)	Handoff other ED patients	Handoff other ED RN patients to RN designated by ED shift manager
ED Primary Stroke Nurse or HUC (on departure of patient from ED to NEUROICU)	Make "Roll-out" call to NEUROICU when ED patient departs, or 5 minutes prior to departure	Alert NEUROICU that patient has left the ED. Does not require RN to RN communication, can be taken by any person in NEUROICU (unless clinical situation has changed). If the report is called and patient will be immediately (<5minutes) transported to the NEUROICU, the "Roll-Out" call is unnecessary.

ED Stroke RN (when NEUROICU bed available)	Depart ED with patient	Transport patient from ED to NEUROICU in accordance with current practice guidelines.
Acute Stroke and ED RN's (when patient arrives in NEUROICU	Transfer patient to NEUROICU bed	1. Place patient on NEUROICU monitor 2. Note time of last recorded aNIHSS and VS and when next is due 3. Obtain arrival vital signs
Acute Stroke RN and ED Stroke RN (when patient arrives in NEUROICU	Conduct bedside report/ hand-off of care	1. Use template as posted 2. Identify the patient using name and date of birth 3. Diagnosis and active problems 4. Recent Events, changes in neurological condition, and treatment plan with rationale 5. Conduct aNIHSS exam together 6. Anticipated changes in patient condition and treatment, contingencies and expectations at next level of care 7. Review vital signs as entered in EHR and ensure validation of VS taken in ED, as well as documentation of aNIHSS. 8. Record arrival set of VS 9. Leave time to answer/ask questions and clarify information
ED Stroke RN	Depart NEUROICU	

Appendix B.

Intervention Standard Work for Stroke Patient Handovers from the ED to NEUROICU

Work performed by (When)	**Major Step**	**Details**
ED Primary Nurse (as aware of pending admission to NEUROICU)	Calls brief report to NEUROICU shift manager Communicates with ED shift manager RN coverage for ED Stroke RN's other patients as needed.	Provide synopsis of patient, including: 1.airway status 2. vasopressor use 3. if anticipate thrombectomy 4. estimated time of departure from ED NEUROICU shift manager verifies: 1. bed status/cleanliness 2. if need to leave IV pump 3. barriers to immediate transport
NEUROICU shift manager (After receiving initial call)	Arrange staffing	1. Assign Acute Stroke RN and Buddy RN. 2. Assign PCA/T to assist.
ED Stroke RN* (before departure from ED) *Primary ED RN assigned to care for the stroke patient	Prepare for report to NEUROICU	Ensure have all patient information at hand including: 1. patient history 2. last known well time 3. time of tPA dose (including amount remaining to infuse) 4. changes in neurologic status
Acute Stroke RN* (on receipt of initial call) *primary RN receiving stroke patient in NEUROICU	Review EHR patient information.	Open patient's chart in EPIC for review.
ED Stroke RN (before departure from ED)	Handover care of other ED patients	Handover other ED RN patients to RN designated by ED shift manager
ED Primary Stroke Nurse or HUC (on departure of patient from ED to NEUROICU)	Make "Roll-out" call to NEUROICU when ED patient departs, or 5 minutes prior to departure	Alert NEUROICU that patient has left ED. Does not require RN to RN communication, can be taken by any person in NEUROICU (unless clinical status has changed). If the report is called and patient will be immediately (< 5 min) transported to the NEUROICU, the "Roll-Out" call is unnecessary.
NEUROICU HUC	Page Stroke Team	Page #### with text reading "Patient name, MRN#, Handover @0000, Room ##."

ED Stroke RN (when NEUROICU bed available)	Depart ED with patient to NEUROICU	Transport patient in accordance with current practice guidelines.
Acute Stroke and ED RN's (when patient arrives in NEUROICU)	Transfer patient to NEUROICU bed.	1. Place patient on NEUROICU monitor 2. Note time of last recorded aNIHSS and vital signs (VS) and when next set is due. 3. Obtain arrival VS.
NEUROICU Provider and Stroke Team Provider	Move to NEUROICU patient room	1. Meet team members in NEUROICU room 2. Use template as posted
Stroke Team Provider (on arrival in NEUROICU room with patient)	Initiate bedside handover of care	1. Identify the patient using name and date of birth 2. Diagnosis and active problems 3. Recent Events: Changes in neurologic condition, initial presentation 4. Conduct shared aNIHSS exam (pertinent findings)
ED Stroke RN	Conduct bedside handover of care	1. Recent Events: progression of neurologic status not covered 2. Anticipated changes in patient condition and treatment, contingencies and expectations at next level of care 3. Leave time to answer/ask questions and clarify information
Stroke Team provider	Depart NEUROICU	1. Answer questions as needed
Acute Stroke RN, and ED Stroke RN	Complete settling patient in room	1. Conduct shared aNIHSS exam 2. Review vital signs as entered in EHR and ensure validation of VS taken in ED, as well as documentation of aNIHSS. 3. Record arrival set of VS
ED Stroke RN, (after completion of handover)	Depart NEUROICU, continue duties	

Appendix C.
Draft Manuscript for Publication

Effects of a structured, interprofessional approach to interunit handovers of care on clinician perceptions of handover quality and interprofessional collaboration

ABSTRACT

Purpose/Objective: Handovers of patients between hospital units, such as those that take place on admission of stroke patients from the emergency department to the neurosciences intensive care unit, are especially critical times, with significant potential for missed information, communication errors and interprofessional tension. To determine if a quality improvement (QI) initiative aimed at standardizing an interprofessional approach to handovers affected clinician perceptions regarding interprofessional collaboration and handover quality.

Description of the Project: A convenience sample of clinical nurses (RN) and licensed independent providers (LIP) caring for stroke patients in the emergency department and neurosciences intensive care unit of a rural academic medical center, were surveyed pre and post-implementation. The Interprofessional Collaboration Scale and Handover Quality Rating Form were used to compare views surrounding handover of care and interprofessional collaboration between professions.

Outcome: Post-implementation overall perceptions of teamwork (Mean difference 1.664, p = .029) increased. LIP's demonstrated a significant decrease in perceived isolation post-implementation (MD 3.700, p = .002), and RN's reported increases in teamwork (MD 2.056, p = .020) and accommodation (MD 3.069, p = .035). Highly complex handover cases demonstrated significantly increased teamwork (MD 2.733, p = .019) and decreased perceptions of time pressure (MD -3.133, p = .002) post implementation.

Conclusion: These findings suggest that increased exposure to other professions through meaningful patient care interactions increases teamwork.

Keywords: Handover, Handoff, Interprofessional, Collaboration, Emergency Department, Stroke

INTRODUCTION

Handovers have a significant role in healthcare, with elements of education, socialization, error detection and team cohesion present in each patient transfer.[1] A handover occurs when one provider (or provider team) transfers "responsibility and/or accountability for patient care" to another.[2(p. 136)]. Handovers have been identified as a time of increased vulnerability and risk.[3] Errors in handover are associated with increased adverse events, increased length of stay and poor outcomes in stroke patients.[4] The transfer of patients from the emergency department to the intensive care unit is often associated with "a significant loss of important clinical information."[5(p.935)] The need for inter-unit transfers (or admissions) is associated with a change in patient status (requiring increased levels of care) and can reflect a high-risk state. The transfers from the ED are especially risk-laden, as one report indicates 29% of physicians (5 ED, 27 internal medicine, 8 hospitalists) reported their patients "experienced (or almost experienced) an adverse event because of inadequate communication between the ED and admitting physician."[1(p. 702)]

Holloway, Tuttle, Baird, and Skelton (2007) analyze a series of reported adverse events that occurred after a patient experienced a stroke (ischemic stroke and intracerebral hemorrhage),

concluding that problems with communication or handover between providers were involved in 10% of preventable adverse events.[4]

Interventions to reduce adverse events due to miscommunication include standardization of handover content, interprofessional collaboration and in-person communication.[1] Poletick and Holly (2010), report approximately 70% of sentinel events result from defects in communication, and ineffective handovers contribute to "wrong treatment, delays in diagnosis, severe adverse events, patient complaints, increased cost and longer lengths of stay."[6(p.123)] Qualitative literature indicates that nursing handovers reflect a hierarchy surrounding information dissemination and that in-person handover would humanize staff members of opposite shifts and positively affect team building.[7] Implications for post-stroke care suggest that implementation of a standardized, in-person bedside report could increase teamwork.

This project implements and evaluates a follow-on QI initiative regarding the effectiveness of a structured team approach to the handover of stroke patients between the ED and the neurosciences intensive care unit (NEUROICU) by collecting clinician perspectives on handover quality and interprofessional collaboration (IPC), pre and post-implementation of the QI initiative. This scholarly practice project evaluates whether a structured interdisciplinary approach to handovers of care occurring on admission from the ED to the NEUROICU improved perceptions of teamwork between the professions involved.

A review of any controlled trial, including those with pre and post design, that produced new data regarding inpatient bedside team (or interprofessional) handovers of care between units was included. (See Figure 2). The time required to complete the standardized handover increased in two studies, [8, 9] with others demonstrating decreased transfer latency (the time between handover and transfer) [10] and decreased time to onset of handover after transfer from the OR.[9] Results of interprofessional bedside handovers of care result in assorted increased teamwork metrics, including team behaviors,[11] increased perception of the number of disciplines involved,[12] and increased teamwork scores. [13] Increased team presence during handover was reported after standardization, [8, 11] with an emphasis on the presence of the surgeon.[13] Common process metrics include adherence with handover procedures,[10] and defects of information transfer.[9] The discussion surrounding care tasks varied, with one focused on completion before the start of verbal handover,[14] and another conducting verbal handover to the side with a core group and care tasks by other team members.[11] Sheth et al. (2016) report increased information transfer using AHRQ metrics and increased provider and patient satisfaction.[10] Quality of patient care was measured by provider's perceptions of care quality, rates of 6-hour ventilator weaning, and duration of mechanical ventilation.[12]

In summary, the majority of articles review the handovers from the OR to the ICU, [8,11,12, 13] (Fabila et al., 2016), with others evaluating the transfer from the OR to the PACU,[9,14] or the ICU to the acute care unit (ACU).[10] The interprofessional and bedside approach is intuitive in this population due to the critical nature of their illness.[9,11] The most common intervention is standardization of the handover process,[8,9,14,15] and use of an instrument to facilitate communication.[10,11,15] The most frequently used instrument to facilitate a uniform process was the SBAR (Q),[11, 15] or the I-PASS.[10] Several other studies utilize a checklist to guide the handover process.[12,13]

This implementation and assessment of a quality improvement project targeted the handover between ED, stroke team and NEUROICU clinicians featuring an enhanced team approach to the admission of patients with a suspected stroke diagnosis. Evaluation of the

quality improvement project included assessment of perceived interprofessional collaboration and handover quality among the nurses and licensed independent providers.

Results

Analysis was conducted using UNICOM SPSS® version 24. Due to the small sample size, reporting results by "RN, MD or NP" could compromise confidentiality, so results are aggregated by profession into RN or licensed independent provider (LIP).

Pre-implementation evaluation

Forty-nine responses were received. Eleven responses were excluded for answering "no" to the question "Have you ever been involved in the transfer of a stroke patient from the ED to the NEUROICU?" Nine entries were excluded for partial completion (set at a 50% instrument completion rate). Results indicated 37.9% were reported as LIPs and 62.1% reported as RNs.

Sub-scale analysis of HQRF and ICS results included surveys that had incomplete results, as long as the respondent completed the entire sub-scale section. The Mann-Whitney U test was used as the samples were un-paired due to the unpredictable nature of stroke admissions and staffing which prevented the same staff members from participating in each (pre and post-implementation) handover of care. Mann-Whitney U of the HQRF and ICS scores by profession category (RN or LIP) indicated no significant differences in mean HQRF score (SD) of 50.82 (7.6) for LIPs, and 50.47 (8.240) for RNs, ($p = .911$). Pre-implementation sub-score analysis indicated no significant difference between professions across the sub-scores of quality, conduct, and teamwork. Differences in the HQRF control variable of time pressure were significant between LIP's and RN's (MD 1.62, $p = .025$). ICS scores demonstrated significance between RNs mean score of 40.50 (3.951) and providers 35.22 (SD 5.071) ($p = .006$). ICS sub-scale results demonstrated significance in the accommodation, (MD 2.34, $p = .016$), and isolation, (MD 2.7, $p \leq .001$) domains. At baseline, no significant differences were noted between cases reported as high complexity or low complexity.

Post-implementation

Thirteen surveys met overall inclusion criteria, with 30.8% LIP's. Mean HQRF scores between LIPs and RNs were not significant (MD 5.14, $p = .500$). Sub-scale analysis indicated all other sub-scores and control variables were insignificant. No significance was noted in mean ICS scores comparing LIP's (n = 4) and RN's (n = 8), nor was there a significant difference in sub-scale analysis. Clinicians that reported high HQRF complexity cases post-implementation had significantly increased mean HQRF conduct sub-score (mean difference 7.5, $p = .008$), compared to low complexity cases. Low complexity cases had significantly higher mean HQRF time pressure scores, (MD 2.98, $p = .003$).

Comparison of pre implementation and post-implementation means

Overall responses revealed significant increases in the mean HQRF teamwork (MD 1.664, $p = .029$). The increase in mean ICS accommodation sub-score approached significance (MD 2.024, $p = .065$). According to profession, RN's had a significant increases in the HQRF teamwork sub-score (MD 2.056, $p = .02$) and the ICS accommodation sub-score (MD 3.069, $p = .035$). RN's also reported decreased HQRF case complexity (MD -1.425, $p = .066$) compared to pre-intervention handovers. LIP responses demonstrated significant increases in the ICS isolation sub-score means (MD 3.700, $p = .002$) post-implementation.

Handovers identified as having high time pressure demonstrated a significant increase in ICS communication (MD 2.143, $p = .047$) and isolation (MD 3.232, $p = .001$) sub-scores. Mean ICS scores (MD 4.045, $p = .055$) approached significance. However, HQRF case complexity

(MD -2.429, p = .001) and conduct sub-scores (mean difference -3.765, p = .028) decreased significantly in high pressure cases.

Significant increases were noted in the HQRF score (MD 8.083, p = .027) and the teamwork sub-score (MD 2.733, p = .019) in handovers identified as having high case complexity. A significant decrease in HQRF time pressure (MD -3.133, p =.002) was noted in highly complex cases. Cases marked with low complexity as demonstrated a significant decrease in HQRF conduct sub-scores (MD -4.038, p = .037).

This evaluation of a quality improvement project applied the concepts of a structured bedside team handover of care with demonstrated effectiveness in the OR to the ICU (or acute care), or OR to PACU areas[8, 9, 10,12,14,15] to handovers occurring between the ED and the NEUROICU. Expanding the existing parallel structure of nurse-to-nurse and provider-to-provider handover to a structured, bedside, interprofessional process resulted in improved perceptions of team performance and accommodation. However, perceptions of the handover process were not significantly affected. The difference between pre and post-implementation could reflect the effect of either the structured process or the in-person, interprofessional component of the handover or some combination of the two.

Results

The interprofessional, in-person portion of the handover process perhaps demonstrated the most impact with the increased HQRF teamwork sub-score, which suggests that clinicians perceived decreased tensions between team members, member handover questions were answered, and the team agreed when the handover was completed. These elements are included in the structured nature of the handover, with the time for questions at the end of the organization specific handover format used in this QI initiative. The standardized information transfer of the handover also includes the conclusion of the handover, which gives the team a shared image of handover, including how to end the encounter.

The ICS accommodation sub-scale asks questions regarding the perception of the disciplines' coordinating and cooperating with patient care and practice delivery and the consideration of other disciplines when planning work processes. The increased overall ICS accommodation sub-score, while statistically insignificant, could suggest that staff perceive each other as more willing to collaborate in patient care. However, the significance (p = .035) of the increase in the RN ICS accommodation sub-score is likely to have weighted the overall value, as the change in mean providers ICS accommodation sub-score post-implementation was insignificant (p = 1.000). It also suggests that the bedside and the in-person component of the handover resulted in a consistent mental image of the patient between professions.

Comparison of pre and post-implementation HQRF quality (MD -1.639) and conduct (MD -1.669) sub-scores, while statistically insignificant, could operationally suggest that RN's perception of the handover quality decreased. It is also noted that a difference in perceptions of what constitutes sufficient documentation could be contributing to these scores as the process of documenting the aNIHSS was also undergoing review in these units. Interestingly, the mean score increased in the HQRF teamwork sub-score (MD 2.056, p=0.020), suggesting RN's witnessed greater teamwork in the post-implementation phase. While the increase in mean RN ICS scores lacked statistical significance (p = 0.144), it could reflect operational significance.

Providers had increased mean HQRF quality sub-scores (MD 1.636, p = .641) post-implementation. This could be related to the addition of the in-person component of handover to their workflow. Notably the provider's mean ICS isolation sub-score nearly doubled post-implementation (MD 3.700, p= .002). This, coupled with the significant differences ($p \leq .001$)

between LIPs and RNs baseline ICS isolation sub-scores, strongly suggests that the involvement of multiple professions in single events of patient care decreases perceptions of isolation. This supports the in-person component of the handover process. Providers also had an increase in ICS communication sub-scores (MD 1.350, $p = .304$) that, while insignificant, could demonstrate operational importance, suggesting that the in-person component, the new change for most of their handover process, resulted in increased perceptions of effective communication.

The overall view of teamwork increased, which could reflect the increased exposure to other disciplines and the collaborative nature of QI. The corresponding increase in ICS accommodation also suggests that this interprofessional awareness improved perceptions of consideration. As the process involved bringing LIPs to the bedside (into a more traditional nursing space) this handover method may have contributed to the RN's perceptions of being more accommodated by LIPs. The structured component of the handover also built in time for questions, encouraging inter-professional dialogue surrounding patient care practices.
The unchanged HQRF scores (in all but the teamwork sub-score) shows that the changed handover process most likely did not result in team perceptions of a more efficient process, but the exposure to professionals from other units may have affected team behaviors. The act of gathering multiple professions together increased perceptions of teamwork and decreased perceptions of isolation. Further evaluation of the process is warranted to determine the most effective method to incorporate interprofessional collaboration into the handover process in this facility.

The literature focuses on bedside team handovers between OR and ICU, both examples of clinical interprofessional groups focused on a single patient at a time. These teams are often located in areas central to care delivery. The addition of a circulating admission team (working out of an office on another unit) to the evaluated handover process increased complexity that may not have contributed to overall clinician workflow. Further scientific evaluation is warranted to evaluate the long-term effects of a structured team handover on interunit relationships and teamwork on a larger scale.

Strengths and Limitations

Limiting the process to only the patients admitted to the NEUROICU from the ED on the stroke service resulted in a small number of patients, which limited the number of handovers in the post-implementation phase. This resulted in a small post-implementation sample size. Given the small post-implementation sample size and the decision to not collect identifying information, it is likely that the survey captured different clinician populations' pre and post intervention based on staffing and scheduling. As a result, unpaired analyses were conducted. However, due to the small size of the resident cohort, it is also probable that survey groups overlapped. Interpersonal effects may have created an unmeasurable source of bias. A significant limitation is the lack of observed handovers and the reliance on self-report.

Strengths include the use of the same resident cohort for pre and post testing and the use of valid, reliable instruments to evaluate the handover. The involvement of interprofessional clinicians in SW development can increase sustainability and buy-in for this process. Additionally, the prospective analysis approach increased the statistical strength of results. Recall bias was decreased by having participants completing the post implementation questionnaires soon after their involvement in the handover process.

References

1. Horwitz, L., Meredith, T., Schuur, J., Shah, N., Kulkarni, R., & Jenq, G. Dropping the Baton: A Qualitative Analysis of Failures During the Transition From Emergency Department to Inpatient Care. *Annals of Emergency Medicine.* 2009;*53*(6): 701-710.

2. Chaboyer, W., McMurray, A., Johnson, J., Hardy, L., Wallis, M., & Chu, F. Bedside Handover: Quality Improvement Strategy to "Transform Care at the Bedside."*Journal of Nursing Care Quality.* 2009;*24*(2): 136-142.

3. Patterson, E., Roth, E., Woods, D., Chow, R., & Gomes, J. Handoff Strategies in Settings with High Consequences for Failure: Lessons for Health Care Operations. *International Journal for Quality in Health Care.* 2004;*16*(2): 125-132.

4. Holloway, R., Tuttle, D., Baird, T., & Skelton, W. The Safety of Hospital Stroke Care. *Neurology.* 2007;*68:* 550-555.

5. Zakrison, T., Rosenbloom, B., McFarlan, A., Jovicic, A., Soklaridis, S., Allen, C., . . . Rizoli, S. Lost Information During the Handover of Critically Injured Trauma Patients: A Mixed-Methods Study. *BMJ Quality and Safety.* 2015;25: 929-936.

6. Poletick, E., & Holly, C. A Systematic Review of Nurses Inter-Shift Handoff Reports in Acute Care Hospitals. *JBI Library of Systematic Reviews.* 2010;*8*(4): 121-172.

7. Holly, C., & Poletick, E. A Systematic Review on the Transfer of Information During Nurse Transitions in Care. *Journal of Clinical Nursing.* 2013;23: 2387-2396

8. Petrovic, M., Aboumatar, H., Baumgartner, W., Ulatowski, J., Moyer, J., Chang, T., . . . Martinez, E. Pilot Implementation of a Perioperative Protocol to Guide Operating Room-to-Intensive Care Unit Patient Handoffs. *Journal of Cardiothoracic and Vascular Anesthesia.* 2012;*26*(1): 11-16.

9. Petrovic, M., Aboumatar, H., Scholl, A., Gill, R., Krenzischek, D., Camp, M., . . . Martinez, E. The Perioperative Handoff Protocol: Evaluating Impacts on Handoff Defects and Provider Satisfaction in Adult Perianesthesia Care Units. *Journal of Clinical Anesthesia.* 2014;*27*: 111-119.

10. Sheth, S., McCarthy, E., Kipps, A., Wood, M., Roth, S., Sharek, P., & Shin, A. Changes in Efficiency and Safety Culture After Integration of an I-PASS-Supported Handoff Process. *Pediatrics.,* 2016;*137*(2): 1-9.

11. Segall, N., Bonifacio, A., Barbeito, A., Schroeder, R., Perfect, S., Wright, M., . . . Mark, J. Operating Room-to-ICU Patient Handovers: A Multidisciplinary Human-Centered Design Approach. *The Joint Commission Journal on Quality and Patient Safety.* 2016;*42*(9): 400-409.

12. Vergales, J., Addison, N., Vendittelli, A., Nicholson, E., Carver, D., Stemland, C., . . . Gangemi, J. Face-to-Face Handoff: Improving Transfer to the Pediatric Intensive Care Unit After Cardiac Surgery. *American Journal of Medical Quality,* 2015;*30*(2): 119-125.

13. Yang, J., & Zhang, J. Improving the Postoperative Handover Process in the Intensive Care Unit of a Tertiary Teaching Hospital. *Journal of Clinical Nursing,* 2015;*25:* 1062-1072.

14. Robinson, N. Promoting Patient Safety With Perioperative Hand-off Communication. *Journal of PeriAnesthesia Nursing,* 2016;*31*(3): 245-253.

15. Fabila, T., Hee, H., Sultana, R., Assam, P., Kiew, A., & Chan, Y. Improving Postoperative Handover from Anaesthetists to Non-Anaesthetists in a Children's Intensive Care Unit: The Receiver's Perception. *Singapore Medical Journal,* 2016;*57*(5): 242-253.