Incorporating TeamSTEPPS Training to Improve Staff Collaboration in an Academic Level I Emergency and Trauma Center

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Abstract

Background: Seamless communication and coordinated teamwork is paramount in high stakes clinical practice settings, such as the emergency department (ED), to prevent medical errors and ensure high quality patient care delivery. Ineffective communication in this fast-paced environment can be detrimental for patient outcomes and staff collaboration.

Purpose: The purpose of this project was to evaluate the effect of TeamSTEPPS® training (Team strategies and Tools to Enhance Performance and Patient Safety), an evidenced based communication-training toolkit, on staff perception of teamwork and communication in an academic Level I Emergency and Trauma Center.

Methods: A prospective, single group, pre-post design with a convenience sample was employed. The sample consisted of thirty-five clinical staff members, including registered nurses (RNs) and patient care technicians (PCTs), recruited from an academic Level I Emergency and Trauma Center. A pre-intervention T-TPQ (TeamSTEPPS® teamwork and Perceptions Questionnaire) measuring staff perception of teamwork and collaboration was administered followed by a one-hour TeamSTEPPS® education session from free published materials. Three weeks later, a post-intervention T-TPQ was administered. Data were collected from January 2020 to February 2020 and were analyzed using SPSS Version 26 (IBM Corporation, 2017). A two-sided p value < 0.05 was used to establish statistical significance. Means, standard deviations, frequencies, and percentages are reported for descriptive data as appropriate. A paired samples t-test was used to analyze changes in scores from pre-test to post-test for outcome measures.

Results: 23 females and 12 males with a mean age of 30 years and 9 years of experience participated. T-TPQ scores showed a mean of 121.4 pre-training and mean of 128.2 after

training. Paired t-test demonstrated overall pre-intervention (mean = 3.52, SD = 0.5) and post-intervention (mean = 3.78, SD = 0.4) scores were significantly improved overall (p <.001, -0.29 - -0.13).

Conclusion: TeamSTEPPS® was an effective communication collaboration program to improve teamwork and communication perceptions in the ED suggesting that an evidence-based multifaceted, multimedia instructional toolkit may promote a collaborative culture of effective communication and teamwork. Long term effects of TeamSTEPPS® training in the ED requires further study.

Keywords: TeamSTEPPS®, communication, T-TPQ, emergency department, collaboration, Donabedian

Incorporating TEAMSTEPPS® Training to Improve Staff Collaboration in an Academic Level I Emergency and Trauma Center

Introduction

Medical error is defined as any preventable adverse effect of medical care whether or not it is evident or harmful to the patient (Makary & Daniel, 2016). The most commonly reported inpatient medical errors include adverse drug events, improper transfusions, misdiagnosis, under-treatment, over-treatment, surgical injury, restrained injury, falls, pressure ulcers, and misidentification of patients. An overwhelming percentage of these errors occur in high stakes clinical practice settings such as the intensive care unit (ICU), operating suites (OR), and the ED (Carver, Gupta, & Hipskind, 2020). After investigating such sentinel events, root cause analysis often reveals that the most common contributing factor to grave error is a serious breakdown in teamwork or miscommunication (Grober & Bohnen, 2005).

In 1999, the Institute of Medicine (IOM) published a report entitled, *To Err is Human: Building a Safer Health System,* which sparked a revolution in healthcare organizations. Medial error cause investigation, or root cause analysis, shifted from targeting individual mistakes to building a culture of safety by cultivating fundamental system changes (Donaldson, n.d.). The IOM challenged health care delivery organizations to overhaul system practices to improve patient safety and reduce medical errors by applying user-centered design, avoiding reliance on memory, attending to safe work environments, avoiding reliance on vigilance, training in teams, involving patients in care delivery, anticipating the unexpected, designing for recovery, and improving timely access to accurate information (Havens & Boroughs, 2000). To ease this transition, the IOM recommended creating the National Center for Patient Safety (NCPS) to act as a repository for evidence-based practices (Donaldson, n.d.). This repository paved the way

for The Department of Defense (DOD) and The Agency for Healthcare Research and Quality (AHRQ) to create an evidenced based, collaborative toolkit to enhance team performance entitled TeamSTEPPS® to mitigate error and improve teamwork (Havens & Boroughs, 2000).

TeamSTEPPS® Framework

TeamSTEPPS® is an evidence-based multifaceted instructional toolkit designed to promote teamwork and collaboration within healthcare delivery teams to improve patient safety and care quality (Clapper & Kong, 2012). The conceptual framework for TeamSTEPPS® is built on team competency outcomes including knowledge of a shared mental model, attitudes of mutual trust, team orientation, and performance of adaptability, accuracy, productivity, efficiency, and safety. Five core principles build the foundation comprised of *communication, team structure, leadership, situation monitoring, and mutual support* (Plonien & Williams, 2015). The interplay of these competencies is dynamic with successful interaction leading to improved communication, teamwork, and quality of care.

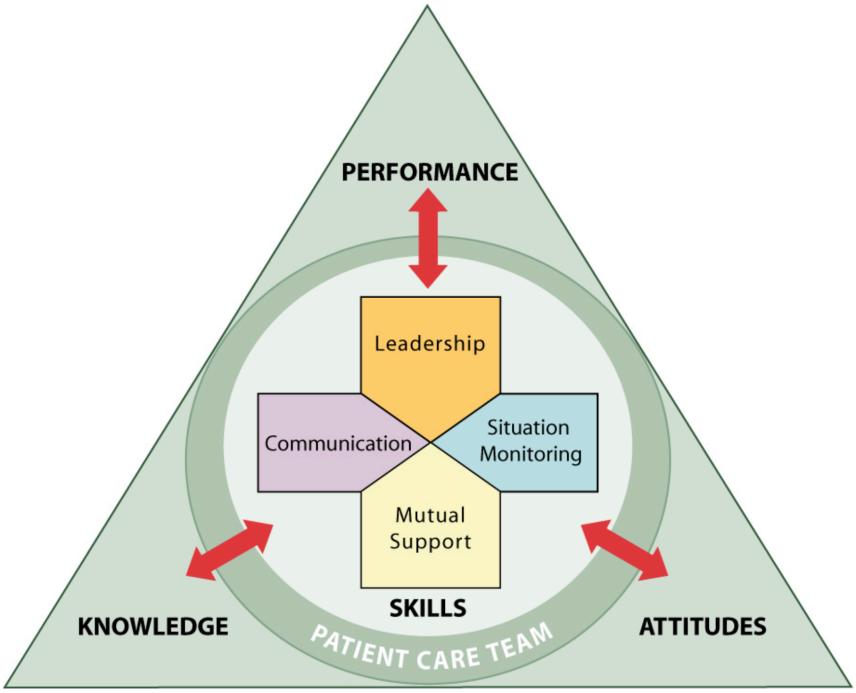

Figure 1. TeamSTEPPS® Framework Triage Model.

TeamSTEPPS® defines *communication* as the intricate process of information exchange among team members, that, in order to be effective, must be accurate, clear, and timely (Stead et al, 2009). TeamSTEPPS® utilizes several techniques to improve communication among team members in high stress situations including SBAR; a mnemonic for structured reporting that includes call-outs, check-backs, and handoff by the mnemonic I PASS the BATON. SBAR is a technique for communicating critical information in high stress situations that require immediate attention and action (Stead et al, 2009) and stands for Situation, Background, Assessment, and Recommendation or Request. Call-outs is a strategy of repeating information back to a leader, communicating critical information by simultaneously informing all team members, and directing responsibility to a specific individual. Similarly, check-back is a three-step closed loop communication strategy where the sender initiates a message, the receiver accepts the message and provides feedback, and the sender double-checks to ensure the message was received. Finally, I PASS the BATON, is a mnemonic designed to enhance information exchanges during transitions in care and stands for Introduction, Patient, Assessment, Situation, Safety Concerns, Background, Actions, Timing, Ownership, and Next.

To address *leadership*, TeamSTEPPS® defines effective team leaders as those who are able to organize the team, identify and articulate clearly defined goals, appropriately assign tasks and responsibilities to team members, allocate recourses, facilitate conflict resolution, and model effective teamwork. Leadership tools include briefs, huddles, and debriefings. Briefs are designed to be short sessions prior to events in which the plan for care is shared, team formation is discussed, and individual roles and responsibilities are established (Stead et al, 2009). This process is designed to address the members of the team, delineate roles and responsibilities, establish the plan of care, and review available recourses. Next, huddles are “ad hoc” meetings

that can be performed at any point by any team member to re-establish situational awareness and reinforce the plan of care. Finally, debriefings are informal exchanges at the conclusion of an event to improve team performance through reinforcement of positive behaviors, identifying areas for improvement, and addressing situational awareness.

The TeamSTEPPS® *situation monitoring* process comprises continuous reevaluation and assessment of team needs and function through situation monitoring, situation awareness, and a shared mental model. Situation monitoring involves continuous situation scanning and assessment while situational awareness is constantly "knowing what is going on around you." Mastering situation monitoring skills results in a shared mental model where each team member is attentive to the task at hand and is "on the same page" (Stead et al, 2009). The memory tool STEP describes the components of situation monitoring including Status of the patient, Team members, Environment, and Progress toward goals. Additionally, cross monitoring is a harm error reduction strategy where members of the team monitor one another's actions to provide a safety net to ensure that mistakes and oversights are caught quickly.

The final principle of *mutual support* has several tools including task assistance, feedback, advocacy and assertion, the two-challenge rule, and CUS, which stands for I'm Concerned, Uncomfortable, and this is a patient Safety concern (Stead et al, 2009). This principle is rooted in assertive statements to ensure team and patient safety by allowing each team member a voice and an opportunity to identify potential safety concerns. Task assistance protects from overload and expects that each team member will foster a climate of offering support. Assertiveness and advocacy are reinforced by appropriate feedback, the two-challenge rule, and the mnemonic CUS. Feedback is essential to growth and improving team performance, but to foster mutual respect, it must be timely, respectful, specific, directed, and considerate. Mutual

support ensures that members of the team are respected and their needs are met to maximize team functionality and collaboration.

Team structure, communication, leadership, situation monitoring, and mutual support build the foundation of the TeamSTEPPS® curriculum with each having tools to enhance team performance in high stress, high stakes practice settings (Lisbon et. al, 2016). Successful team collaboration is contingent on optimizing these principles by incorporating specific communication tools, establishing a common framework, and mastering competencies. This curriculum has been validated in many high-stake settings such as aviation and nuclear power; however, there is little evidence to support its impact on team collaboration in the ED. This quality improvement (QI) project imitative provides an opportunity to validate this program in the ED.

Theoretical Framework

The theoretical framework guiding this project was Donabedian's structure-process-outcome quality of care model (Donabedian, 2005). Donabedian conceptualized that structure variables such as physical environments, human aspects, and system characteristics, influence process measures, which ultimately influence outcome measures. Identifying outcome measures, process measures, structure measures, and balancing measures help to determine if a process improvement project achieved the desired impact or not. Outcome measures, for example, can reflect the impact on patient safety and demonstrate the end results of process improvement. Examples could include length of stay or improved patient experience. Process measures reflect the system delivering the desired outcome and could include variables such as staff compliance with hand washing practices. Structure measures show the attributes of the organization such as staff to patient ratios. Balancing measures demonstrate unintended consequences of the

proposed change. Donabedian theorized that outcome measures where the ultimate validators of effectiveness and quality of healthcare while process measures reflect the clinical impact of quality improvement (Donabedian, 2005).

The Donabedian framework is flexible and can be adapted to various practice settings to measure and implement quality improvement practice change. According to Donabedian, improvements in care delivery structures should improve clinical processes, leading to improvements in patient outcomes (Moore, Lavoie, Gilles, & Lapointe, 2015). The ED is a high stakes clinical practice setting where lapses in structure can significantly impact patient care delivery and quality of care. Applying Donabedian's classification system to this population will assess and compare the quality of structure, process, and outcome measures. This project aimed to evaluate staff perception of teamwork and collaboration before and after implementing TeamSTEPPS® training; thus, attempting to challenge systems measures in the ED.

Quality Improvement Project Purpose

TeamSTEPPS® is an evidenced-based collaborative framework with standardized communication tools designed to optimize team performance. This program has been well validated to successfully improve communication and collaboration in environments such as aviation, nuclear engineering, and specialized military settings; however, evidence is needed to validate this program in the healthcare setting. Therefore, the purpose of this project was to determine the effect of TeamSTEPPS® training on staff attitude, perception of teamwork, and collaboration in an academic Level I Emergency and Trauma Center.

Review of the Literature

A comprehensive literature review was conducted to determine current standard practice and evidence-based guidelines for communication and collaboration. This search strategy was

developed with the assistance of an academic librarian and refined upon subsequent meetings (Figure 2). Investigative strategies included an inclusive search of electronic databases incorporating PubMed, MEDLINE, CINAHL, Web of Science, Cochrane Library, and Joanna Briggs with the following key terms: (*"TeamSTEPPS®*" OR "*Team Strategies and Tools to Enhance Performance and Patient Safety*") AND ("*communication*" OR "*emergency department*" OR "*team dynamics*" OR "*collaboration*").

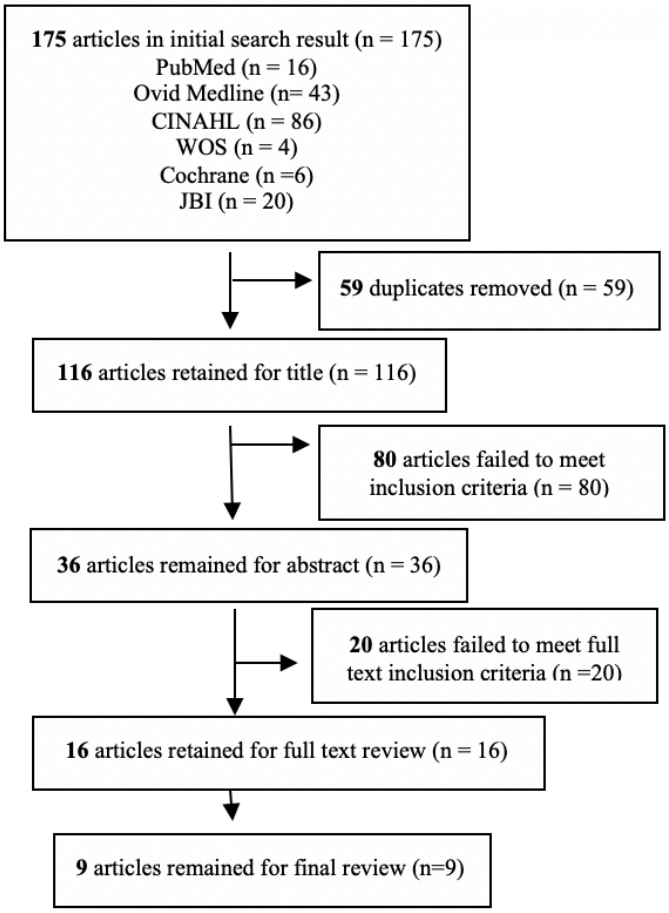

Figure 2. TeamSTEPPS Literature Search PRISMA Diagram.

The initial search resulted in 175 articles with 154 remaining after duplicates were removed. Inclusion criteria included peer-reviewed articles with application of TeamSTEPPS® to improve communication, full text articles, and articles written in English. Exclusion criteria

included application of TeamSTEPPS® in practice settings unrelated to healthcare and older than fifteen years. After applying inclusion and exclusion criteria and reading abstracts, nine relevant studies remained. Four of these studies directly related to the ED and five related to other high stakes clinical practice settings. Secondary investigation strategies included consultation with practice experts in the ED, Google searches, a Google Scholar review, and textbook review published by the Emergency Nurses Association (ENA) regarding clinical practice and systematic assessment. Additional searches of supplementary materials yielded free to the public published TeamSTEPPS® recourses, questionnaire manuals, assessment tools, and supplementary videos from the DOD and AHRQ websites.

Lisbon et al. (2016) published a pilot report entitled, *Improved Knowledge, Attitudes, and Behaviors after Implementation of TeamSTEPPS® Training in an Academic Emergency Department.* The researchers implemented a four-hour training session lead by 10 master trainer coaches at an academic medical center ED. The training consisted of didactic instruction utilizing the published TeamSTEPPS® curriculum. Evaluation methods included administration of the TeamSTEPPS® Knowledge Test, version 1 at three timepoints: one day prior to training; 45 days after training; and again 90 days after training. This 21-question multiple-choice format examination measured knowledge retention of TeamSTEPPS® tactics and definitions. Researchers found statistically significant improvement of TeamSTEPPS® knowledge after training (x^2 test, $p < .05$), 45 days after training from baseline, and 90 days after training from baseline in 15 questions. On day 90, the assessment showed sustained knowledge over baseline; however, the level of sustained knowledge did not reach statistical significance from day 45 (x^2 test, $p < .05$). Unfortunately, the authors did not correct for multiple comparisons. This study had several limitations including lack of a control group to compare findings and lack of

observance of clinical patient outcomes; however, the researchers laid the foundation for validating the TeamSTEPPS® curriculum in this clinical practice setting.

Obenrader, Yap, Broome, & Jamison (2019) conducted a QI project implementing TeamSTEPPS® in a community hospital ED. A convenience sample of 57 ED team members completed formal TeamSTEPPS® training and completed three questionnaires prior to training sessions, 15 days later, and again 30 days later. This was a repeated measures design that tracked teamwork perceptions utilizing the Teamwork Perceptions Questionnaire (T-TPQ), teamwork attitudes by the Teamwork Attitudes Questionnaire (T-TAQ), and culture assessment with the Nursing Culture Assessment Tool (NCAT). Metrics were reported in each of the five TeamSTEPPS® core principles for each assessment tool. Each category demonstrated statistical significance according to the T-TP-Q 30 days after formal training for communication (F (1.340, 56.29) = 439.600, $p < .001$), teamwork (F (1.608, 67.533) = 46.920, $p < .001$), situation monitoring (F (1.24, 52.02) = 266.92, $p < .001$), mutual support (F (1.15, 48.43) = 23.44, $p < .001$), and behavior (F (1.43, 29.93) = .00, $p < .05$). Obenrader, Yap, Broome, & Jamison (2019) reported that the group increased perception of the importance of engagement in situation monitoring as well as increasing mutual support. While this project had several limitations including a convenience sample and small sample size, the results showed statistical significance in improvement of staff attitudes and perceptions of teamwork and communication.

Peters et al. (2018) implemented a TeamSTEPPS® Trauma Nurse Academy at a Level I Emergency and Trauma Center. This program included multidisciplinary didactic education components, TeamSTEPPS® essentials, and interactive learning simulation to improve teamwork during trauma resuscitations. This QI project that took place from 2011 - 2013 included 82 registered nurses. The researchers reported a statistically significant increase in self-

confidence ratings and knowledge scores (pretest mean = 68.29, SD = 18.35; post-test mean = 88.48, SD = 5.44, t (65) = 1.997, $p < 0.001$). While this study utilized a convenience sample, it was a larger sample than previous studies. This study shows an important contribution to emergency nursing by adding to the evidence that supports trauma teamwork training can increase knowledge and self-confidence in high-stake clinical environments.

Tuner (2012) described the implementation of TeamSTEPPS® training in an academic Level I Emergency and Trauma Center. A team of master trainers including three physicians and three nurses led TeamSTEPPS® training. The team designed a four-hour curriculum utilizing the published platform. The author describes administering the T-TAQ to obtain baseline data, but metrics were not reported. This QI project has several limitations and limited generalizability as data was not appropriately gathered or analyzed. However, the author describes the implementation of a TeamSTEPPS® curriculum in an academic Level I Emergency and Trauma Center, some of the lessons learned, and the challenges faced.

Outside of the ED, Natafgi et al. (2017) implemented a QI project incorporating TeamSTEPPS® shift-change handoff communication in a critical access hospital to enhance teamwork and collaboration. This qualitative study used semi-structured interviews and observation of handoff processes. Natafgi et al. (2017) identified barriers to implementation of TeamSTEPPS® tools, as well as defined how a standardized handoff impacts teamwork and collaboration. This set precedent for further investigation as to the effect of TeamSTEPPS® training on individual perception of collaboration.

The Joint Commission Journal on Quality and Patient Safety published *The Role of TeamSTEPPS® Competencies and Tools in Patient Safety Events,* supporting the success of TeamSTEPPS® training to improving patient safety in a deployed medical treatment

environment. The researchers measured survey analyzed values reported through the T-TPQ before and after formal training, showing an overall reduction in communication discrepancies and medical errors by an overwhelming 65 percent ($p < 0.05$). The researchers self-reported incident-to coding as a study limitation, possibly skewing reported measures; however, this study laid the foundation for implementing TeamSTEPPS® training in common practice. Overall, they reported clinical and statistical significance within this specialized population.

In summary, TeamSTEPPS® is a validated, comprehensive, evidence-based curriculum aimed at improving safety and teamwork in high stakes settings. Substantial literature validates the curriculum in industries such as aviation, nuclear power, and military operations (Ward, Zhu, & Lampman, 2013); however, there is limited application to the ED. The DOD and AHRQ have published step-by-step application instructions according to practice environments along with the entire TeamSTEPPS® curriculum, but few investigations have been conducted in the ED. The purpose of this project was to add to the literature by evaluating the application of TeamSTEPPS®, a well-validated, evidence-based, multimodal educational program, on staff perceptions, attitudes, and communication in an academic Level I Emergency and Trauma Center.

Methods

A prospective, single group, pre-post design with a convenience sample was employed to investigate the effect of TeamSTEPPS® training on staff perception of collaboration and teamwork in the ED. The principle question of this quality improvement project was: What is the effect of TeamSTEPPS® training on staff attitude, perception of teamwork, and collaboration in an academic Level I Emergency and Trauma Center? The study design was a quality improvement project with research design created to illustrate and determine the immediate

effect of TeamSTEPPS® training of staff perception. Data was collected from January 2020 to February 2020. Prior to project implementation, Institutional Review Board granted approval protocol number 3293. Prior to project participation, project information was provided and written informed consent obtained. TeamSTEPPS® published materials were permitted for free download from the organizational website. All investigators completed CITI training.

Setting

This quality improvement project utilized a prospective pre-post design in the ED of an academic Level I Emergency and Trauma Center in the mid-Atlantic region of Virginia. This medical center serves as a gateway to specialists and generalist practitioners alike. In 2018, the institution reported that the inpatient facility had a total of 612 beds with an average daily census of 494 patients. The staff was comprised of approximately 744 residents and fellows, 889 full time faculty physicians, and 2,309 professional nurses. The Level I Emergency and Trauma Center had an annual average of 65,000 visits with approximately 28,000 hospital admissions (U.S. News, 2018). This large volume medical center serves both suburban and rural communities with patients transferred from various surrounding facilities for specialized care.

Sample

The project utilized a convenience sample consisting of 34 multidisciplinary direct-care clinical team members including registered nurses (RNs) and patient care technicians (PCTs). Of the 34 enrolled participants, 32 completed pre and post intervention surveys, with two lost to follow up. Participants included full time and part time staff members with varied lengths of employment. Exclusion criteria included non-clinical staff including unit clerks, registration clerks, and radiology technicians. Participation was voluntary and recruitment was conducted through e-mail and visual flyers placed in the ED two weeks prior to planned implementation.

Participants were recruited from every shift including day, evening, and nightshift and compensated with educational time with support of institutional executive leadership.

Measures

Primary project outcomes included staff attitude, perception of teamwork, and collaboration measured using the TeamSTEPPS® Teamwork Perceptions Questionnaire (T-TPQ). The T-TPQ is a 35-question Likert-style instrument that measures participant perceptions of team structure, leadership, situation monitoring, mutual support, and communication (Lineberry et. al, 2013). Consent was built into the beginning page of the pre-intervention questionnaire before the participant was able to continue to subsequent questions. Three weeks following intervention, the T-TPQ was administered again to determine if the sessions were associated with a change in staff perception of teamwork (ARHQ, 2017).

Two validated methods of scoring the T-TPQ are outlined in the TeamSTEPPS® T-TPQ manual with variations for analysis depending on the desired metric. Both methods include calculating an overall score with a variation to calculate scores for each of the five constructs to compare pre-intervention and post-intervention subcategory scores (Baker et al., 2010). The T-TPQ is well validated and has an internal consistency with Cronbach's alpha demonstrated values from 0.786 to 0.844 on each of the five categories (Ballangrud, Husebo, & Hall-Lord, 2017). The T-TPQ questions ranged from strongly disagree to strongly agree with a range of 1 – 5 respectively, with a higher score being more favorable. Total possible score for the T-TPQ was 175 points with 35 questions with a maximum 5 points possible per question. There were 7 questions to assess each of the 5 constructs including communication, team structure, leadership, situation monitoring, and mutual support. In addition to analyzing each construct individually, an overall score was calculated and analyzed.

Procedure

The project was constructed in conjunction with the expert practice mentors, clinical nurse leaders, executive leadership, and academic advisors. The published, freely available TeamSTEPPS® curriculum was adapted for the ED setting following established guidelines to fit within a 60-minute educational session. The TeamSTEPPS® pocket guide drove the educational intervention with the published presentation adapted for convenience in teaching between shifts. Prior to implementation, the primary investigator successfully completed the online master TeamSTEPPS® trainer modules and finished the ED specific clinical scenario trainings through published resources.

The formal in-person educational program started with the consent process, participant's rights, and an overview of the doctoral research process. This was followed by a pre-intervention survey, the T-TPQ, to measure baseline understanding of staff perception of collaboration and teamwork in the ED. Included in this survey was a demographic sheet to collect age, gender, role, years of experience in role, and years of employment at the current institution. The educational program included a sixty-minute presentation of the foundational principles established in the TeamSTEPPS® curriculum. The curriculum followed the essential course guidelines from TeamSTEPPS® and covered framework and key principles, team structure, communication through SBAR, characteristics of effective leadership, situation monitoring through cross checks, and mutual support through advocacy and assertion. The intervention concluded with an opportunity to apply principles to "real life ED scenarios" and question and answer session. Scenarios were adapted from the TeamSTEPPS® ED examples to include a situation where a team member needed to challenge an order given by a provider for patient safety.

The formal educational intervention was supplemented by several informal on site, in-person, one on one sessions where a master trainer was available to answer additional questions and provide resources. One week following the formal intervention, an e-mail summarizing presented information was sent to participants along with a link to complete a computer-based learning module to solidify and reaffirm introduced principles. Three weeks later, a follow up T-TPQ was administered to determine knowledge retention and overall change in staff perception of teamwork and collaboration. Included in the follow up survey was a narrative section where staff could share an experience in which TeamSTEPPS® principles impacted a clinical case, in addition to perceived barriers to implantation and retention. During the time between the initial intervention and follow up survey, the primary investigator was available in person on the unit for additional questions and provided subsequent published TeamSTEPPS® materials.

Data Analysis

De-identified demographic data including age, gender, years of practice, primary role in the healthcare team, and years in the institution were collected. This was analyzed using descriptive statistics with SPSS, the Statistical Package for Social Sciences (IBM Corporation, Armonk, NY, 2017). Each participant was assigned a number at the beginning of the training session, known only to them and the primary investigator. This ensured that pre-intervention and post-intervention scores could be analyzed while maintaining participant anonymity. At the conclusion of the intervention, pre-intervention surveys and post-intervention surveys were matched and answers were anonymously transcribed into excel and imported into SPSS. Data analysis included means, standard deviations, frequencies and percentages for descriptive data as appropriate. A paired samples t-test was used to analyze changes in scores from pre-test to post-test for the overall scores and for the communication subset as both met normality testing.

Additional inferential statistical analysis by Wilcoxon signed-rank test was conducted for team structure, leadership, situation monitoring, and mutual support subcategories as they violated normality testing. Statistical significance was set at a p-value <0.05 and the confidence interval was estimated at 95%.

Results

A total of thirty-four participants were enrolled with two lost to follow up (employment changes; Table 1). The majority of the sample were female (*N* = 32, 82%) and Registered Nurses (*n* = 26, 76.5%). The mean age of participants was 35 years (*SD* ± 10.75; range 22 - 66 years). The majority of participants achieved a baccalaureate degree (*n* = 17, 49.9%), followed by a diploma in nursing (*n* = 5, 14.7) or master's degree (*n* = 5, 14.7%; Table 1). The mean number of years of experience (Figure 3) in current role was 8.6 (*SD* ± 10.7, range 0.5 years to 35 years) and participants had an average of 3.4 years (*SD* ± 5.7, range 0.5 years to 28 years) reported in current position within the institution (Figure 4).

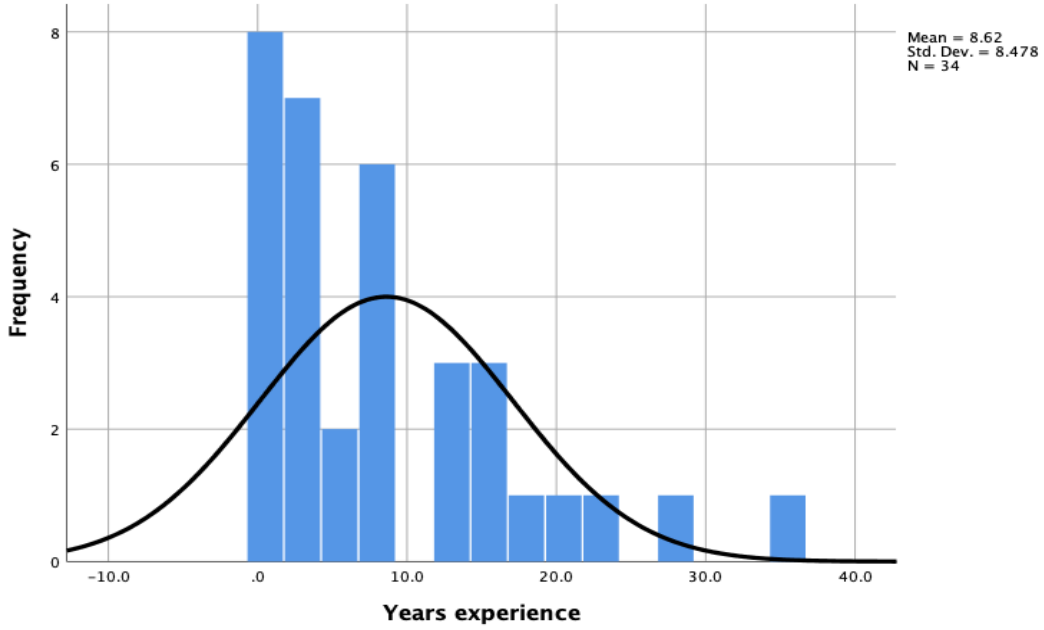

Figure 3. Histogram of participant years of experience

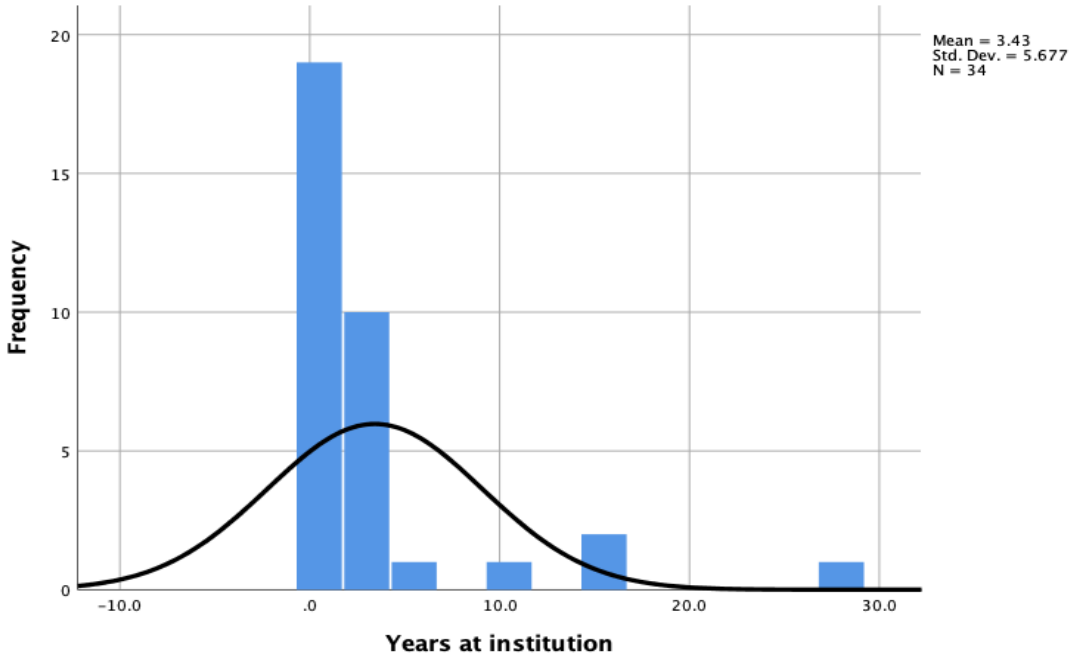

Figure 4. Histogram of participant years in position at current institution

Scores for the T-TPQ revealed a significant increase (Table 2) in mean overall scores from pre to post-intervention (mean = 121.4, SD ± 16.88, mean = 128.24, SD ± 17.29, respectively; t(28) = 39.9, p <0.05). The communication subscale revealed significantly higher post-intervention scores than pre-intervention scores, (mean = 3.6, SD ± 0.5, mean = 4.1, SD ± 0.5, respectively; t(31) = -5.5, p < 0.05). Staff perception of teamwork and collaboration significantly increased from pre-intervention to post-intervention (mean = 3.52, SD + 0.5, mean = 3.78, SD ± 0.4, respectively; summary scores t(26) = -5.49, p<0.05). Non parametric analysis was conducted by performing Wilcoxon signed-rank test for the remaining subcategories of situation monitoring, mutual support, leadership, and team structure as each violated the Sharpiro-Wilk test for normality. The Wilcoxon signed-rank test demonstrated a statistically significant change in situation monitoring (mean = 3.7, SD ± 0.5, mean = 4.03, SD ± 0.5, respectively; Z = -3.45, p = 0.001). There was no significant change found for leadership (mean = 2.89, SD ± 0.88, mean = 2.83, SD ± 0.94, respectively; Z = -1.63, p = 0.10), team structure

(mean = 3.31, SD ± 0.6, mean = 3.35, SD ± 0.79, respectively; Z = -1.93, p = 0.05), or mutual support (mean = 3.79, SD ± 0.5, mean = 3.9, SD ± 0.64, respectively; Z = -1.94, p = 0.05). Although these subcategories did not meet statistical significance, a trend was observed. Overall, the results demonstrate statically significance for TeamSTEPPS® training improving overall staff perception of teamwork and collaboration with individual emphasis on significance for communication and situation monitoring.

Discussion

Summary

The findings of this study demonstrated that overall T-TPQ scores and the communication subset scores improved after TeamSTEPPS® training. This suggests that TeamSTEPPS® may be an effective program for increasing staff perception of collaboration and teamwork in the ED. These findings add to the literature and mirror the findings of the aforementioned ED studies. Communication and ineffective teamwork in the ED have been identified as a leading cause of sentinel events and preventable medical error. By incorporating TeamSTEPPS principles and formal training in these high stakes clinical practice settings, these project findings are evidence to support TeamSTEPPS® training that may improve collaboration in the ED, even within the constraints of a 60-minure period.

TeamSTEPPS® training significantly improved staff perception of teamwork and collaboration. The staff were engaged with incorporating needed changes to promote process improvement as evidenced by their rate of project retention. Narrative comments included real time examples of TeamSTEPPS® principles in clinical scenarios, as well as perceived barriers to implication and retention. Several participants reported that they were in various scenarios in which they were able to utilize the mnemonic CUS to escalate a clinical scenario and having a clear “universal language” got the attention and assistance of teammates quickly. One of the

examples described a nurse who reported being emotionally and physically overwhelmed in a situation where a patient was decompensating rapidly. They stated by utilizing the communication principles and available technology, she was able to quickly recognize the need for help and utilize SBAR to update her teammates upon arrival. An additional participant reported that they were able to deescalate an aggressive and agitated patient who was unstable and demanding to leave. They utilized situation monitoring and communication principles to call the appropriate staff members and get the patient the help they needed.

There were many barriers to retention and longevity of TeamSTEPPS® principles in this setting reported by participants. Twelve of the sixteen who responded to the question regarding perceived barriers reported that limited time was the most influential barrier to implementing TeamSTEPPS®. On elaboration, there were various perceptions of what implication this had. Few reported that there was a limited amount of time to conduct needed training for the entire staff, limited time for "meeting" as a team after critical scenarios to discuss, and the workload and workflow of the department was not conducive. Additionally, leadership and managerial support was reported as a perceived barrier to implication with suggestions that TeamSTEPPS® be implemented "from the top down." Overall, the narrative section supported success with implementation and suggested more dedicated time to implementing TeamSTEPPS® education. Overall, the population included younger and less experienced staff. A younger population may reflect a willingness of participants to immerse themselves in the culture of TeamSTEPPS and aided in project retention. Participants were more often full-time staff that may represent staff familiarity and agreed to participate. Additionally, staff were engaged and participated in on site real time clinical scenarios, responded to summation e-mails with intriguing questions, challenged barriers to implementation, and provided narrative examples of implementing

TeamSTEPPS® in the ED environment. In total, 75% of participants completed the additional optional computer-based learning module offered at the end of the intervention, solidifying buy-in and encouraging information dissemination and longevity.

Limitations

This quality improvement has several limitations. The convivence sample was small and included only RNs and PCTs. This limited participation and recruitment of additional members of the multidisciplinary team including advanced practice providers, respiratory therapists, and physicians. Ideally every member of the team involved in critical scenarios should have training to impact overall improvement. This institution values a multidisciplinary team approach to patient care, so targeting the entire team would have been more impactful to the clinical practice setting. There were also time restraints to complete the project, limiting instructional time and the interventional period. Finally, reporting bias was inherent in this project as measures were dependent on the self-reported Likert-style T-TPQ.

The academic medical center environment is valuable and specialized and encompasses a wide range of experience among clinicians of multiple disciplines. The institution participates in evidence-based practice indicatives and supports doctoral research; however, with such a large facility came great time restraints. The project gained support from executive and directorial leadership. The initial training session was slated to be between two and four hours, but realistically this was not possible. The intervention was scaled to fit within a one-hour timeframe in a semi-casual “lunch and learn” session. This restraint likely impacted knowledge retention and overall translation of TeamSTEPPS® principles into practice; however, there was significant overall improvement in staff perception of teamwork and collaboration even with only a 60-minute intervention.

Several available studies including Lisbon et al. (2016) and Turner et al. (2018) studied the retention of behaviors and perceptions over time; however, this project did not investigate long term retention in the ED due to these time restraints. This was mitigated with several follow up e-mails, computer based self-paced learning modules, supplemental published materials from the TeamSTEPPS® website, and real time onsite participation and dialogue with master trainers. When the project began, the staff of the ED was preparing for a very large setting change to a brand-new environment. This inherently impacted staff participation and researcher ability to recruit members of the team. Additionally, staff turnover in the ED was high impacting potential participation as there were several employees that reported they did not want to participate because they would be leaving the studied practice setting or the institution.

Ethical Considerations

Ethical considerations were investigated collaboratively and thoroughly to make every effort to protect participant privacy and anonymity throughout program implication. All primary investigators completed CITI training (Appendix A) and made every effort to uphold the protection of voluntary participants. The project, along with all auxiliary materials, were submitted and approved by the institutional IRB, protocol number 3293 (Appendix B). Consent was obtained and the project process was explained in detail with affirmation that participants could withdraw at any time (Appendix D). Every measure was taken to protect confidentiality through data collection practices by utilizing an anonymous reporting system. All data was generalized and reported in a way to protect participants. Detailed contact information was provided in the event of questions. The project was approved by institutional executive and director leadership and extensive efforts were made to reduce any investigator conflict of interest.

Conclusion

The nursing profession is comprised of a conglomeration of various experts in numerous disciplines such as clinical practice, executive management, advanced practice, informatics, or research. Each field utilizes and values evidence-based protocols and guidelines to drive various decisions. Quality improvement and project evaluation are essential to the clinical practice to ensure that current recommendations are in fact validated by evidence and indicative of base practice. This project supports a well-validated program and adds to the body of knowledge in that TeamSTEPPS® positively impacts staff perceptions of teamwork and collaboration in the ED. This project positively advanced practice by quality improvement delivery, successful implication of evidence-based practice, advocacy, and interprofessional collaboration. Enhancing communication, collaboration, and teamwork is paramount to multidisciplinary team functioning. By delivering a tangible solution to improving these skills, this project advances the nursing practice and ultimately directly impacts patient care.

Sustainability and buy-in are paramount for retention of quality improvement in healthcare. Site buy-in was successful, and overall, engagement and participation were high, but inevitability, this dwindles with time. Strategies for follow up, continued education, and dissemination of findings are in development and supported by institutional leadership. In conclusion, TeamSTEPPS® is a well validated, evidence-based, multifaceted, multimedia instructional toolkit developed to promote a culture of safety through effective communication and collaboration. This project sought to test if this evidence-based educational intervention would prove effective in an academic Level I Emergency and Trauma Center. The data analysis aligned with the known body of evidence that TeamSTEPPS® is a successful intervention for improving staff perception of teamwork and collaboration. Each of tools is self-directed and can

be altered depending on practice setting, thereby empowering each member of the ED team to be vigilant and anticipate challenges to care delivery. This tool kit provided clinicians with tools to enhance communication, leadership, team structure, situation monitoring, and mutual support may improve team dynamics and ultimately impact patient outcomes. With the reported data from this intervention, further investigation is warranted to discern longevity and retention of TeamSTEPPS® education.

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Table 1

Participant Demographics

Characteristic		Frequency	Percent
Gender	Female	28	82.4
Level of Education	GED/HS	1	2.9
	Diploma	5	14.7
	College Credit	3	8.8
	Associate Degree	3	8.8
	Baccalaureate Degree	17	49.9
	Master Degree	5	14.7
	Doctoral Degree	0	0
Years of Experience	0.5 – 5 years	16	47
	6 – 10 years	7	20.5
	11 – 20 years	8	23.4
	> 20 years	3	8.7
Years at Institution	0.5 – 5 years	30	88.1
	6 – 10 years	1	2.9
	11 – 20 years	2	5.9
	> 20 years	1	2.9
Role	RN	26	76.5
	PCT	8	23.5

Table 2

Paired Samples Test from Overall and Communication scores from T-TPQ

		Mean	Std. Deviation	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Pair 1	Overall pre/post intervention	-0.21	0.2	-0.3	-0.12	-5.5	26	$p < 0.05$
Pair 2	Communication pre/post intervention	-0.43	0.45	-0.6	-0.3	-5.5	31	$p < 0.05$

Table 3

Wilcoxon Signed Ranks Test Statistics for leadership, team structure, mutual support, and situation monitoring T-TPQ results.

	Leadership Post/Pre	Team Structure Post/Pre	Mutual Support Post/Pre	Situation Monitoring Post/pre
Z	-1.634[c]	-1.93[b]	-1.94[b]	-3.448[b]
p value	0.102	0.053	0.052	0.001

Note.
a. Wilcoxon Signed Ranks Test
b. Based on negative ranks
c. Based on positive ranks

Appendix A: CITI Training Completion Certificate

CITI PROGRAM

Completion Date 16-Apr-2019
Expiration Date 15-Apr-2022
Record ID 31321354

This is to certify that:

Caitlin Matzke

Has completed the following CITI Program course:

GCP – Social and Behavioral Research Best Practices for Clinical Research (Curriculum Group)

GCP – Social and Behavioral Research Best Practices for Clinical Research (Course Learner Group)

1 - Basic Course (Stage)

Under requirements set by:

CITI
Collaborative Institutional Training Initiative

University of Virginia

Verify at www.citiprogram.org/verify/?w2461c90f-5a64-4d0e-8243-6a8dafd50b8c-31321354

Appendix B: Institutional IRB Approval Certificate

Office of the Vice President for Research

Human Research Protection Program

Institutional Review Board for the Social and Behavioral Sciences

IRB-SBS Chair: Moon, Tonya

IRB-SBS Director: Blackwood, Bronwyn

Protocol Number (3293) Approval Certificate

The UVA IRB-SBS reviewed "Incorporating TeamSTEPPS Training to Improve Staff Collaboration in an Academic Level I Emergency and Trauma Center" and determined that the protocol met the qualifications for approval as described in 45 CFR 46.

Principal Investigator: Esquivel, Jill

Protocol Number: 3293

Protocol Title: Incorporating TeamSTEPPS Training to Improve Staff Collaboration in an Academic Level I Emergency and Trauma Center

Is this research funded? No

Review category: Exempt Review

2ii. Educational tests, surveys, interviews, observations (no surveys or interviews for minors): no risk to criminal/civil liability, financial standing, employability, education advancement, reputation

Review Type:

Modifications: No
Continuation: No
Unexpected Adverse Events: No

Approval Date: 2019-12-02

As indicated in the Principal Investigator, Faculty Sponsor, and Department Chair Assurances as part of the IRB requirements for approval, the PI has ultimate responsibility for the conduct of the study, the ethical performance of the project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the IRB-SBS.

The PI and research team will comply with all UVA policies and procedures, as well as with all applicable Federal, State, and local laws regarding the protection of human subjects in research, including, but not limited to, the following:

1. That no participants will be recruited or data accessed under the protocol until the Investigator has received this approval certificate.
2. That no participants will be recruited or entered under the protocol until all researchers for the project including the Faculty Sponsor have completed their human investigation research ethics educational requirement (CITI training is required every 4 years for UVA researchers). The PI ensures that all personnel performing the project are qualified, appropriately trained, and will adhere to the provisions of the approved protocol.
3. That any modifications of the protocol or consent form will not be implemented without prior written approval from the IRB-SBS Chair or designee except when necessary to eliminate immediate hazards to the participants.
4. That any deviation from the protocol and/or consent form that is serious, unexpected and related to the study or a death occurring during the study will be reported promptly to the SBS Review Board in writing.
5. That all protocol forms for continuations of this protocol will be completed and returned within the time limit stated on the renewal notification letter.
6. That all participants will be recruited and consented as stated in the protocol approved or exempted by the IRB-SBS board. If written consent is required, all participants will be consented by signing a copy of the consent form unless this requirement is waived by the board.
7. That the IRB-SBS office will be notified within 30 days of a change in the Principal Investigator for the study.
8. That the IRB-SBS office will be notified when the active study is complete.
9. The SBS Review Board reserves the right to suspend and/or terminate this study at any time if, in its opinion, (1) the risks of further research are prohibitive, or (2) the above agreement is breached.

Date this Protocol Approval Certificate was generated: 2020-03-09

Appendix C: Recruitment Flyer

Implementing Team Strategies & Tools Used to Enhance Performance & Patient Safety in the Emergency Department

UVA IRB-SBS #3293

cmm5gq@virginia.edu

Caitlin Matzke
434-760-5841
1215 Lee Street
Charlottesville, Va 22902

What is TeamSTEPPS?

Evidence-based program developed by the U.S. Department of Defense and Agency for Health Research and Quality to optimize team performance and collaboration among multidisciplinary health care teams to enable them to respond quickly and effectively to whatever situations arise.

DNP Clinical Capstone Project

What is the effect of TeamSTEPPS training on staff attitude, perception of teamwork, and collaboration in the ED of an academic level I trauma center?

TeamSTEPPS Quick Facts

- Entire TeamSTEPPS curriculum is free, downloadable, and customizable to practice setting
- Core of framework is comprised of four skills including leadership, situation monitoring, mutual support, and communication
- Team competency outcomes include improved knowledge, attitudes, and performance.
- Tools include SBARQ Communication, CUS, check outs and call backs, and STEP tool
- Team events including briefs, huddles, and debriefing

Appendix D: Participant Consent Form

Incorporating TeamSTEPPS® Training to Improve Staff Collaboration in an Academic Level I Emergency and Trauma Center
Protocol number 3293

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the project.

Purpose of the research project: The purpose of this project is to evaluate the effect of TeamSTEPPS®; an evidenced based communication-training toolkit, on staff perceptions of teamwork and communication in a level I emergency department (ED).

What you will do in the project: Participate in formal TeamSTEPPS® Training

Time required: The project will require about 3 hours of your time.

Risks: There are no anticipated risks in this project.

Benefits: There are no direct benefits to you for participating in this project, but your feedback may help understand the effect of TeamSTEPPS® training on staff attitude, perception of teamwork, and collaboration in the ED.

Confidentiality: The information that you give in the project will be handled confidentially. Your name and other information that could be used to identify you will not be collected or linked to the data. If it is possible for you (the researcher) to deduce the participant's identity, state the following: Because of the nature of the data, it may be possible to deduce your identity; however, there will be no attempt to do so and your data will be reported in a way that will not identify you.

Confidentiality cannot be guaranteed:
In some cases, it may not be possible to guarantee confidentiality (e.g. an interview of a prominent person, a focus group interview). Please use the following text if you cannot guarantee confidentiality: Because of the nature of the data, I cannot guarantee your data will be confidential and it may be possible that others will know what you have reported. Please note that in some cases if confidentiality cannot be guaranteed, it may be a risk to the participant and should be explained in the "Risks" section as well.

Voluntary participation: Your participation in the project is completely voluntary. Your decision to participate will have no effect on your employment.

Right to withdraw from the project: You have the right to withdraw from the project at any time without penalty.

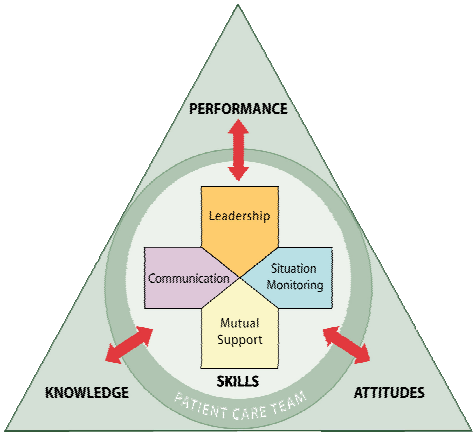
Payment: You will be compensated for your time at your base rate for educational time.

If you have questions about the project, contact:
Caitlin Matzke at Cmm5gq@virginia.edu or 757-291-7091
Jill Howie-Esquivel at jhe9F@virginia.edu or 434 924 0086

202 Jeanette Lancaster Way I PO Box 800782 Charlottesville, Va 22902
To obtain more information about the project, ask questions about the research procedures, express concerns about your participation, or report illness, injury or other problems, please contact:
Tonya R. Moon, Ph.D.
Chair, Institutional Review Board for the Social and Behavioral Sciences
One Morton Dr Suite 500
University of Virginia, P.O. Box 800392
Charlottesville, VA 22908-0392
Telephone: (434) 924-5999
Email: irbsbshelp@virginia.edu
Website: https://research.virginia.edu/irb-sbs
Website for Research Participants: https://research.virginia.edu/research-participants
UVA IRB-SBS # **3293**
Agreement:
I agree to participate in the research project described above.

Signature: _____ **Date:** _____
You will receive a copy of this form for your records.

Appendix E: TeamSTEPPS® Supplemental Handout



TeamSTEPPS™

TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety) is an evidence-based framework to optimize team performance across the healthcare delivery system.

The core of the TeamSTEPPS framework is comprised of four skills: **Leadership**, **Situation Monitoring**, **Mutual Support**, and **Communication**. These skills must interplay with the Team Competency Outcomes: **Knowledge**, **Attitudes**, and **Performance**.

LEADERSHIP

There are two types of leaders: 1) Designated and 2) Situational. In effective teams, any member of the team with the skills to best manage the situation can assume the leadership role.

An effective team leader: organizes the team; articulates clear goals; makes decisions through collective input of members; empowers members to speak up and challenge, when appropriate; actively promotes and facilitates good teamwork; and skillfully resolves conflicts.

Team Events
- **Brief:** This is a short session for planning prior to start to discuss team formation; assign essential roles; establish expectations and climate; and anticipate outcomes and likely contingencies
- **Huddle:** When problem solving is needed, this ad hoc planning is used to reestablish situation awareness; reinforce plans already in place; and assess the need to adjust the plan.
- **Debrief:** This informal information exchange session is designed to improve team performance and effectiveness. Feedback from the team drives future process improvement.

SITUATION MONITORING

Situation monitoring is the process of continually scanning and assessing what's going on around you to maintain situation awareness. (STEP = Status of the patient, Team members, Environment, Progress towards goal)

Situation awareness is "knowing what is going on around you" and knowing the conditions that affect your work.

Shared mental models result from each team member maintaining his or her situation awareness and sharing relevant facts with the entire team. Doing so helps ensure that everyone on the team is "on the same page."

Cross Monitoring: an error reduction strategy that involves monitoring actions of other team members; providing a safety net within the team; ensuring mistakes or oversights are caught quickly and easily; and "watching each other's back"

MUTUAL SUPPORT

Task assistance is one form of mutual support in which team members:
- Protect each other from work overload situations
- Place all offers and requests for assistance in the context of patient safety
- Foster a climate where it is expected that assistance will be actively sought and offered

COMMUNICATION

Effective communication is complete, clear, brief, and timely.

SBARQ is a technique for communicating critical information that requires immediate attention and action concerning a patient's condition and is especially important during handoff.

Situation—What is going on with the patient? **Background**—What is the clinical background or context? **Assessment**—What do I think the problem is? **Recommendation and Request**—What would I do to correct it? **Questions—**An opportunity to ask or answer any questions.

Using "CUS" words is one way to "stop the line" and alert other team members to your concerns.

I am **C**oncerned I am **U**ncomfortable This is a **S**afety issue or I don't feel like this is **S**afe!

Examples: "Dr. Adams, I am *concerned* about Mr. Smith's heart rate. I'm *uncomfortable* with what we're seeing. I don't feel like this is *safe*. I think we should call the Rapid Response Team."

"I am *concerned* about Mrs. Roberts' labor. I'm *uncomfortable* watching these late decelerations. I just don't think it's *safe* to continue labor.

Two Challenge Rule

When an initial assertion is ignored:
- It is your responsibility to assertively voice concern at least *two times* to ensure it has been heard
- The team member being challenged must acknowledge the concern
- If the outcome is still not acceptable:
  - Take a stronger course of action
  - Utilize supervisor or chain of command

The two challenge rule empowers all team members to "stop the line" if they sense or discover an essential safety breach.

There are other tools that everyone is expected to use to improve communication during team events:
- **Call Outs**: used to communicate important information to all team members simultaneously
- **Check Backs**: closed-loop communication to ensure that information conveyed by the sender is understood by the receiver as intended (i.e. restate what was said)

Appendix F: T-TPQ Pre/Post-intervention

TeamSTEPPS®

Teamwork Perceptions Questionnaire

Instructions: Please complete the following questionnaire by placing a check mark [√] in the box that corresponds to your level of agreement from *Strongly Agree* to *Strongly Disagree*. Please answer every question, and select only one response for each question. The questionnaire is **anonymous**, so please do not put your name or any other identifying information on the questionnaire.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Team Structure						
1.	The skills of staff overlap sufficiently so that work can be shared when necessary.					
2.	Staff are held accountable for their actions.					
3.	Staff within my unit share information that enables timely decisionmaking by the direct patient care team.					
4.	My unit makes efficient use of resources (e.g., staff supplies, equipment, information).					
5.	Staff understand their roles and responsibilities.					
6.	My unit has clearly articulated goals.					
7.	My unit operates at a high level of efficiency.					
Leadership						
8.	My supervisor/manager considers staff input when making decisions about patient care.					
9.	My supervisor/manager provides opportunities to discuss the unit's performance after an event.					
10.	My supervisor/manager takes time to meet with staff to develop a plan for patient care.					
11.	My supervisor/manager ensures that adequate resources (e.g., staff, supplies, equipment, information) are available.					
12.	My supervisor/manager resolves conflicts successfully.					
13.	My supervisor/manager models appropriate team behavior.					
14.	My supervisor/manager ensures that staff are aware of any situations or changes that may affect patient care.					

PLEASE CONTINUE TO THE NEXT PAGE ⇨

TeamSTEPPS®

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Situation Monitoring						
15.	Staff effectively anticipate each other's needs.					
16.	Staff monitor each other's performance.					
17.	Staff exchange relevant information as it becomes available.					
18.	Staff continuously scan the environment for important information.					
19.	Staff share information regarding potential complications (e.g., patient changes, bed availability).					
20.	Staff meets to reevaluate patient care goals when aspects of the situation have changed.					
21.	Staff correct each other's mistakes to ensure that procedures are followed properly.					
Mutual Support						
22.	Staff assist fellow staff during high workload.					
23.	Staff request assistance from fellow staff when they feel overwhelmed.					
24.	Staff caution each other about potentially dangerous situations.					
25.	Feedback between staff is delivered in a way that promotes positive interactions and future change.					
26	Staff advocate for patients even when their opinion conflicts with that of a senior member of the unit.					
27.	When staff have a concern about patient safety, they challenge others until they are sure the concern has been heard.					
28.	Staff resolve their conflicts, even when the conflicts have become personal.					

PLEASE CONTINUE TO THE NEXT PAGE

TeamSTEPPS®

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Communication						
29.	Information regarding patient care is explained to patients and their families in lay terms.					
30.	Staff relay relevant information in a timely manner.					
31.	When communicating with patients, staff allow enough time for questions.					
32.	Staff use common terminology when communicating with each other.					
33.	Staff verbally verify information that they receive from one another.					
34.	Staff follow a standardized method of sharing information when handing off patients.					
35.	Staff seek information from all available sources.					

Appendix G: Manuscript for Journal of Emergency Nursing

Medical error is defined as any preventable adverse effect of medical care whether or not it is evident or harmful to the patient (Makary & Daniel, 2016). The most commonly reported inpatient medical errors include adverse drug events, improper transfusions, misdiagnosis, under-treatment, over-treatment, surgical injury, restrained injury, falls, pressure ulcers, and misidentification of patients. An overwhelming percentage of these errors occur in high stakes clinical practice settings such as the intensive care unit, operating suites, and the ED (Carver, Gupta, & Hipskind, 2020). After investigating such sentinel events, root cause analysis often reveals that the most common contributing factor to grave error is a serious breakdown in teamwork or miscommunication (Grober & Bohnen, 2005).

In 1999, the Institute of Medicine (IOM) published a report entitled, *To Err is Human: Building a Safer Health System,* which sparked a revolution in healthcare organizations. Medial error cause investigation, or root cause analysis, shifted from targeting individual mistakes to building a culture of safety by cultivating fundamental system changes (Donaldson, n.d.). The IOM challenged health care delivery organizations to overhaul system practices to improve patient safety and reduce medical errors by applying user-centered design, avoiding reliance on memory, attending to safe work environments, avoiding reliance on vigilance, training in teams, involving patients in care delivery, anticipating the unexpected, designing for recovery, and improving timely access to accurate information (Havens & Boroughs, 2000). To ease this transition, the IOM recommended creating the National Center for Patient Safety (NCPS) to act as a repository for evidence-based practices (Donaldson, n.d.). This repository paved the way for The Department of Defense (DOD) and The Agency for Healthcare Research and Quality (AHRQ) to create an evidenced based, collaborative toolkit to enhance team performance

entitled TeamSTEPPS® to mitigate error and improve teamwork (Havens & Boroughs, 2000).

TeamSTEPPS® Framework

TeamSTEPPS® is an evidence-based multifaceted instructional toolkit designed to promote teamwork and collaboration within healthcare delivery teams to improve patient safety and care quality (Clapper & Kong, 2012). The conceptual framework for TeamSTEPPS® is built on team competency outcomes including knowledge of a shared mental model, attitudes of mutual trust, team orientation, and performance of adaptability, accuracy, productivity, efficiency, and safety. Five core principles build the foundation comprised of *communication, team structure, leadership, situation monitoring, and mutual support* (Plonien & Williams, 2015). The interplay of these competencies is dynamic with successful interaction leading to improved communication, teamwork, and quality of care.

TeamSTEPPS® defines *communication* as the intricate process of information exchange among team members, that, in order to be effective, must be accurate, clear, and timely (Stead et al, 2009). TeamSTEPPS® utilizes several techniques to improve communication among team members in high stress situations including SBAR; a mnemonic for structured reporting that includes call-outs, check-backs, and handoff by the mnemonic I PASS the BATON. SBAR is a technique for communicating critical information in high stress situations that require immediate attention and action (Stead et al, 2009) and stands for Situation, Background, Assessment, and Recommendation or Request. Call-outs is a strategy of repeating information back to a leader, communicating critical information by simultaneously informing all team members, and directing responsibility to a specific individual. Similarly, check-back is a three-step closed loop communication strategy where the sender initiates a message, the receiver accepts the message and provides feedback, and the sender double-checks to ensure the message was received.

Finally, I PASS the BATON, is a mnemonic designed to enhance information exchanges during transitions in care and stands for Introduction, Patient, Assessment, Situation, Safety Concerns, Background, Actions, Timing, Ownership, and Next.

To address *leadership*, TeamSTEPPS® defines effective team leaders as those who are able to organize the team, identify and articulate clearly defined goals, appropriately assign tasks and responsibilities to team members, allocate recourses, facilitate conflict resolution, and model effective teamwork. Leadership tools include briefs, huddles, and debriefings. Briefs are designed to be short sessions prior to events in which the plan for care is shared, team formation is discussed, and individual roles and responsibilities are established (Stead et al, 2009). This process is designed to address the members of the team, delineate roles and responsibilities, establish the plan of care, and review available recourses. Next, huddles are "ad hoc" meetings that can be performed at any point by any team member to re-establish situational awareness and reinforce the plan of care. Finally, debriefings are informal exchanges at the conclusion of an event to improve team performance through reinforcement of positive behaviors, identifying areas for improvement, and addressing situational awareness.

The TeamSTEPPS® *situation monitoring* process comprises continuous reevaluation and assessment of team needs and function through situation monitoring, situation awareness, and a shared mental model. Situation monitoring involves continuous situation scanning and assessment while situational awareness is constantly "knowing what is going on around you." Mastering situation monitoring skills results in a shared mental model where each team member is attentive to the task at hand and is "on the same page" (Stead et al, 2009). The memory tool STEP describes the components of situation monitoring including Status of the patient, Team members, Environment, and Progress toward goals. Additionally, cross monitoring is a harm

error reduction strategy where members of the team monitor one another's actions to provide a safety net to ensure that mistakes and oversights are caught quickly.

The final principle of *mutual support* has several tools including task assistance, feedback, advocacy and assertion, the two-challenge rule, and CUS, which stands for I'm Concerned, Uncomfortable, and this is a patient Safety concern (Stead et al, 2009). This principle is rooted in assertive statements to ensure team and patient safety by allowing each team member a voice and an opportunity to identify potential safety concerns. Task assistance protects from overload and expects that each team member will foster a climate of offering support. Assertiveness and advocacy are reinforced by appropriate feedback, the two-challenge rule, and the mnemonic CUS. Feedback is essential to growth and improving team performance, but to foster mutual respect, it must be timely, respectful, specific, directed, and considerate. Mutual support ensures that members of the team are respected and their needs are met to maximize team functionality and collaboration.

Team structure, communication, leadership, situation monitoring, and mutual support build the foundation of the TeamSTEPPS® curriculum with each having tools to enhance team performance in high stress, high stakes practice settings (Lisbon et. al, 2016). Successful team collaboration is contingent on optimizing these principles by incorporating specific communication tools, establishing a common framework, and mastering competencies. This curriculum has been validated in many high-stake settings such as aviation and nuclear power; however, there is little evidence to support its impact on team collaboration in the ED. This quality improvement (QI) project imitative provides an opportunity to validate this program in the ED.

TeamSTEPPS® is a validated, comprehensive, evidence-based curriculum aimed at improving safety and teamwork in high stakes settings. Substantial literature validates the curriculum in industries such as aviation, nuclear power, and military operations (Ward, Zhu, & Lampman, 2013); however, there is limited application to the ED. The DOD and AHRQ have published step-by-step application instructions according to practice environments along with the entire TeamSTEPPS® curriculum, but few investigations have been conducted in the ED. The purpose of this project was to add to the literature by evaluating the application of TeamSTEPPS®, a well-validated, evidence-based, multimodal educational program, on staff perceptions, attitudes, and communication in an academic Level I Emergency and Trauma Center.

Methods

A prospective, single group, pre-post design with a convenience sample was employed to investigate the effect of TeamSTEPPS® training on staff perception of collaboration and teamwork in the ED. The principle question of this quality improvement project was: What is the effect of TeamSTEPPS® training on staff attitude, perception of teamwork, and collaboration in an academic Level I Emergency and Trauma Center? The study design was a quality improvement project with research design created to illustrate and determine the immediate effect of TeamSTEPPS® training of staff perception. Data was collected from January 2020 to February 2020. Prior to project implementation, Institutional Review Board granted approval protocol number 3293. Prior to project participation, project information was provided and written informed consent obtained. TeamSTEPPS® published materials were permitted for free download from the organizational website. All investigators completed CITI training.

Setting

This quality improvement project utilized a prospective pre-post design in the ED of an academic Level I Emergency and Trauma Center in the mid-Atlantic region of Virginia. This medical center serves as a gateway to specialists and generalist practitioners alike. In 2018, the institution reported that the inpatient facility had a total of 612 beds with an average daily census of 494 patients. The staff was comprised of approximately 744 residents and fellows, 889 full time faculty physicians, and 2,309 professional nurses. The Level I Emergency and Trauma Center had an annual average of 65,000 visits with approximately 28,000 hospital admissions (U.S. News, 2018). This large volume medical center serves both suburban and rural communities with patients transferred from various surrounding facilities for specialized care.

Sample

The project utilized a convenience sample consisting of 34 multidisciplinary direct-care clinical team members including registered nurses (RNs) and patient care technicians (PCTs). Of the 34 enrolled participants, 32 completed pre and post intervention surveys, with two lost to follow up. Participants included full time and part time staff members with varied lengths of employment. Exclusion criteria included non-clinical staff including unit clerks, registration clerks, and radiology technicians. Participation was voluntary and recruitment was conducted through e-mail and visual flyers placed in the ED two weeks prior to planned implementation. Participants were recruited from every shift including day, evening, and nightshift and compensated with educational time with support of institutional executive leadership.

Measures

Primary project outcomes included staff attitude, perception of teamwork, and collaboration measured using the TeamSTEPPS® Teamwork Perceptions Questionnaire (T-TPQ). The T-TPQ is a 35-question Likert-style instrument that measures participant perceptions

of team structure, leadership, situation monitoring, mutual support, and communication (Lineberry et. al, 2013). Consent was built into the beginning page of the pre-intervention questionnaire before the participant was able to continue to subsequent questions. Three weeks following intervention, the T-TPQ was administered again to determine if the sessions were associated with a change in staff perception of teamwork (ARHQ, 2017).

The T-TPQ is well validated and has an internal consistency with Cronbach's alpha demonstrated values from 0.786 to 0.844 on each of the five categories (Ballangrud, Husebo, & Hall-Lord, 2017). The T-TPQ questions ranged from strongly disagree to strongly agree with a range of 1 – 5 respectively, with a higher score being more favorable. Total possible score for the T-TPQ was 175 points with 35 questions with a maximum 5 points possible per question. There were 7 questions to assess each of the 5 constructs including communication, team structure, leadership, situation monitoring, and mutual support. In addition to analyzing each construct individually, an overall score was calculated and analyzed.

Procedure

The project was constructed in conjunction with the expert practice mentors, clinical nurse leaders, executive leadership, and academic advisors. The published, freely available TeamSTEPPS® curriculum was adapted for the ED setting following established guidelines to fit within a 60-minute educational session. The TeamSTEPPS® pocket guide drove the educational intervention with the published presentation adapted for convenience in teaching between shifts. Prior to implementation, the primary investigator successfully completed the online master TeamSTEPPS® trainer modules and finished the ED specific clinical scenario trainings through published resources.

The formal in-person educational program started with the consent process, participant's rights, and an overview of the doctoral research process. This was followed by a pre-intervention survey, the T-TPQ, to measure baseline understanding of staff perception of collaboration and teamwork in the ED. Included in this survey was a demographic sheet to collect age, gender, role, years of experience in role, and years of employment at the current institution. The educational program included a sixty-minute presentation of the foundational principles established in the TeamSTEPPS® curriculum. The curriculum followed the essential course guidelines from TeamSTEPPS® and covered framework and key principles, team structure, communication through SBAR, characteristics of effective leadership, situation monitoring through cross checks, and mutual support through advocacy and assertion. The intervention concluded with an opportunity to apply principles to "real life ED scenarios" and question and answer session. Scenarios were adapted from the TeamSTEPPS® ED examples to include a situation where a team member needed to challenge an order given by a provider for patient safety.

The formal educational intervention was supplemented by several informal on site, in-person, one on one sessions where a master trainer was available to answer additional questions and provide resources. One week following the formal intervention, an e-mail summarizing presented information was sent to participants along with a link to complete a computer-based learning module to solidify and reaffirm introduced principles. Three weeks later, a follow up T-TPQ was administered to determine knowledge retention and overall change in staff perception of teamwork and collaboration. Included in the follow up survey was a narrative section where staff could share an experience in which TeamSTEPPS® principles impacted a clinical case, in addition to perceived barriers to implantation and retention. During the time between the initial

intervention and follow up survey, the primary investigator was available in person on the unit for additional questions and provided subsequent published TeamSTEPPS® materials.

Data Analysis

De-identified demographic data including age, gender, years of practice, primary role in the healthcare team, and years in the institution were collected. This was analyzed using descriptive statistics with SPSS, the Statistical Package for Social Sciences (IBM Corporation, Armonk, NY, 2017). Each participant was assigned a number at the beginning of the training session, known only to them and the primary investigator. This ensured that pre-intervention and post-intervention scores could be analyzed while maintaining participant anonymity. At the conclusion of the intervention, pre-intervention surveys and post-intervention surveys were matched and answers were anonymously transcribed into excel and imported into SPSS. Data analysis included means, standard deviations, frequencies and percentages for descriptive data as appropriate. A paired samples t-test was used to analyze changes in scores from pre-test to post-test for the overall scores and for the communication subset as both met normality testing. Additional inferential statistical analysis by Wilcoxon signed-rank test was conducted for team structure, leadership, situation monitoring, and mutual support subcategories as they violated normality testing. Statistical significance was set at a p-value <0.05 and the confidence interval was estimated at 95%.

Results

A total of thirty-four participants were enrolled with two lost to follow up (employment changes; Table 1). The majority of the sample were female ($N = 32$, 82%) and Registered Nurses ($n = 26$, 76.5%). The mean age of participants was 35 years ($SD \pm 10.75$; range 22 - 66 years). The majority of participants achieved a baccalaureate degree ($n = 17$, 49.9%), followed

by a diploma in nursing (n = 5, 14.7) or master's degree (n = 5, 14.7%; Table 1). The mean number of years of experience (Figure 3) in current role was 8.6 (SD ± 10.7, range 0.5 years to 35 years) and participants had an average of 3.4 years (SD ± 5.7, range 0.5 years to 28 years) reported in current position within the institution (Figure 4).

Scores for the T-TPQ revealed a significant increase (Table 2) in mean overall scores from pre to post-intervention (mean = 121.4, SD ± 16.88, mean = 128.24, SD ± 17.29, respectively; $t(28) = 39.9$, $p < 0.05$). The communication subscale revealed significantly higher post-intervention scores than pre-intervention scores, (mean = 3.6, SD ± 0.5, mean = 4.1, SD ± 0.5, respectively; $t(31) = -5.5$, $p < 0.05$). Staff perception of teamwork and collaboration significantly increased from pre-intervention to post-intervention (mean = 3.52, SD + 0.5, mean = 3.78, SD ± 0.4, respectively; summary scores $t(26) = -5.49$, $p<0.05$). Non parametric analysis was conducted by performing Wilcoxon signed-rank test for the remaining subcategories of situation monitoring, mutual support, leadership, and team structure as each violated the Sharpiro-Wilk test for normality. The Wilcoxon signed-rank test demonstrated a statistically significant change in situation monitoring (mean = 3.7, SD ± 0.5, mean = 4.03, SD ± 0.5, respectively; $Z = -3.45$, $p = 0.001$). There was no significant change found for leadership (mean = 2.89, SD ± 0.88, mean = 2.83, SD ± 0.94, respectively; $Z = -1.63$, $p = 0.10$), team structure (mean = 3.31, SD ± 0.6, mean = 3.35, SD ± 0.79, respectively; $Z = -1.93$, $p = 0.05$), or mutual support (mean = 3.79, SD ± 0.5, mean = 3.9, SD ± 0.64, respectively; $Z = -1.94$, $p = 0.05$). Although these subcategories did not meet statistical significance, a trend was observed. Overall, the results demonstrate statically significance for TeamSTEPPS® training improving overall staff perception of teamwork and collaboration with individual emphasis on significance for communication and situation monitoring.

Discussion

Summary

The findings of this study demonstrated that overall T-TPQ scores and the communication subset scores improved after TeamSTEPPS® training. This suggests that TeamSTEPPS® may be an effective program for increasing staff perception of collaboration and teamwork in the ED. These findings add to the literature and mirror the findings of the aforementioned ED studies. Communication and ineffective teamwork in the ED have been identified as a leading cause of sentinel events and preventable medical error. By incorporating TeamSTEPPS principles and formal training in these high stakes clinical practice settings, these project findings are evidence to support TeamSTEPPS® training that may improve collaboration in the ED, even within the constraints of a 60-minure period.

TeamSTEPPS® training significantly improved staff perception of teamwork and collaboration. The staff were engaged with incorporating needed changes to promote process improvement as evidenced by their rate of project retention. Narrative comments included real time examples of TeamSTEPPS® principles in clinical scenarios, as well as perceived barriers to implication and retention. Several participants reported that they were in various scenarios in which they were able to utilize the mnemonic CUS to escalate a clinical scenario and having a clear “universal language” got the attention and assistance of teammates quickly. One of the examples described a nurse who reported being emotionally and physically overwhelmed in a situation where a patient was decompensating rapidly. They stated by utilizing the communication principles and available technology, she was able to quickly recognize the need for help and utilize SBAR to update her teammates upon arrival. An additional participant reported that they were able to deescalate an aggressive and agitated patient who was unstable

and demanding to leave. They utilized situation monitoring and communication principles to call the appropriate staff members and get the patient the help they needed.

There were many barriers to retention and longevity of TeamSTEPPS® principles in this setting reported by participants. Twelve of the sixteen who responded to the question regarding perceived barriers reported that limited time was the most influential barrier to implementing TeamSTEPPS®. On elaboration, there were various perceptions of what implication this had. Few reported that there was a limited amount of time to conduct needed training for the entire staff, limited time for "meeting" as a team after critical scenarios to discuss, and the workload and workflow of the department was not conducive. Additionally, leadership and managerial support was reported as a perceived barrier to implication with suggestions that TeamSTEPPS® be implemented "from the top down." Overall, the narrative section supported success with implementation and suggested more dedicated time to implementing TeamSTEPPS® education. Overall, the population included younger and less experienced staff. A younger population may reflect a willingness of participants to immerse themselves in the culture of TeamSTEPPS and aided in project retention. Participants were more often full-time staff that may represent staff familiarity and agreed to participate. Additionally, staff were engaged and participated in on site real time clinical scenarios, responded to summation e-mails with intriguing questions, challenged barriers to implementation, and provided narrative examples of implementing TeamSTEPPS® in the ED environment. In total, 75% of participants completed the additional optional computer-based learning module offered at the end of the intervention, solidifying buy-in and encouraging information dissemination and longevity.

Ethical Considerations

Ethical considerations were investigated collaboratively and thoroughly to make every effort to protect participant privacy and anonymity throughout program implication. All primary investigators completed CITI training (Appendix A) and made every effort to uphold the protection of voluntary participants. The project, along with all auxiliary materials, were submitted and approved by the institutional IRB, protocol number 3293 (Appendix B). Consent was obtained and the project process was explained in detail with affirmation that participants could withdraw at any time (Appendix D). Every measure was taken to protect confidentiality through data collection practices by utilizing an anonymous reporting system. All data was generalized and reported in a way to protect participants. Detailed contact information was provided in the event of questions. The project was approved by institutional executive and director leadership and extensive efforts were made to reduce any investigator conflict of interest.

Conclusion

The nursing profession is comprised of a conglomeration of various experts in numerous disciplines such as clinical practice, executive management, advanced practice, informatics, or research. Each field utilizes and values evidence-based protocols and guidelines to drive various decisions. Quality improvement and project evaluation are essential to the clinical practice to ensure that current recommendations are in fact validated by evidence and indicative of base practice. This project supports a well-validated program and adds to the body of knowledge in that TeamSTEPPS® positively impacts staff perceptions of teamwork and collaboration in the ED. This project positively advanced practice by quality improvement delivery, successful implication of evidence-based practice, advocacy, and interprofessional collaboration. Enhancing communication, collaboration, and teamwork is paramount to multidisciplinary team

functioning. By delivering a tangible solution to improving these skills, this project advances the nursing practice and ultimately directly impacts patient care.

Sustainability and buy-in are paramount for retention of quality improvement in healthcare. Site buy-in was successful, and overall, engagement and participation were high, but inevitability, this dwindles with time. Strategies for follow up, continued education, and dissemination of findings are in development and supported by institutional leadership. In conclusion, TeamSTEPPS® is a well validated, evidence-based, multifaceted, multimedia instructional toolkit developed to promote a culture of safety through effective communication and collaboration. This project sought to test if this evidence-based educational intervention would prove effective in an academic Level I Emergency and Trauma Center. The data analysis aligned with the known body of evidence that TeamSTEPPS® is a successful intervention for improving staff perception of teamwork and collaboration. Each of tools is self-directed and can be altered depending on practice setting, thereby empowering each member of the ED team to be vigilant and anticipate challenges to care delivery. This tool kit provided clinicians with tools to enhance communication, leadership, team structure, situation monitoring, and mutual support may improve team dynamics and ultimately impact patient outcomes. With the reported data from this intervention, further investigation is warranted to discern longevity and retention of TeamSTEPPS® education.