



## Enhancing interprofessional education through patient safety and quality improvement team-training: A pre-post evaluation<sup>☆</sup>



Beth Quatrara<sup>a,\*</sup>, Valentina Brashers<sup>a</sup>, Marianne Baernholdt<sup>b</sup>, Wendy Novicoff<sup>c</sup>,  
Katherine Schlag<sup>d</sup>, Julie Haizlip<sup>e,h</sup>, Margaret Plews-Ogan<sup>f</sup>, Christine Kennedy<sup>g</sup>

<sup>a</sup> University of Virginia School of Nursing and Center for Academic Strategic Partnerships for Interprofessional Research and Education, 225 Jeanette Lancaster Way, Charlottesville, VA 22903-3388, United States of America

<sup>b</sup> Virginia Commonwealth University School of Nursing, Langston Center for Quality, Safety and Innovation, 1100 East Leigh Street, Richmond, VA 23298-0567, United States of America

<sup>c</sup> Public Health Sciences at the University of Virginia, and Research in Quality and Patient Safety, 100 Hospital Drive, Charlottesville, VA 22908, United States of America

<sup>d</sup> Department of Medicine Quality Program, University of Virginia School of Medicine, 100 Hospital Drive, Charlottesville, VA 22908, United States of America

<sup>e</sup> University of Virginia School of Nursing, 225 Jeanette Lancaster Way, Charlottesville, VA 22903-3388, United States of America

<sup>f</sup> Department of General Medicine at the University of Virginia School of Medicine, 100 Hospital Drive, Charlottesville, VA 22908, United States of America

<sup>g</sup> Academic Programs at the University of Virginia School of Nursing, 225 Jeanette Lancaster Way, Charlottesville, VA 22903-3388, United States of America

<sup>h</sup> University of Virginia School of Medicine and Center for Academic Strategic Partnerships for Interprofessional Research and Education, 100 Hospital Drive, Charlottesville, VA 22908, United States of America

### 1. Introduction

As highlighted in the American Association of Colleges of Nursing (AACN) publication *Advancing Healthcare Transformation: A New Era for Academic Nursing*, academic institutions must partner with healthcare facilities to prepare students to function as nurses of the future (AACN, 2016). Since the 1999 publication by the Institute for Medicine, *To Err is Human: Building a Safer Health System*, concerns about quality of patient care, healthcare errors and exorbitant costs have been at the forefront of endeavors to create change in healthcare settings (Institute of Medicine [IOM], 2015). Yet despite improvements over the past 20 years, gaps in quality care and medical errors continue to plague healthcare with costly repercussions (Classen et al., 2011; Makary and Michael, 2016). Interprofessional approaches to patient safety that incorporate collaborative communication and the application of rigorous quality improvement (QI) processes are a promising solution to these deficits within the healthcare system. Intentional teamwork efforts directed at quality care demonstrate success in enhancing patient care while optimizing fiscal outcomes (Salas et al., 2008; Neily et al., 2010; Donovan et al., 2018). Therefore, educational models that fully integrate the AACN Essentials which emphasize *Organizational and Systems Leadership for Quality Improvement and Systems Thinking with Interprofessional Collaboration for Improving Patient and Population Health Outcomes* are needed to produce interprofessional, team-ready clinicians who can engage effectively in collaborative approaches to patient care and problem solving within the healthcare setting (AACN, 2006).

### 2. Background

Highly functional interprofessional teams are the cornerstone of safe and efficient care in hospital environments (American Association of Critical Care Nurses, 2005; Weaver et al., 2013). Quality care is maximized when the unique skills of a variety of team members join to optimize the provision of care to an individual patient (Donovan et al., 2018). Nurses are frequently involved in QI initiatives due to their proximity to the patient and experience with the functionality of the system. Nurses are in the clinical setting around the clock, often serving as the linchpin in coordinating care within and across units. Of course, the level of involvement with quality process enhancements certainly varies from nurse to nurse and setting to setting. However, it is expected that doctorally-prepared nurse clinicians are actively engage in the development and implementation of structured and reliable processes that reduce error and promulgate safe patient care (World Health Organization, 2010; Frank et al., 2010). They are expected to lead quality improvement teams using evidence-based approaches to care, improvement science and highly-developed interprofessional skills (AACN, 2006; AACN, 2011; Sherwood and Barnsteiner, 2017).

The knowledge, skills and attitudes required to effectively lead interprofessional teams in QI are developed over time through training and experience. It is typically anticipated that these attributes are established during academic coursework, especially during graduate education. Yet, many graduate nursing schools continue to function with siloed approaches and encounter many obstacles in readily establishing team-training. Among these obstacles are difficulties

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\* Corresponding author.

E-mail address: [bad3e@virginia.edu](mailto:bad3e@virginia.edu) (B. Quatrara).

developing interprofessional programs or activities with other professional schools and the complexities of adapting already dense curricular programs (Dow and Thibault, 2017). The implementation of firmly established teamwork education and training throughout graduate healthcare programs is not uniformly institutionalized (IOM, 2013; Cox and Naylor, 2013; Brandt, 2015). Therefore, systematically and intentionally targeting educational initiatives in collaborative teamwork to prepare doctorally-prepared Advanced Practice Nurses (APNs) and interprofessional colleagues is necessary to enhance QI in the clinical arena.

### 3. Methods

#### 3.1. Program objective

The primary objective of this 3-year Health Resources and Services Administration (HRSA) sponsored program was for doctor of nursing practice (DNP) students within the acute care adult-gerontology APN track and medical residents to learn together to apply QI methodologies using a team-based approach in a collaborative practice environment. DNP students and internal medicine residents participated in a broad range of learning strategies in order to obtain key Interprofessional Education Collaborative (IPEC) and Patient Safety and Quality Improvement (PSQI) competencies. In order to bridge the gap between education and practice, practical application of these competencies was demonstrated by each DNP student's ability to work with medical residents and other health professionals to complete a collaborative PSQI project aimed at improving the quality of care for patients and their families. Linking interprofessional education with measurable improvements in teamwork and QI competencies has the potential to not only improve patient and population outcomes but also to create significant cost savings for the U.S. healthcare system.

#### 3.2. Participants and design

Institutional review board approval was obtained prior to initiating the “Creating a Culture of Safety” program. The program was designed by an interprofessional team to engage learners in fostering meaningful interprofessional communication, employing shared problem solving and collaboratively integrating QI methods. Incoming DNP students enrolled in the 3-year acute care adult-gerontology APN track were informed via in-person information sessions about the opportunity to apply to participate. Students who met criteria were invited to take part in the program across their 3-year DNP program and participation was voluntary. The program included 100 h of learning which was in addition to the required DNP degree coursework. Degree. During the same year, all medical residents selected for the 3-year residency program received information about the program. The residents then participated with DNP students in approximately 30 h of required interprofessional workshops, simulations and invited speaker presentations.

Through the “Creating a Culture of Safety” program, students and residents learned together over the course of 3 years. Educational sessions were held monthly. IPEC and PSQI competencies as well as QI tools were woven throughout the program using a theoretical framework that incorporates interprofessional relational factors, team leadership and practical QI tools called the ASPIRE Model (Fig. 1) (Brashers et al., in press). This model organizes competencies so that they can be prioritized and more easily applied to clinical practice. The ASPIRE Model has been empirically tested as an approach to provide interprofessional training for “real-world” application by clinicians, faculty, and graduate trainees. Using this model, DNP students and medical residents learned about practical tools for teamwork such as communication skills, interprofessional handoffs, and team-based rounding; as well as practical PSQI tools such as systems thinking, root cause analysis, Lean Six Sigma® methodology, project design and implementation, and data collection and interpretation. Leadership topics

included team leadership models, change management, providing a business case for QI, and leading interprofessional rounds. Relational factors such as ethics, wisdom, appreciative practices, positivity, and crucial conversations were also emphasized. Teaching strategies implemented for both medical residents and DNP students included 7 two-hour workshops, 4 patient care simulations, and 6 cutting-edge discussions with nationally-recognized interprofessional experts. DNP students also participated in 13 ninety-minute interactive DNP brown bag seminars covering a wide range of teamwork and PSQI topics followed by 7 three-hour project development team meetings. All of these sessions aimed to provide the knowledge, skills and attitudes required for the DNP students to fully implement and evaluate the results of an interprofessional quality improvement project in the acute or critical care environment. The medical residents did not participate in the project development sessions because they do not complete a written PSQI project as part of their training.

Educational sessions were taught by an interprofessional team. Faculty experts from nursing, medicine, pharmacy, social work, business, public health, and healthcare administration were tapped to provide interactive learning experiences.

#### 3.3. Data collection

The evaluation and outcomes analysis of the “Creating a Culture of Safety” program was performed in accordance with institutional review board standards. Participant anonymity and confidentiality were maintained throughout the evaluative process. Evaluation of the program was conducted through anonymous evaluations completed by learners after every program activity. Assessment of learner outcomes occurred through the use of pre-post assessment instruments and analysis of interprofessional quality improvement project proposals.

#### 3.4. Data analysis

Program evaluative data was collected on all DNP/Resident IPE PSQI workshops, DNP brown bag seminars, patient care simulations and invited speaker sessions. The learners evaluated the programs using a 7-point Likert scale. Means scores were calculated for each program.

The analysis plan for the assessment of learner outcomes included 3 components: changes in attitudes toward teamwork, self-analysis of QI skills, and QI knowledge application. Changes in attitude toward teamwork for both DNP students and medical residents were measured using the TEAMSTEPS® Teamwork Attitudes Questionnaire (T-TAQ) prior to beginning the program and at the completion of the 3rd year of the program. The T-TAQ is comprised of 30 questions and uses a 5-point Likert scale incorporating the 5 domains of team structure, leadership, situation monitoring, mutual support, and communication to self-report teamwork perceptions (Agency for Healthcare Research and Quality, 2017). The self-analysis of QI skills was measured for both medical residents and DNP students using the Quality Assessment Improvement Curriculum (QAIC) Assessment Tool (Ogrinc et al., 2004). The QAIC is a 12-question instrument that uses a 4-point Likert scale. Each QAIC statement is preceded by the statement, “How comfortable are you in your current skills with the following aspects of quality assessment and improvement?”. The QAIC was administered pre- and post-program participation as a self-analysis of learning. For the DNP students, QI knowledge application was measured using the Quality Improvement Proposal Assessment Tool (QIPAT-7) (Leenstra et al., 2007). This assessment was not applicable to the medical residents because they do not complete a written PSQI project proposal as part of their training. The QIPAT-7 tool assesses problem definition, stakeholder identification, root cause analysis, QI approach, potential of proposed intervention, and implementation and evaluation of the project. The students underwent this evaluative process in order to identify gaps in their knowledge of interprofessional quality improvement and address them prior to the program completion. During year 2, the DNP students

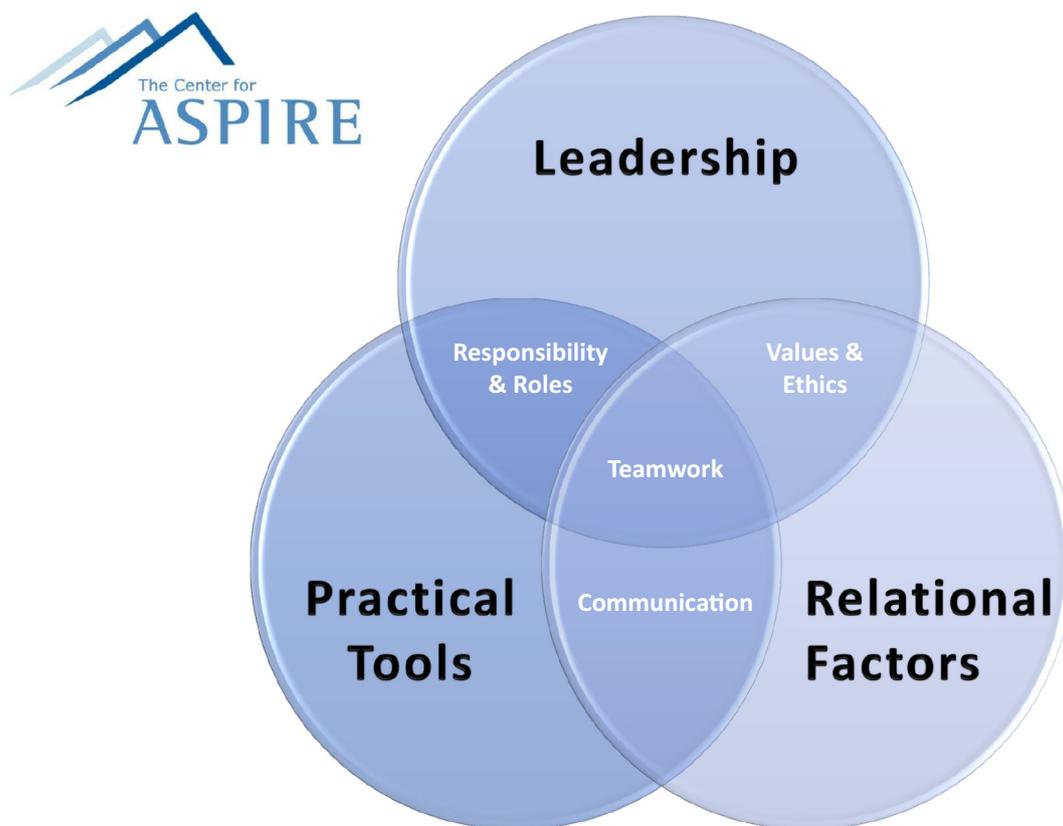


Fig. 1. The ASPIRE Model for organizing teamwork and quality improvement competencies.

completed a 10-item structured questionnaire reflecting on the QI process and the application of the QI process to a potential case. The questionnaire was scored using the QIPAT-7. Incorporating a pre-post evaluation, the QIPAT-7 tool was used again to evaluate the application of QI processes within the DNP student final project during the 3rd year of the program. All data were analyzed using SPSS version 23 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.).

#### 4. Results

Over the course of 3 years, the entire first cohort of 7 volunteer DNP students completed the program. All 7 students attended the learning sessions and participated in the complete set of evaluative processes. All 32 medical residents in the first cohort were required to participate in the joint learning sessions and completed the pre/post assessment surveys.

##### 4.1. Program evaluation

Evaluative data was collected on all DNP/Resident IPE PSQI workshops, DNP brown bag seminars, patient care simulations, and invited speaker sessions. Means of the responses to the 7-point Likert scale were computed. The highest mean score within the DNP/Resident IPE PSQI workshops focused on the topic of Human Factors and Systems Thinking with a mean of 6.84, the lowest mean score was affiliated with the workshop on Variation Run & Control Charts with a mean of 3.87. The brown bag seminars were rated with a mean ranging from 5.7 to 7.0, and with a mode of 7.0. Similarly, the simulation means spanned 4.5 to 7.0 with a mode of 7.0. The means for the national speakers ranged from 6.64 to 6.98. Overall the findings were highly positive and cited the benefits of the learning sessions.

##### 4.2. Attitudes toward teamwork

The T-TAQ mean scores were calculated for both the DNP students and the medical residents pre and post-program involvement. Individual question and overall T-TAQ score averages were analyzed. One question about monitoring the emotional and physical status of other team members yielded a statistically significant improvement among DNP students after participation in the program ( $p = 0.030$ ). No statistically significant differences were noted across the other 29 questions or within the overall T-TAQ score for DNP students. However, the medical residents demonstrated statistically significant increases in the scores of 4 of the 30 questions. These improvements included the topics of monitoring patients and team members for their contributions and emotional and physical status (Table 1).

##### 4.3. Quality improvement skills

Similarly, the mean QAIC scores were calculated pre and post-program participation for the DNP students and the medical residents. The means for individual questions and overall QAIC scores were analyzed. The DNP student scores demonstrated a statistically significant improvement in 8 of the 11 questions, while the medical resident responses revealed statistically significant improvement in all 11 questions (Table 2). Furthermore, both the students and the residents exhibited statistically significant increases in total QAIC scores from pre to post-program engagement ( $p < 0.001$ ).

The QIPAT-7 scores were also computed. The QIPAT-7 scores of the DNP students who completed the 10-item questionnaire in year 2 were compared to their QIPAT-7 scores on their final projects in Year 3. The comparison demonstrated significant improvements in knowledge within all areas. (Fig. 2).

**Table 1**  
DNP student and medical resident team STEPPS Attitude Questionnaire (TAQ) results.

	DNP students (n = 7)			Medical residents (n = 32)		
	Pretest mean	Posttest mean	p	Pretest mean	Posttest mean	p
Individuals can be taught how to scan the environment for important situational cues.	4.33	4.29	0.999	3.89	4.06	0.015
Monitoring patients provides an important contribution to effective team performance	4.44	4.57	0.356	4.07	4.19	0.030
It is important to monitor the emotional and physical status of other team members.	4.11	4.86	0.030	4.28	4.40	0.038
Team members who monitor their emotional and physical status on the job are more effective.	4.22	4.86	0.172	4.31	4.43	0.020

DNP – Doctor or Nursing Practice; p — probability value.

**5. Discussion**

The “Creating a Culture of Safety” program findings support the importance of team-based education in quality improvement as a strategy to enhance QI skills and knowledge. DNP nursing students in the acute care adult-gerontology APN track trained with internal medicine residents and effectively learned to apply patient safety and QI methodologies through a team-based approach. Further incorporating the learnings into a QI project emphasized the value of the interprofessional education program and the opportunity to integrate interprofessional collaborative team-training into acute care practice settings.

The outcomes assessment of the “Creating a Culture of Safety” program include several remarkable findings in the QI realm. The statistically significant improvement in QAIC scores for both the DNP students and the medical residents highlights an impressive improvement in self-perceived QI knowledge and skills. Despite the limitations of the self-reporting functionality of the instrument and the potential for response bias, the results are striking. Both the DNP students and the residents emphasized enhancements in their ability to distinguish best practices, manage adverse events, implement small cycles of change, use a trusted framework and link data trends appropriately. These are core components of effective quality improvement efforts, and the skills needed to transform the healthcare system (Moran et al., 2016). This is particularly important in the acute care settings where several individual experts are often summoned to provide care to a severely ill or complex patient. Without a collaborative team-leader to support the unification of experts, individuals are enculturated into working in silos and patient care is not optimized (Weaver et al., 2013). The definitive growth identified through QAIC scores points to the value of the “Creating a Culture of Safety” program approach in training DNP-prepared APNs and medical residents to enter the complex acute and critical care settings as collaborative team-leaders equipped to enhance patient safety through QI.

The DNP students demonstrated significant improvement in only one item within the T-TAQ survey. This is likely due to the fact that the DNP students who self-selected to participate in the program were already invested in teamwork prior to their involvement in the program, as noted by the high pretest score means of > 4 out of 5 for all items.

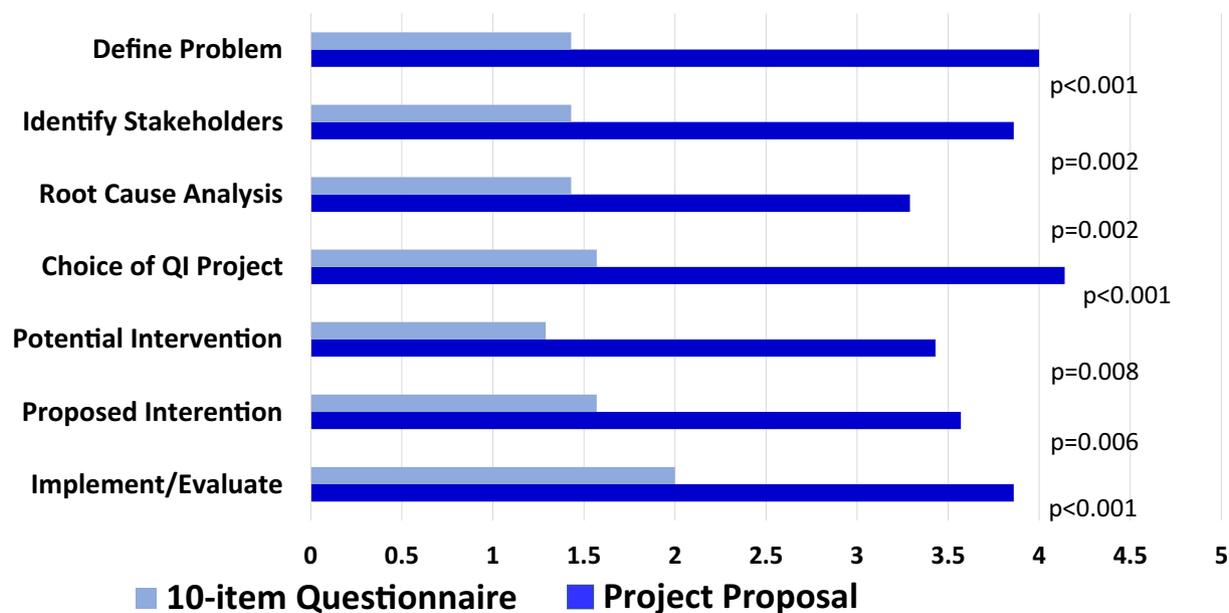
Interestingly, the one item that did demonstrate statistical significance among the DNP students (“It is important to monitor the emotional and physical status of other team members.”) aligns with one of the most highly rated seminars, ‘Relational Factors in Teamwork’ (Mean score of 6.96 out of a possible 7.0; SD 0.07). Competencies related to mutual staff support are included in national quality and patient safety guidelines (Moran et al., 2016), and this outcome suggests that, although the students may have begun the program with teamwork exposure and skills, a comprehensive multi-dimensional approach to interprofessional teamwork training that includes emotional awareness did bring about new learning to these seasoned clinicians. The attitude improvements for medical residents also included this same survey item, as well an item related to an awareness that monitoring their own emotional and physical status is important. Residents also improved in their attitude toward scanning the environment and monitoring patients as important contributors to team performance. These concepts are traditional components of nursing education but are less emphasized in medical education.

For the DNP students, these interprofessional QI competencies were further documented by their significantly improved ability to incorporate relevant skills and knowledge into their final project proposals as assessed by the QIPAT – 7 analysis. These findings are important in terms of the role of the DNP graduate who is expected to “Use advanced communication skills/processes to lead quality improvement and patient safety initiatives in health care systems” and “Employ consultative and leadership skills with intraprofessional and interprofessional teams to create change in health care and complex healthcare delivery systems” (AACN, 2006). With continued emphasis on preventing ‘never events’ such as medication errors and laboratory

**Table 2**  
DNP student and medical resident Quality Assessment Improvement Curriculum (QAIC) survey results.

	DNP students (n = 7)			Medical residents (n = 32)		
	Pretest (Mean)	Posttest (Mean)	P	Pretest (Mean)	Posttest (Mean)	P
Writing a clear problem statement	2.56	3.86	0.022	2.86	3.49	< 0.001
Applying the best professional knowledge	2.78	3.43	0.231	2.78	3.38	< 0.001
Using measurement to improve skills	2.89	3.57	0.172	2.61	3.29	< 0.001
Studying the Process	2.78	3.71	0.045	2.64	3.14	< 0.001
Making changes in a system	2.67	3.43	0.094	2.23	2.90	< 0.001
Identifying whether a change leads to an improvement in your skills	2.78	3.71	0.017	2.69	3.20	< 0.001
Using small cycles of change	2.44	3.57	0.018	2.49	3.12	< 0.001
Identifying best practices and comparing these to your local practice/skills	2.89	3.71	0.008	2.70	3.15	< 0.001
Implementing a structured plan to test a change	2.44	3.86	< 0.001	2.48	3.12	< 0.001
Using the PDSA model as a systematic framework for trial and learning	1.33	3.86	< 0.001	2.17	2.97	< 0.001
Identifying how data is linked to specific processes	2.33	3.71	0.003	2.38	3.07	< 0.001
Building your next improvement upon success or failure	2.67	3.71	0.038	2.63	3.27	< 0.001
Total score (summed values for each variable)	30.56	44.14	< 0.001	30.68	37.91	< 0.001

DNP – Doctor or Nursing Practice; p — probability value.



QIPAT- Quality Improvement Proposal Assessment Tool; p – probability value

Fig. 2. DNP student QIPAT-7 Scores (Scales 1–5).

test result miscommunication (AHRQ, 2018), knowledge and skills in implementing team-based, practice setting specific QI strategies are essential. Comprehensively responding to complex issues such as readmissions, medication reconciliation, delays in care treatments and incomplete handoff of care will require experience with interprofessional team-based approaches to QI. Team-based learning strategies can be used to develop these competencies and improve the safety and effectiveness of healthcare delivery (IOM, 2015; Salas et al., 2008; Weaver et al., 2014). Training DNP students and medical residents to work collaboratively with the entire healthcare team to resolve issues can have far-reaching implications for patient safety, error reduction and cost containment.

The project had several limitations. The self-selection process used to recruit DNP students is a limitation of the study, as is the self-reporting nature of the QAIC and T-TAQ instruments. Additionally, the DNP students volunteered to participate while the medical residents were assigned to the program. These differences within the participation status of these two groups may also have contributed to some of the differences noted in the results, particularly the more statistically significant changes noted in some of the medical resident T-TAQ and QAIC results. However, there were also several strengths of the project. The program was comprehensively applied by an interprofessional team of faculty over 3 years and included 100-h of coursework. Moreover, the results are based upon multiple anonymous learner assessments and represent a thorough analysis of the learning outcomes.

The success of the “Creating a Culture of Safety” program provides an incentive to more fully and effectively embed interprofessional patient safety and quality improvement training as a core component of DNP education. The intensive nature of this 100-h program may not be feasible for all graduate programs, but key elements can and should be embedded in curricula in order to best prepare graduates to rapidly transition into leaders in interprofessional collaborative practice settings.

## 6. Conclusions

This study demonstrates that deliberate interprofessional team-based learning can develop the skills needed to engage effectively in collaborative practices that drive quality improvement and patient

safety initiatives in an acute care environment. Healthcare environments need DNPs and residents who know how to communicate collaboratively under pressure to avoid error. Simultaneously, clinicians who can forge substantial and lasting changes in the care setting by promptly addressing concerns, accessing best practices, engaging team members, and instituting reliable quality improvement frameworks are needed to improve quality outcomes. Healthcare settings are safest when high-functioning teams are ready to actively engage in meaningful patient safety and quality improvement efforts. Interprofessional team training in patient safety and QI is a strategy to build a safer healthcare system. Efforts to indelibly embed team-based quality improvement education into DNP curricula fosters the partnering of academia and health care institutions to develop nurses of the future while paving the way to a safer patient care environment.

## Declaration of Competing Interest

There are no Conflicts of Interest to report.

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