Comprehensive Resident Simulation Training to Improve Patient Outcomes After Rapid Response Events at University of North Carolina Medical Center

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2. **Why are you interested in participating in the Improvement Scholars Program?**
We would like to participate in the Improvement Scholars Program for the opportunity to: 1) collaborate with a multidisciplinary team including nurses, advanced practice providers, resident physicians, and junior and senior faculty; 2) receive structured training, experience, and mentorship in quality improvement work; and 3) develop a sustainable training program for housestaff that will improve clinical outcomes and bridge gaps in the equitable provision of medical care for patients hospitalized at University of North Carolina Medical Center (UNCMC). Participation in this program will effectively position us to become future stewards and leaders in quality and safety at UNCMC.

3. **Which UNC Health improvement priority will your project address?**
The main UNC Health improvement priority addressed by our project is patient harm prevention and mortality reduction. Our project will significantly increase provider knowledge, familiarity, and readiness in leading rapid response events (RREs), with the downstream effect of improved clinical outcomes for patients who experience RREs at UNCMC.

4. **What is the problem or gap in quality you seek to improve?**
Rapid response teams (RRTs) are multidisciplinary teams charged with evaluating, triaging, and treating patients with signs of clinical deterioration outside of the intensive care unit (ICU).[1] The implementation of rapid response systems is associated with a reduction in hospital mortality and cardiopulmonary arrests in adult patients.[2] Rapid response teams are activated for a variety of reasons, and there are often no specific care protocols or algorithms for responding team members to follow; this is in stark contrast to cardiopulmonary arrests (code blues) or traumas. At UNC, RRTs are comprised of a rapid response nurse trained in critical care, a respiratory therapist, the patient's primary nurse, and the patient's primary licensed medical provider. In 2021, there were a total of 3,213 RREs at UNCMC. In over 80% of rapid responses at UNC Medical Center (UNCMC), trainees/residents are forced to immediately perform as the sole primary medical provider leading the team. However, trainees may lack the experience and/or knowledge to adequately respond to the clinically deteriorating patient and often feel unprepared to do so.

An internal data analysis by the UNC Adult Rapid Response System Committee showed that patients who experience at least one RRE had better outcomes when cared for by a licensed independent practitioner (i.e., an attending hospitalist physician or a nurse practitioner)

compared to patients cared for by resident physicians. In the analysis, the average expected mortality rates for all patients and for patients who experienced at least one rapid response event during their hospitalization were similar between those patients admitted to a hospitalist service versus a general medicine teaching service, suggesting a similar disease severity for patients across services. The results showed that the number of RRT activations, rate of repeat RREs within 48 hours of a prior RRE, length of stay for patients who experienced a RRE, mortality index for patients who experienced a RRE, and percent of code blues for patients who experienced a RRE, were all higher for patients on general medicine teaching teams compared to hospitalist teams. The difference in outcomes after RREs between patients cared for primarily by residents and those cared for by licensed independent practitioners, and residents' lack of confidence in their ability to lead RRTs, represents a gap in quality at UNCMC.

5. **Describe the patient population affected, scope, and impact of the problem (1 page)**
    a. **What is the specific patient population your project will impact?**
    All patients admitted to inpatient teaching services (cardiology, family medicine, gynecology, infectious disease, general medicine U/W/L, nephrology, neurology, neurosurgery, obstetrics, oncology/hematology, oral/maxillofacial surgery, orthopedic surgery, otolaryngology, physical medicine & rehabilitation, psychiatry, upper / lower GI surgery, plastic surgery, thoracic surgery, transplant surgery, urology, vascular surgery, and trauma surgery) acute or intermediate care status at UNCMC and UNC Hillsborough Campus who experience at least one RRE during their hospitalization.
    b. **How many patients are in the population?**
    There was a total of 2,667 RREs in calendar year 2021 and 2,689 RREs in calendar year 2022 for the service lines listed above. For the general medicine teaching services alone (med U/W/L), there were 444 and 509 total RREs in calendar years 2021 and 2022, respectively.
    c. **How frequently does the problem occur?**
    11.6% of patients admitted to general medicine teaching services experienced a RRE during their hospitalization in the years 2020-2021.
    d. **What is the impact of the problem?**
    The mortality rate of patients who experience at least one rapid response during their hospitalization and are admitted to a general medicine teaching team was 19-20% over the calendar years 2020-2021. As discussed above, outcomes are worse for patients who experience a RRE and are cared for primarily by residents as compared to attending physicians, despite both populations having similar severity of illness and expected mortality, as shown in the following figures and tables:

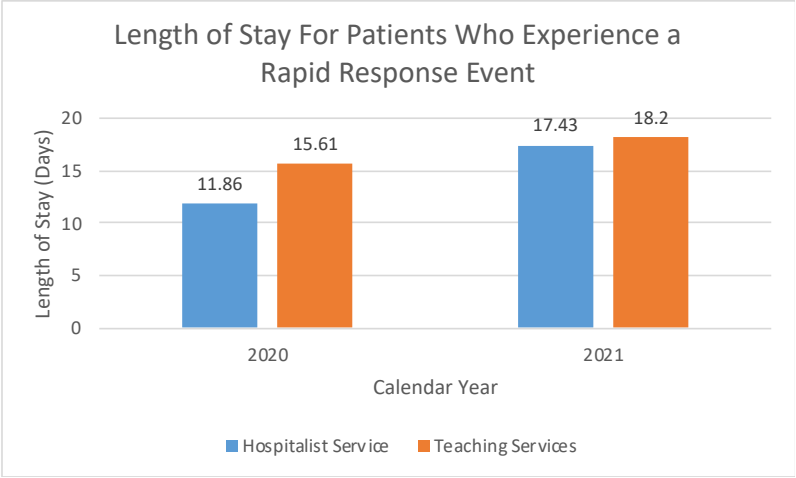

Figure 1. Differences in length of stay for patients who experienced a RRE based on the primary service line

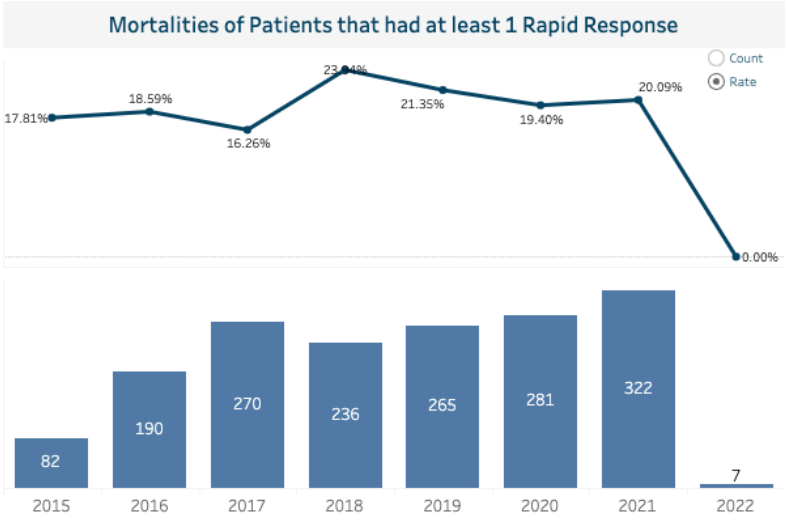

Figure 2. Annual (calendar years) percent mortality of patients on teaching services (MDU and MDW) who experienced at least one rapid event

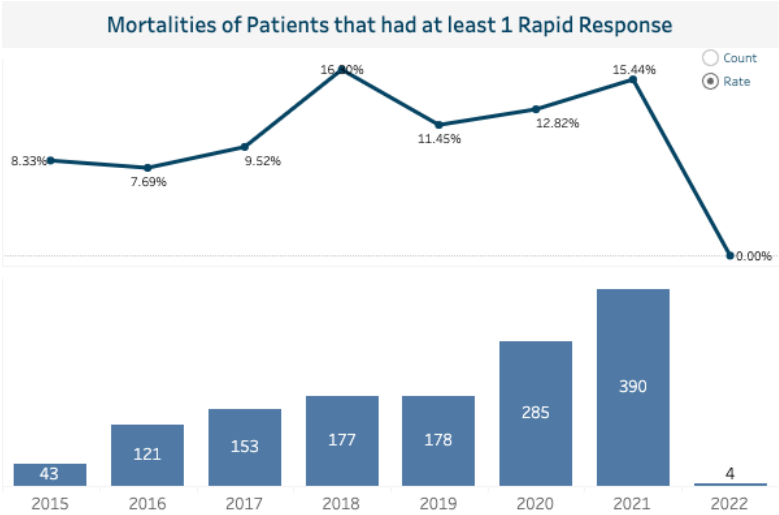

Figure 3. Annual (calendar years) percent mortality of patients on hospitalist services (MDH, MDJ, MDZ) who experienced at least one rapid event

	Percent of Repeat RRE within 48 hours of previous RRE for All Patients Who Experienced a RRE During Hospitalization	
Calendar Year	Hospitalist	Teaching
2020 and 2021 (combined)	1.37%	1.89%

Table 1. Percent of repeat RRE within 48 hours of an index RRE for all patients who experienced a RRE during their hospitalization in calendar years 2020 and 2021.

	Percent of Code Blues for All Patients Who Experienced a RRE During Hospitalization	
Calendar Year	Hospitalist	Teaching
2020 and 2021 (combined)	5.85%	8.95%

Table 2. Percent of cardiac arrest calls for all patients who experienced a RRE during their hospitalization in calendar years 2020 and 2021.

These data suggest that patients who experience a RRE during their hospitalization and are primarily cared for by residents are being managed differently and in a way that does not optimize their outcomes compared to patients being managed by licensed independent practitioners.

6. **What do you think are the underlying causes of the problem? Why do you think the problem is happening? (1/2 page)**
   Residents primarily learn how to manage patients according to an apprenticeship model of on-the-job learning, acquiring skills through guided trial and error. Residency training programs at UNC vary in how they prepare housestaff for their transition from internship to senior resident,

when they become the designated leaders of RREs for patients admitted to their service lines. It is known, however, that this transition typically occurs without any formal practice of, or feedback on, their leadership/communication/teamwork skills, medical knowledge base, and decision-making during RREs.[3] This on-the-job learning model promotes practice drifts, lacks standardization of specific care protocols, allows under-developed staff to institute team cohesion and leadership, and subjects patients to risk and harm, due to latency of the care delivery model. The lack of algorithmic care, the diversity of clinical scenarios and responding team members, and the inherent drawbacks of less experienced primary providers represent a barrier to providing consistent, high-quality care during rapid response events.

7. **What is the history of improvement or attempted improvement at UNC Health? What work will your proposed improvement build on? (1/2 page)**
   There have been many efforts to improve the rapid response system at UNCMC including the creation of the Adult Rapid Response System Committee, the use of deterioration index scores to better identify patients at risk for acute decompensation, and the deployment of a rapid response nurse consult process for earlier rapid response team activation and intervention on deteriorating inpatients. Our proposed project builds on a previous IHQI Improvement Scholars project co-led by Drs. Lauren and Evan Raff to improve rapid response team performance and patient outcomes by implementing enhanced communication techniques and a standardized RRE 'timeout' (consisting of team member introductions, expectations, and background about the patient) and debriefing system. Our project would incorporate these communication strategies into dedicated training for housestaff, with the aim of improving clinical outcomes following RREs for patients admitted to teaching services. In addition, our project will build on the simulation training experiences on how to lead rapid responses that have already been implemented by the Department Neurology for its residents.

8. **Please complete the "Measures Table". Please describe the anticipated outcome measure(s), 2-3 process measures, and one balancing measure. Please do not include more than 5 measures total.**

Measure Name	Measure Type	Measure Calculation	Measure Exclusion	Data Source	Baseline*	Goal	Collection Frequency
Repeat RRE	**Outcome**	Numerator: Patients aged 18+ who experience a RRE within 48 hours after index rapid response Denominator: Patients aged 18+ who experience a RRE during their hospitalization		EMR	1.89%	1.4%	Monthly
In-Hospital Mortality	**Outcome**	Numerator: Patients aged 18+ who experience at least one RRE during their hospitalization and died during their hospitalization Denominator: Patients aged 18+ who experience at least one RRE during their hospitalization		EMR	20%	15%	Monthly

Measure Name	Measure Type	Measure Calculation	Measure Exclusion	Data Source	Baseline*	Goal	Collection Frequency
Trainee Comfort Level	**Process**	Numerator: Second year residents who report a 4 or 5 (comfortable or very comfortable managing RREs) on 5-point Likert scale Denominator: Second year residents who complete a Likert scale re: comfort managing RREs		Questionnaire	12.5%	50%	Quarterly
Team Dynamics	**Process**	Numerator: RREs led by second year residents in which all parts of communication bundle (timeout, synopsis, expectations, debrief) are completed Denominator: RREs led by second year residents		Questionnaire	70%	85%	Quarterly

Measure Name	Measure Type	Measure Calculation	Measure Exclusion	Data Source	Baseline*	Goal	Collection Frequency
Over triage or Overutilization of ICU	**Balancing**	Numerator: Patients aged 18+ who are transferred to ICU immediately (<3 hours) after a RRE and are transferred back out of ICU within 24 hours after same RRE Denominator: Patients aged 18+ who are transferred to ICU immediately (<3 hours) after a RRE		EMR	***	***	Monthly

*Baseline percentages are from general medicine teaching services (U/W) in calendar years 2021 and 2022.

9. **What ideas do you have for changes that will result in improvement?** (1-2 pages)
Our project aims to develop and implement structured training for managing inpatients who experience RREs on teaching services at UNC. The primary focus of our improvement efforts will be the development of comprehensive simulation experiences for second-year residents across specialties that are designed to improve provider confidence, communication, teamwork, and successful medical decision-making and task completion during RREs. The anticipated downstream effects of such efforts will be reflected in improved clinical outcomes (as previously described) for patients who experience RREs. This project builds on prior efforts to 1) improve team dynamics and performance during RREs at UNCMC; and 2) provide formal RRE simulation training for UNC neurology residents. These efforts will allow UNC to continually uphold the Institute for Healthcare Improvement's Save 100,000 Lives campaign and improve patient outcomes.

In the first 3 months of the project, we will assess all second-year residents' baseline confidence in their ability to lead a RRE using a brief questionnaire. During this period, we will begin training sessions with a smaller cohort of approximately 30 residents. Individual training sessions will last approximately 3 hours, involve approximately 5 residents and one faculty preceptor, and encompass management of the most common RRE scenarios (hypotension, hypoxemia, tachycardia, altered mental status, and sepsis). The training sessions will first consist of pre-simulation didactics on TeamSTEPPS principles, including the standard communication bundle for RREs (timeout, synopsis, expectations, debrief), as well as a review of important etiologies of, and diagnostic tests / interventions for, the most common RRE clinical scenarios. Following the didactics, each resident will undergo a standardized simulation experience in the simulation lab for each of the common RRE clinical scenarios. During the simulation, each resident will take a turn playing a different role on the RRT. The training sessions will end with a debrief in which residents are provided the opportunity to reflect on their experience and receive formal feedback on their compliance with the communication bundle, the appropriateness of recommended tests and interventions, and their overall performance as RRT leader. Following the training session, residents will complete another questionnaire re-evaluating their confidence in the ability to lead a RRT, as well as provide feedback on the helpfulness of the training session. After each training session, we will use this feedback to perform PDSA cycles and refine the process. By providing residents with standardized training for the most common rapid response scenarios in a low-stakes, psychologically safe environment, we hope to increase their confidence in leading RREs and improve their communication, performance, and medical decision-making during real-life RREs.

For the remaining 9 months of the project, we will continue to perform training sessions with additional residents, with the goal of training at least 75% of second-year residents for the academic year of 2023-2024. During this time, we will also engage house supervisors, who are present at every RRE, to act as third-party observers. The house supervisor role will be to complete questionnaires about the primary provider leading RREs at UNCMC and UNC Hillsborough Campus. We will use these questionnaires to identify RREs led by second-year residents and determine compliance with the standard communication bundle. We will also use data from the electronic medical record to track the measures listed in the table above to monitor patient outcomes and team dynamics over time, as more and more residents complete the simulation training. We will also be able to use historical data to monitor outcomes after RREs before, during, and after the implementation of the training program. Throughout the

academic year, we will re-assess all second-year residents' confidence in leading RRTs by questionnaire. As we learn from PDSA cycles, we will also trial in situ RRE simulations to allow residents to practice what they have learned in low-stakes, more realistic scenarios within the hospital.

10. **How has this problem has been addressed successfully elsewhere? (1 page)**
    Simulation training and leadership experiences have been shown to improve team performance and relevant outcomes in cardiopulmonary resuscitation.[4] Similarly, simulation training for RREs can improve interpersonal communication skills, integration of competencies, augmentation of rapid response technical skills, and exposure to complex and rare cases that creates dialogue for early prevention. Simulation experiences during the transition course from PGY-1 to PGY-2 increased trainees' perceived preparedness to lead RREs and their value of interdisciplinary communication.[3] Simulation experiences in managing cardiac arrests for interns improved their confidence in handling critical situations, as well as their medical decision making.[5] There is also a strong correlation between residents' medical decision-making and successful team behaviors and dynamics in rapid response scenarios.[6] However, to our knowledge, there is no published literature showing the impact of simulation training for residents on clinical outcomes for patients who experience a RRE during their hospitalization.

11. **How will high performance management tools (Just Culture, SAFE reporting, team communication and teaming skills, huddles, and visual management boards) be used to support the work? Although use of these tools is not required, applications including them will be strengthened.**
    Our project targets Just Culture by adequately preparing resident physicians to lead RREs, thereby improving their psychological safety in these high-stress situations, and by seeking their feedback on ways to improve the training they receive. It targets TeamSTEPPS and huddles by providing residents with dedicated training on appropriate communication, including time outs and debriefs, and team dynamics during RREs and allows them to role-play as various members of the RRT during their simulation experiences.

12. **Please describe how your project addresses each of the 5 elements reflected in the Quintuple Aim for Health Care Improvement. (1 page)**
    - **Improved health**: Improving RRE training for residents has the potential to improve clinical outcomes for patients who experience RREs by increasing provider confidence, knowledge, and skills.
    - **Enhanced patient experience:** Residents who receive RRE training, which includes instructions in team dynamics and communication, will be more likely to engage in time-outs, introductions, and debriefing, which allows the patient to be more engaged in the care they are receiving and to trust that they are receiving appropriate care from an interdisciplinary team.
    - **Enhanced clinician and staff experience:** Residents who receive RRE training will be more confident and have enhanced psychological safety when leading RRTs due to their preparation (having received feedback on their leadership skills through the program). Interdisciplinary members of the RRT will also have enhanced psychological safety due to increased compliance with the communication bundle and improved team dynamics that result from program training.

- **Health equity**: Providing standardized training to residents ensures that all patients admitted to teaching services, who may be uninsured or underinsured or of poor health literacy, receive appropriate care when they experience RREs.
- **Reduced costs:** Patients who experience RREs that are managed by residents who have received simulation training may have reduced length of stay and risk of repeat RREs compared to patients who are cared for by residents who have not received training. They may also be triaged to intensive care sooner and be able to be stabilized more quickly, again reducing length of stay and duration of stay at a higher level of care.

13. **Leadership Support and Engagement (1/2 page)**
Dr. Winnie Lau, Adult Neurology Residency Program Director, has already implemented a rapid response training simulation program for Neurology and Neurosurgery residents at UNC. She has offered to share data, her experience, and her expertise to serve as the groundwork for building our broader simulation practice. She has also offered to recruit interested residents for roles on the project team. Dr. Debra Bynum, Internal Medicine Residency Program Director and Vice Chair of Education, has been seeking ideas for interprofessional training for incoming interns and has expressed her full support for this project. Dr. Jennifer McEntee, Internal Medicine Residency Associate Program Director, similarly has given her support and expressed interest in incorporating the project into the housestaff transition curriculum between first and second year. Drs. Aaron Fried and Leslie Appleton, current Internal Medicine Chief Residents, have already helped recruit several Internal Medicine residents to participate, and Dr. Alisa Siebrasse, a rising Internal Medicine Chief Resident, has also expressed interest in a role on the project team. All these leaders recognize the gap in rapid response training for trainees at UNC and are motivated to incorporate dedicated instruction. Dr. Carlton Moore, Associate Chief for Research and Quality Improvement for the Division of Hospital Medicine, has been involved with project planning and development. Jennifer Mack, MHA, MBA, BSN, RN, UNCMC Adult Rapid Response Committee Co-Chair, has also provided her support and been involved in project development. Jeff McQueen, UNC Clinical Skill/Patient Simulation Center Director of Operations, has given his support to the project and has confirmed that the Simulation Center has resources and bandwidth to accommodate a simulation curriculum for residents.

14. **Who will comprise the project team? List names and roles of team members, describe how the project team will function and how the team's work impacts other teams/units and/or is impacted by other teams/units. Successful improvement project teams are interprofessional, multidisciplinary, and often include patient and family members. Although not required, applications listing interdisciplinary co-leads (e.g., nurse and provider co-leads, or pharmacist and provider co-leads) will be strengthened. Access this link to learn additional helpful information about improvement teams. (1/2 page)**
Lindsey Phillips, MD: Project lead. Academic hospitalist who will have close support and oversight from faculty mentors including Evan Raff and Carlton Moore.

Ellenita Kornegay, BSN, RN, CNIII: Project co-lead. Rapid response nurse who will meet weekly with Dr. Phillips to support the implementation of all aspects of this proposal and will assist with the development of the training curriculum with residents, particularly the communication bundle and interdisciplinary team dynamics portion, and will liaise with members of the Rapid Response Team, including house supervisors and rapid response nurses.

Evan Raff, MD: Faculty sponsor/Quality Improvement expert. Dr. Raff is the Co-Chair for the Adult Rapid Response System Committee. Throughout the project, Dr. Raff will meet monthly with Dr. Phillips and RN Kornegay to provide guidance and help integrate this project into the Adult Rapid Response Committee quality improvement focus.

Carlton Moore, MD: Faculty advisor/Data analyst. Dr. Moore is the Associate Chief of Quality Improvement for the Division of Hospital Medicine. Throughout the project, Dr. Moore will assist with data analysis and provide advising support.

15. **How will you ensure sufficient time to dedicate to the project over the scholar year? Although time commitment to the program varies throughout the year, Scholars may expect to spend at least 2 hours per week (with range from 1 hour minimum to 5 or more hours a week) on project-related activities.**
    We are strongly motivated by our own experiences, and by the engagement of many other staff and faculty, to make this project a priority during its time course. We have support from our direct supervisors to participate in this project. Lindsey Phillips will be working 0.8 FTE clinical shifts during the project timeline, with the remaining 0.2 FTE dedicated to non-clinical responsibilities, including this one. As a hospitalist, her clinical shift schedule is flexible, and she can trade shifts with colleagues to accommodate periods of heavier project demands. With two project co-leads, as well, we will have greater bandwidth to ensure at least one co-lead is present for weekly team meetings.

16. **What factors do you anticipate will foster and hinder improvement?** (1 page)
    Factors that will foster improvement include strong resident and residency leadership interest and engagement in improving training for RREs. In addition, the full support of the Adult Rapid Response Committee leadership and their prioritization of this initiative will lend itself to the success of this project. Finally, the training program developed for neurology residents will serve as a foundation for our training experiences for all residents at UNC.

    One factor that will hinder improvement is the diversity of scenarios for which RREs are activated, making it difficult to create an algorithmic approach to management and to create standards of care for each scenario. Another potentially hindering factor is limited flexibility in residents' schedules to participate in training sessions and completing questionnaires. Lastly, our ability to detect a statistically significant improvement in patient outcomes after RREs may be limited by the relatively small number of RREs led by second year residents who have received simulation training at any given point in the year; however, this can be mitigated by comparing historical data from prior years to data collected at the end of the project timeline, when a greater number of residents will have completed the training.

17. **What ideas do you have for sustaining the improvement? How do you see the work you start with IHQI's support continuing?** (1/2 page)
    Following completion of the initial project with second year residents, we hope to expand the training to all incoming interns and rising second year residents (who were interns during the initial project timeline), so that multiple classes of residents will receive the standardized training, in hopes of continuing to improve patient outcomes by training all potential providers who may lead RREs. Our hope is that the program becomes part of the standard onboarding process for incoming housestaff across all specialties, like the Central Line Training Program required of all interns at UNC (another initiative that began as an IHQI project). Senior residents

and faculty would be given opportunities for leadership and mentorship by serving as preceptors for the training sessions, which would also reinforce their own knowledge and skills. The curriculum could be updated regularly based on feedback from trainees and interdisciplinary members of the Rapid Response Team, as well as based on data from patient outcomes. The program could also be adapted for training bedside nurses and rapid response nurses.

18. **Implementation Timeline** (1 page)

	2023				2024							
	Sept	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**
Development Phase												
Develop simulation curriculum												
Recruit & train faculty preceptors												
Execution Phase												
Training sessions with residents												
Resident confidence questionnaires												
Collect & assess data from RRE observers												
Assess data on RRE outcomes from EMR												
Final data analysis												
Present to IHQI												

19. **References**

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