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Improvement in Hematology Interprofessional Care: Simulation With an Emphasis on Collaboration

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Abstract

Introduction: For many training programs, including hematology, there are limited structured opportunities to practice collaboration as a competency. Training is often limited to ad hoc interactions during clinical rotations. Accordingly, there is further need for immersive and standardized collaboration educational programs. This pilot study explored simulation for developing and assessing collaboration competency among hematology residents. **Methods:** Two standardized simulation center scenarios were developed that required residents to work in interprofessional teams. The objectives were to develop collaboration competence and confidence through experiential learning and facilitated reflection. Team members included education and simulation experts as well as hematology nurses as embedded participants. Case 1 presented a 72-year-old male with stage 4 lymphoma experiencing shortness of breath during a rituximab infusion. Case 2 presented a 68-year-old male who suffered a provoked pulmonary embolism. Both cases utilized a simulated clinic space. Pre, post, and 3-month questionnaires (self-assessed collaboration competency and simulation evaluation) were completed. Each session included structured debriefing with facilitated reflection focused on collaboration. **Results:** Seven senior hematology subspecialty residents participated. Despite residents entering the simulation cases with confidence in collaboration, higher collaboration confidence ratings were observed on postsimulation questionnaires (8.2 vs. 7.6 on a 10-point Likert scale). Residents demonstrated awareness of appropriate collaboration skills, but at times failed to implement knowledge into action. Facilitated reflection during the debrief helped residents critique their collaboration performance and develop improvement plans. **Discussion:** Simulation is a promising tool for teaching and assessing collaboration within hematology training.

Keywords

Simulation, Hematology, Collaboration, CanMEDS, Interprofessional Education, Clinical Teaching/Bedside Teaching, Internal Medicine, Qualitative Research

Educational Objectives

By the end of the simulation activity, learners will be able to:

1. Increase confidence collaborating in a complex medical case.
2. Identify core concepts required for effective collaboration in a complex medical case.
3. Critically analyze collaboration performance.
4. Lead an interprofessional team in providing emergency care for a patient with a rituximab infusion reaction or massive pulmonary embolism.

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Introduction

The practice of hematology is changing rapidly with a dynamic and increasingly complex multidisciplinary health care environment. Within this context, it is imperative to provide trainees with structured and high-quality training in collaboration, specific to the hematology milieu. Unfortunately, there is an education gap in the development of collaboration skills within many residency training programs.[1] There is also little in the literature to specifically guide the development of collaboration curricula for residency training programs.[2-5]

At our institution, the hematology residency program (like many other training programs across North America) currently has an informal collaboration curriculum where residents learn to collaborate in an ad hoc manner through participation in clinical rotations. Within this model, it can often be difficult to support experiential learning with high-quality feedback and

reflection. Particular challenges within hematology include remote supervision (e.g., both residents and staff are offsite for many call duties), a focused number of faculty members with expertise in teaching collaboration, and prioritization of more traditional roles such as the medical expert. Beyond our local experience, these issues have also been described in the literature.[6,7] The use of simulation with intensive debriefing, provides the potential to centralize experiential collaboration teaching and facilitate reflecting learning.[6,8]

While there are currently many well designed simulation cases around collaboration,[3,5,9-11] there remains a need for cases that meet the distinct needs of hematology and other specialty residency training programs. For example, specialty residents often need to consider an expanded differential diagnosis beyond that which is typically included in simulation cases designed for junior medical learners. Moreover, there is also a need to prepare specialty residents for less commonly encountered practice settings such as the ambulatory chemotherapy clinic. Finally, many specialty services act as consulting rather than primary physicians, which requires unique collaboration skills.

Simulation programs incorporating these elements have demonstrated effectiveness with senior medical learners and practicing clinicians in medical specialties.[12-14] For example, a simulation workshop focused on the management of anaphylaxis in patients receiving chemotherapy, led to improvements in knowledge, confidence, and adherence to best treatment practices.[12] While, teamwork skills were included in the assessment model, collaboration was not the primary focus of the workshop.

We described two collaboration-focused simulation cases designed specifically for hematology trainees within a stand-alone simulation center. These were evaluated as part of a pilot study. Within our simulation activity, there was an opportunity to directly observe and coach residents during collaborative practice. In addition, structured debriefing following the simulation encouraged self-reflection on collaboration.

Overall, we believe that these cases can benefit a wide range of residents. We therefore aimed to make them available to others involved in residency education, especially teachers working with trainees in specialty programs.

Methods

Development and Target Audience

The simulation cases were developed by hematology educators in consultation with specialists in simulation education from a Royal College of Physicians and Surgeons of Canada accredited simulation program (Allan Waters Family Simulation Centre, St. Michael's Hospital, Toronto, ON). The cases were designed to support a structured collaboration curriculum for hematology residents (PGY 4 and PGY 5) with the secondary goals of supporting medical expert skills and improving self-efficacy in providing urgent care. These are residents completing subspecialty training in hematology and are akin to hematology/oncology fellows in the United States. As this was a pilot study, we began with a focused group of trainees.

A rituximab infusion reaction (Appendix A) and massive pulmonary embolism (Appendix B) were selected as simulation cases for the following reasons: (1) the cases required the learner to provide emergent care in an interprofessional environment, therefore providing rich opportunities for collaboration; and (2) the topics were identified by hematology faculty, residents, and clinical nurses as areas requiring more hands-on experience.

From a collaboration competency perspective, residents who participated in the simulation came into the scenarios with ample experience working in interprofessional clinical settings. While residents may have had previous collaboration training (e.g., during medical school), they were not expected to have participated in dedicated collaboration training specific to hematology. In terms of the medical expert domains (i.e., identification and management of rituximab infusion reaction and administration of systemic thrombolysis for a massive pulmonary embolism), residents were expected to arrive with working knowledge. This was achieved in part through dedicated classroom-based lectures as part of a comprehensive 2-year hematology academic half-day curriculum. Residents were not expected to have had substantial hands-on experience in these areas.

Finally, as the simulation activity included components considered to fall under research, approval was obtained by research ethics boards at both the hospital and university levels. Residents signed informed consent prior to participating and were able to opt out of the study at any time.

Equipment/Environment

In our study, simulations were run in a stand-alone simulation center. This was not mandated by our cases but was done for convenience. The simulation center included the use of a high-fidelity manikin to function as the patient (Sim Man 3G, Laerdal). The manikin had the ability to talk and respond to clinicians via a facilitator in the control room. The simulation center was prepared to mimic the appropriate clinical environment and differed slightly

between the two cases (chemotherapy unit vs. surgical ward). For both cases equipment included a patient monitor, a patient bed, and various props to add to the realism of the cases. Moulage was used for the pulmonary embolism case, specifically a hip scar and redness/swelling of the leg. Scans were displayed on a computer monitor in the room. Relevant labs/ECGs were printed and available to the learner at the bedside (Appendix C).

Personnel

The scenario involved the following team members: hematology educators, simulation educators, simulation specialists, and embedded participants. Team members had diverse clinical backgrounds and included physicians, registered nurses, a nurse educator, a nurse practitioner, a respiratory therapist and a physiotherapist. In addition to discipline-specific clinical qualifications, credentials among the simulation/hematology educators included a Master's degree in medical education and completion of the Royal College of Physicians and Surgeons of Canada Simulation Educator Training course.

The hematology and simulation educators were responsible for directing the embedded participants via earpieces and simulation environment (e.g., patient vitals) in real time to ensure that the scenario met the defined case objectives. The clinical educators were also responsible for assessing learners, providing focused feedback, and facilitating the postsimulation debrief. Simulation specialists oriented learners to the simulation environment and implemented the simulation design (e.g., manikin characteristics, diagnostic images, changes to vitals).

With regards to the embedded participants, roles were developed within each scenario ahead of the simulation day. The rituximab infusion reaction (case 1) required two embedded participants to play the role of nurses. The massive pulmonary embolism scenario (case 2) required embedded participants to play the role of an orthopedic surgery resident by phone, a bedside nurse, and an ICU nurse/resident. Notably all embedded participants were selected from clinicians (nurses/nurse practitioner) working in the hematology unit.

As our simulation was part of a pilot study, the personnel also included research coordinators who obtained informed consent and administered pre- and postsimulation questionnaires (Appendix D).

Implementation

Two, 1-hour preparation sessions were held with the simulation team to review the setup, simulation objectives, and scenario design. The team also met 2 hours prior to the session on the day of to prepare the simulation lab. For both cases, the simulation rooms were prepared with an adult male computerized manikin, patient monitor, telephone, and crash cart. In addition, paper printouts were available for lab work, diagnostic imaging, and ECGs. For the rituximab infusion case (Appendix A) the manikin was positioned in a treatment chair mimicking the chemotherapy unit, and additional props included an IV bag labeled as rituximab and syringes labeled for demerol, solumedrol, ranitidine, and diphenhydramine. For the massive pulmonary embolism case (Appendix B) the manikin was positioned in a hospital bed. The manikin was further adapted to show a right hip scar and red right leg. The cost for the simulation activity was included as part of a comprehensive simulation program.

The simulation scenarios were implemented with all available PGY 4 and PGY 5 hematology residents at our institution. Residents were allocated to 40-minute slots. Residents were oriented to the simulation center and prebriefed to review learning objectives and create a psychologically safe environment. This included describing the characteristics of the computerized manikin (e.g., where to feel for a pulse), available equipment (e.g., crash cart, telephone), location orientation, and simulation best practices (e.g., maintaining confidentiality and suspending disbelief). The simulation case itself was designed to run for 10-15 minutes, followed by a 20-25 minute structured debrief. The debrief was attended by the resident completing the scenario, embedded participants, as well the hematology and simulation educators. The debriefs were structured and followed the Promoting Excellence And Reflective Learning in Simulation (PEARLS) framework.[15] Both medical expert and collaboration skills were highlighted in the debrief. The debrief also included an opportunity to readdress any issues regarding psychological safety that may have arisen during the simulation.

Learners completed pre- and postsimulation questionnaires in the simulation lab (Appendix D) as well as a 3-month follow-up questionnaire (Appendix E) distributed by email. Audiovisual recordings were made of both the simulation and debrief for qualitative analysis.

Assessment

A mixed methods approach was used with emphasis on the first level (learner reactions) and second level (learning outcomes) of Kirkpatrick's model for program evaluation.[16] Evaluations were completed both at the time of the simulation activity and at 3 months. Evaluation tools utilized include the following:

1. A collaboration competency questionnaire the Health Professional Collaborative Competency Perception Scale

(HPCCPS)17 was administered to residents before and after the simulation. The pre- and postsimulation scores were compared to determine if the simulation increased learning and confidence with regards to collaborative ability (Appendix D).
2. A follow-up questionnaire (Appendix E) was distributed 3 months after the simulation activity to assess for learner satisfaction and learning retention.
3. Audiovisual recordings were created for both the simulation and the debrief. Qualitative analysis was subsequently performed by two independent reviewers. Analysis was carried out using phenomenological inquiry, which encompassed qualitative approaches to inductively understand a human phenomenon (i.e., collaboration learning through simulation) in a context-specific setting.18 The themes generated provided valuable input on resident satisfaction with the learning activity as well as achievement of the medical expert and collaboration objectives stated above.

As this was a pilot study intended for learning and feasibility, no formal statistical analysis was performed. In addition, there was no summative assessment of the participants with regards to either the medical expert or collaborator role. However, formative assessment was guided by the critical action checklists. Collaborator-specific critical actions were based on a modified version of the Ottawa Crisis Resource Management Global Rating Scale.[19,20] Medical expert specific critical actions were determined through expert consultation (with hematology educators) and were designed to align with national standards for hematology training.[21]

Debriefing

Although multiple debriefing formats are available, we followed the PEARLS format.[15] The PEARLS template is a semi-structured approach that organizes the debrief into three successive components: (1) learner self-assessment, (2) guided reflection and discussion, and (3) directive feedback. This was selected as our debriefing format because it emphasized reflective learning and active learner engagement. In keeping with the collaboration focus of our simulation, all embedded participants were included in the debrief and their input from an interprofessional perspective was emphasized.

Results

Overall, seven PGY 4 ($n = 3$) and PGY 5 ($n = 4$) hematology residents completed the simulation; there were eight active hematology residents and one was unable to attend. The group consisted of four male residents and three female residents. There was considerable variation in simulation exposure prior to hematology training with a median of five to ten prior simulation experiences.

On the presimulation HPCCPS questionnaire, residents described relatively high confidence in their ability to collaborate (mean HPCCPS question rating of 7.6). On the postsimulation HCCPS questionnaire, despite the high initial ratings, we observed higher ratings in collaboration confidence across all domains (mean HPCCPS question rating of 8.2; objective 1). A detailed breakdown of pre- and postsimulation resident ratings on the HPCCPS scale is shown in Figure 1.

On the 3-month follow-up survey (Figure 2) most residents believed that the simulation exercise should be included as a mandatory part of hematology residency education (mean rating of 4.4 on a 5-point scale). In addition, in terms of learner transference, the majority agreed that the exercise improved their approach to subsequent patient management (mean rating of 4 on a 5-point scale). When specifically asked about improvements in medical knowledge and collaboration skills related to the case, mean resident ratings on a 5-point scale were 4.4 and 4.1 respectively. While no summative assessment for either the medical expert or collaboration role was applied, residents generally performed well but were still felt to require minimal supervision. Residents were able to complete the critical action checklists with prompting (objective 4).

Through qualitative analysis, we gathered additional valuable feedback on both positive and negative aspects of the exercise. The simulation exercise was generally well received by the participants. The residents believed that the simulation improved their collaboration skills and helped them feel more comfortable collaborating in patient care. One resident pointed out that they were “more aware” of their collaborative skills following the exercise. Most were able to reflect and identify specific aspects of collaboration that they improved upon, or wish to develop further.

The debriefing exercise was especially well received, as most residents believed the guided reflection and discussion were helpful in improving their approach to patient care. Many described the debrief itself as a collaborative exercise, valuing the different perspectives and insights of the interprofessional medical team involved. Some felt that the reflection during the debrief helped build upon the collaborative skills gained from the simulation, and “helped solidify the team approach.” Specifically, one resident valued the “specific feedback about communication style” (objective 3).

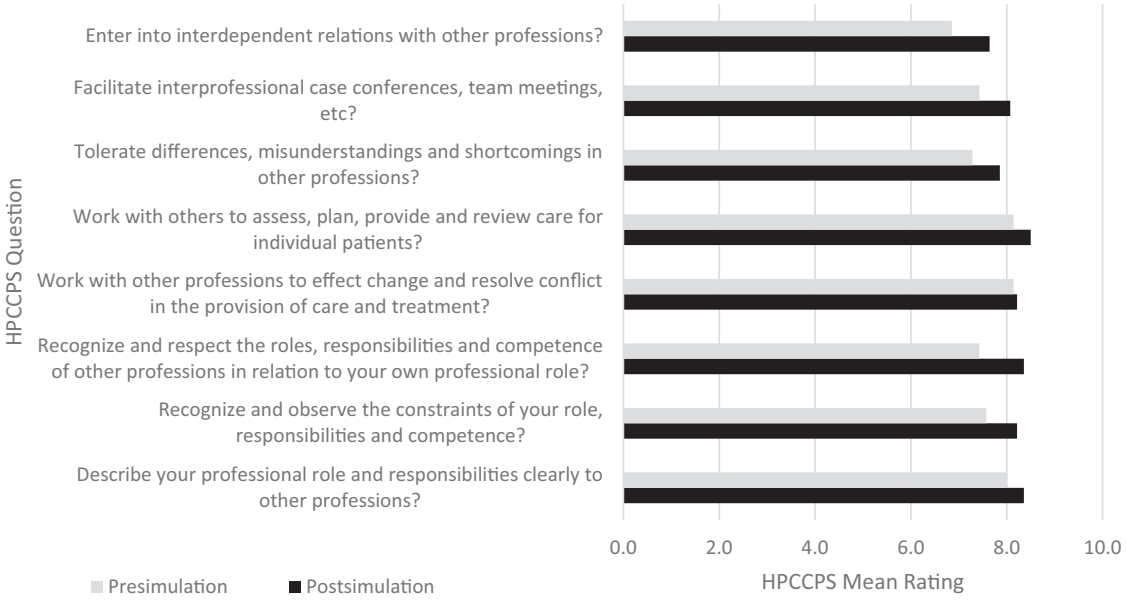

Figure 1. Mean scores per question on the Health Professional Collaborative Competency Perception Scale (HPCCPS), before and after the simulation exercise.

Although residents noted that the exercise helped "highlight strengths and weaknesses" and improve awareness around collaboration, some residents felt that the exercise would have to happen several more times in order to create a lasting change on their subsequent management.

Thematic analysis also identified learner perspectives around components of good collaboration (Table). It was evident through the thematic analysis that the residents were aware of, and had good knowledge pertaining to, elements of good collaborative practice. As residents reflected during the debriefs, they pointed out collaborative actions that they would have taken in hindsight; for example, not "explaining [their] thought process," or not "think[ing] quickly about calling the ICU to help" (Table; objective 2).

From a medical expert perspective, most residents felt increasingly confident in their ability to manage similar situations

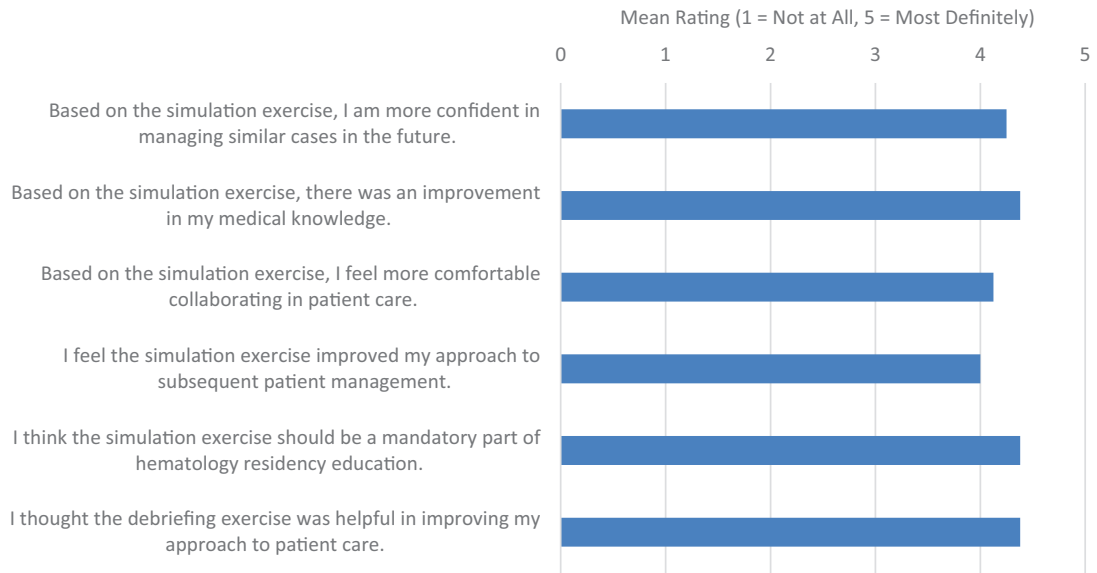

Figure 2. Mean resident ratings on 3-month follow-up survey. Full survey can be found in Appendix E.

Table. Thematic Analysis of Debriefings Focusing on Qualities of Successful Collaboration

Themes	Comments
Acting appropriately in stressful situations.	Rationalize back-up plans.Prioritize.Time management.Remain calm and collected.
Clear and efficient communication.	Communicate thoughts out loud.Explain rationale for decisions.Closed-ended directions.
Using all available resources and assistance.	Consult nurse(s).Patient is a source of information.Consult other departments for expertise.
Taking the lead as the resident.	Assign roles and responsibilities to team.Create organized plan.Collaborative conflict resolution.
Positive mannerisms.	Pleasant attitude.Self-introduce to new staff.Addressing team members by name.

in the future as a result of the simulation. Many of their responses addressed the difficulty of the scenario, and the value of encountering these uncommon situations in practice.

Discussion

Using a mixed methods approach with validated instruments we demonstrated that through facilitated reflection, simulation can improve collaboration skills and confidence for even experienced senior hematology trainees.

This work expanded on the existing literature in several ways. Importantly, the cases were uniquely designed towards collaboration training for senior specialty residents. This was reflected in the complexity, context, and focus of the cases. For example, adding in complexities to collaboration (e.g., remote communication, difficult embedded participants), situating the case in an ambulatory clinic, and having the learner participate as a consultant, provided unique learning opportunities. Moreover, utilizing real world hematology nurses as embedded participants enhanced the fidelity and generalizability of the cases.

Unlike many other published simulation cases for collaboration, our findings were anchored in a robust assessment framework that included a validated scale. The evidence of learning in our qualitative analysis combined with high resident satisfaction with the simulation scenarios, supports further implementation of collaboration-focused simulation into hematology training programs. We also envision the cases being a valuable learning experience for general internal medicine residents who rotate through hematology, as well as postfellowship learners completing additional training in hematology and oncology. In addition, we believe that the general structure of the simulation activity (with adapted medical expert content) is highly applicable to other medical specialties.

Importantly, we were able to gain insight into limitations and areas for improvement. Based on feedback from trainees we will adjust future cases to maximize learning. This includes providing additional simulation opportunities within a longitudinal collaboration curricula (e.g., multiple simulation cases over the entire 2-year hematology residency program), and increasing the collaboration complexity of the cases to better reflect the confidence of trainees.

We also learned through reflecting on our experience in developing and implementing the simulation activity. For example, initially the cases were developed independently by hematology educators. However, this resulted in missed opportunities and implementation challenges. While these issues were ultimately rectified in consultation with the simulation team, case development could have been more efficient if collaboration had been earlier. For those looking to implement our cases, we advocate for including simulation experts during all development stages, setting appropriate objectives, and ensuring adequate time for structured evidence-based debriefing.

In addition, although we used a scenario with a computerized high-tech manikin, this was not identified as an essential component by both trainees and educators alike. While technology may enhance the learning environment, we feel confident that the cases can be implemented with success using alternative settings (e.g., in hospital training environment with a trained simulated patient). Conceptual and emotional realism might be higher if these scenarios could be run in the actual clinical environment (i.e., in situ simulation). A low-technology manikin could also be used instead, since the objectives of the simulation exercise focused on opportunities for collaboration.

Our simulation project had several limitations. We had small numbers of trainees and only two simulation cases from which to investigate collaborative learning. Generalizability should be used with caution as with any pilot project. Secondly, we were unable to assess learning and improvement in allied health clinicians. Future work should include a more comprehensive assessment of nursing or other discipline learning.

An additional potential limitation of our simulation cases was the need for multiple trained embedded participants which may be difficult to obtain and is also resource intensive. However, we found that many of the nurses and other multidisciplinary colleagues in our hospital were highly receptive to participating in the simulation and, as described above, provided increased fidelity to the cases. This had the added benefit of improving team building between trainees and health care practitioners on the ward.

Simulation is a promising mechanism for teaching collaboration skills in a hematology training program. As curriculum objectives

change across multiple medical specialties, and the need for interprofessional learning matures, simulation will likely play an important role for all clinician trainees.

Appendices

A. Case 1.docx

B. Case 2.docx

C. Simulation Images.docx

D. Pre and Postquestionnaire.doc

E. 3-Month Follow-up Survey.doc

All appendices are peer reviewed as integral parts of the Original Publication.

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Ethical Approval
The Toronto Academic Health Sciences Network Review Board approved this study.

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