Canadian Paramedic Program Use of Realistic Simulation in Education (PURSE): a descriptive study

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BACKGROUND

Literature suggests that simulation-based learning is an important modality in medical education. Although there is a large body of evidence in other medical fields, there has been little reported evidence of simulation use in paramedic education. This study aimed to report patterns of simulation use in paramedic programs across Canada.

METHODS

This was a cross-sectional survey of Primary Care and Advanced Care paramedic programs across Canada. An online questionnaire was distributed to all identified paramedic program coordinators in Canada.

RESULTS

Of the 44 invitations sent, 20 complete responses (45%) were received and analyzed. Paramedic programs reported they own or have access to a wide range of simulation resources. The majority of programs (85%) agreed that simulation directly impacted patient care but only 60% trained faculty on how to design and facilitate simulation. Only 3 programs (15%) reported using simulation as a supplement or to augment training, typically skill-based clinical hours. Standardized patients are underused in simulation. Typical barriers reported to simulation implementation were cost, time, and availability of resources

CONCLUSION

Simulation based learning has become an important aspect of multiple health care professions. As the paramedic profession continues to develop, it is important that initial paramedic education incorporates simulation effectively. Faculty education surrounding inexpensive and effective ways to incorporate simulation will likely increase use of simulation in paramedic programs. Future research should investigate how simulation in paramedic education impacts patient outcomes.

INTRODUCTION

Paramedics are routinely required to treat patients in austere environments with limited resources. These environments are constantly changing and can create significant challenges for the practicing paramedic. Often in these new environments, paramedics are required to perform critical and time sensitive interventions that have high potential benefit to patients.[1] However, due to the unpredictable nature of paramedic practice, these clinical encounters are typically low volume in nature. This becomes particularly relevant during paramedic student transition to clinical practice, such as during internship or preceptorship phases. To better prepare students for these low-volume, high-risk situations, paramedic education often prioritizes exposing paramedic students to these experiences during their initial education.[2] An effective method for providing an alternative to clinical exposure to these encounters is simulation.

Simulation in the context of health professional education, is a complex modality and not just a technology. It helps to expose participants to realistic patient care encounters with the intention of eliciting realistic responses.[3] This is accomplished through immersion of participants, by recreating or replicating aspects of the real world in a context that is both effective for the learner and safe for the patient.[3,4] This approach allows learners to repetitiously practice approaches to clinical encounters, while benefiting from instructor and peer feedback.[4,5]

As simulation use has increased in healthcare, numerous additional technologies have been developed specifically for this purpose. This transition to advanced technologies in healthcare has demonstrated consistent improvements in student knowledge, skills, and behaviours. Technology use in healthcare simulation has also been associated with positive improvements in patient outcomes, although these are smaller effects than in other areas measured.

An abundance of literature exists on the benefits of simulation use in the training, education, and maintenance of competency in medical and nursing education.[6] There is however little data investigating the use of simulation in paramedic education. A recent study by McKenna et al. (2015) examined the use of simulation in paramedic education in the United States.[7] This study demonstrated that although simulation is used widely throughout paramedic education in the U.S, there is significant variability in how, and how often it is used by individual programs.[7]

Paramedic education in the U.S. is very different compared to paramedic education in Canada. Although there are differences between provinces, in Canada, generally speaking, paramedics complete a minimum of one year of education, with the majority completing two years at an accredited college. This then entitles individuals to write various provincially administered exams, and once licenced or certified, to work for an ambulance service as a Primary Care Paramedic. Additional qualifications may be earned by completing additional education. Given the differences between paramedic education in the U.S. and in Canada, a gap exists in the literature regarding the use of simulation and simulation equipment in paramedic education in Canada.

OBJECTIVE AND RATIONALE

The purpose of this study was to examine physical inventory, and patterns of simulation used in paramedic education programs across Canada. By understanding the current status of simulation use in paramedic education, we can recommend targeted improvements to the educational process to improve the use of simulation in paramedic education, ultimately better preparing paramedics and benefiting patients. Our review of the literature highlighted that there are a large number of factors involved in simulation. We identified four key areas:

1. Inventory available, whether owned or shared
2. Inventory used, how often and for what purpose
3. Aspects of "fidelity" used in simulations
4. Barriers to simulation use and the replacement (if any) of clinical education with simulation

METHODS

Participants
This was a cross-sectional census survey of paramedic education programs in Canada. We generated a list of paramedic programs across the country, through provincial ministry websites, the Paramedic Association of Canada, and online searches of college and training institution websites. A list of program coordinator contacts was compiled for all identified programs. The final list comprised 44 paramedic programs across Canada. These programs represented individuals from Ontario, New Brunswick, Nova Scotia, Newfoundland, Quebec, Alberta, Manitoba, Saskatchewan, and British Columbia. This study received ethical approval from the Research Ethics Board at Fanshawe College (protocol no. 16-03-07-1).

Instrument
The survey instrument was developed after completion of a comprehensive literature review to investigate these four distinct areas of simulation. Each of the questions provided participants with the opportunity to provide additional discussion if desired. The questions were reviewed by a panel of paramedic educators to ensure questions elicited the desired information. Input from the authors of the US-based 'SUPER' study (McKenna et al. 2015) was also sought.[7] Questions were revised after discussion with the panel and reviewed again prior to distribution of the survey.

The survey consisted of a mix of 38 multiple-choice and open-ended questions that were divided into five sections: program demographics, simulation equipment inventory, simulation equipment use, fidelity in simulation, and perceptions of simulation use in education.

Simulation equipment was divided into the same categories as previous studies. Equipment was categorized as task trainers (e.g., IV arm; airway head); manikins-simple (e.g., CPR manikin); manikins-intermediate (e.g., with airway, IV, ECG); manikins-advanced (fully programmable); standardized/simulated live patients; computer-based (games, scenarios); and virtual reality (3D or complex computer-generated images) or haptic (create kinesthetic or tactile perception) simulation.[7]

All participants were asked if they incorporated different types of fidelity into their simulations. These 'types' of fidelity were referenced from the Paramedic Association of Canada's National Occupational Competency Profile [2], and are outlined as follows:

- Procedural fidelity – performing actual procedures such as IV initiation, injections, airway management;
- Physiological fidelity – changes in patient conditions including vital signs throughout the simulation;
- Interpersonal fidelity – interactions with partners, bystanders, family members, etc.;
- Environmental fidelity – placing the simulations in the actual environment or as close as they can using the constraints of the space available.

The survey was created on LimeSurvey, an open-source survey administration tool. It was distributed via email with a unique single-use token login to ensure only invited recipients were able to respond. The survey remained active for a three month period between March and June of 2016, with reminder emails sent to participants twice throughout this period. Participation was voluntary, and the participants were instructed that they could leave the survey at any time. It was made clear to participants that no program identifiable data would be disclosed at any stage.

Analysis
Anonymized data were exported from the LimeSurvey platform into SPSS 20 (IBM Corporation) for statistical analysis. Incomplete responses and respondents who declined to consent were excluded. The data were coded in preparation for analysis, and descriptive statistics were conducted.

RESULTS

At the end of the study period 20 responses from educators across Canada had been received. This represents a 45%

response rate. The majority of responses (n=15, 75%) came from Ontario based paramedic program coordinators. This result was expected due to the fact that Ontario has a significantly higher number of paramedic programs in comparison to other provinces in Canada.

The majority of respondents represented programs which were two years in length (n=14, 70%); responses were also received from programs that were shorter than two years (n=5, 25%) and longer than two years in duration (n=1, 5%). The majority of programs (n=15, 75%) had greater than 30 students enrolled in their programs during each class.

The majority of programs within Canada are taught at the Primary Care Paramedic level and this represented the majority of respondents (n=18, 90%). Responses were also received from Advanced Care and Critical Care program coordinators, in both land and air ambulance services (n=9, 45%). Some program coordinators are responsible for both PCP and ACP level courses, therefore the total number of programs represented exceeds the number of individual survey responses.

Simulation resources
The majority of program coordinators indicated that their programs owned, or had access to, task specific trainers (n=18, 90%). These include items such as intubation and airway manikins as well as IV arms and simulated trainers for any specific tasks. The majority of programs owned, or had access to, simple manikins (n=17, 85%) and intermediate manikins (n=18, 90%), which allow for procedures such as IV access and airway manoeuvres to be performed. A total of 16 programs (80%) owned, or had access to, fully programmable, or what are typically defined as "high fidelity" adult manikins.

Nine (45%) programs had access to standardized adult patients in their education curriculum, while five (24%) had access to computer based simulation, and four (20%) had access to virtual reality simulation. One program indicated it owned no simulation equipment, but had access. Over 70% of programs had spaces designated for

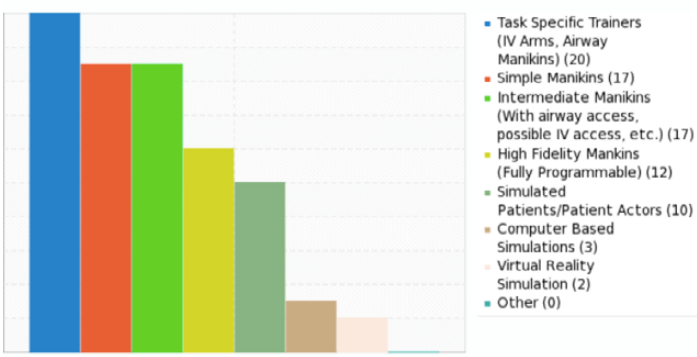

Figure 1: Access to simulation resources

simulation and simulation based learning.

Consistently, respondents reported greater access to simulation equipment and trainers that was modelled after adult patients compared to other patient populations. The higher the complexity of the simulation equipment the less likely the programs were to have it. Sixteen (84%) programs had access to basic neonatal manikins while only seven (35%) had access to advanced programmable neonatal manikins. No programs had access to neonatal simulated patients. Programs reported higher access to paediatric advanced manikins (n=9, 45%) but reported similar use of standardized patients with only two (10%) having access to standardized paediatric patients. Only three programs (15%) had access to older adult specific manikins or advanced programmable manikins, and only two programs (10%) reported using standardized older adult patients.

Simulation Use
During skills training, task specific trainers were consistently used (n=19, 95%). Intermediate manikins and advanced programmable manikins were also used regularly (n=16, 80%; n=12, 60% respectively). Nine of the programs (45%) reported frequent use of standardized patients. Only one program (5%) reported consistent use of virtual reality simulation.

Programs did report less use of task trainers (n=15, 75% vs n=19, 95%) and more use of simulated patients (n=11, 55% vs n=9, 45%) for assessment purposes. No programs reported using virtual reality simulations for student progression and only one program reported using computer based simulations. The majority (n=14, 70%) of programs used a non-mobile simulated ambulance space regularly for student training. Less programs (n=10, 50%) regularly used a simulated ambulance which allowed students to drive.

Seventeen (85%) of the programs reported having components of the curriculum as mandatory, and many of the programs reported that every skill and laboratory component had a simulation aspect. Only three programs (n=3, 15%) used simulation as a direct replacement for clinical experience. These programs replaced airway management, certain practical skills, and IV management clinical experience with simulation.

Programs reported similar equipment use for examinations used to progress students to the next semester or semester equivalent, including graduation and preceptorship.

Simulation Fidelity
Fourteen (70%) of the programs provided students with the opportunity to participate in high-fidelity simulation.

One program reported moving away from high-fidelity exercises due to cost outweighing benefit. Physiological and procedural were the main types of fidelity incorporated into simulation exercises (n=18, 90%). Environmental fidelity was the least frequently incorporated (n=14, 70%).

Perceptions
Seventeen respondents (85%) agreed or strongly agreed that simulation is an important aspect of paramedic education. Sixteen (80%) agreed or strongly agreed that simulation experience has a direct impact on patient outcomes. Ten (50%) believed that they were using the right amount of simulation in their programs.

Nine (45%) believed that they could incorporate more simulation into their programs. All agreed or strongly agreed that simulation was an effect method of assessment for determining progression in their programs. Twelve (60%) reported specific training for the faculty in simulation design and execution. Ten (50%) reported that their faculty had received training in how to use programmable advanced manikins.

DISCUSSION

These results indicate that paramedic programs across Canada have access to, or own, a large variety of equipment for simulation. The respondents reported utilizing the equipment in a wide variety of ways.

Task trainers were much more frequently used (95%) than intermediate (80%), advanced programmable manikins (60%), or simulated patients (45%). Programs were much less likely to have dedicated advanced manikins for neonatal, pediatric, or older adult populations. This is consistent with the findings of McKenna et al. (2015) in US paramedic programs.[7] Although task trainers are important learning tools for clinical skills, and were identified as the most commonly used simulation equipment by respondents, they represent the lowest aspect of the fidelity spectrum, and their use should ideally be limited to initial procedural skill learning. The use of task trainers can be effective in learning the stepwise conduct of a procedure; however, even when used for this limited purpose, not all task trainers are equal, and some provide a better student experience than others.

Many of the programs used simulation, but simulation equipment use tended to focus around assessment. Testing in a high fidelity environment is an effective way to model if students are ready to progress to clinical and field experiential learning placements. However, this use should not overshadow the use of simulation throughout the educational process. Simulation-based education has been demonstrated across a variety of health professions education as an effective tool to improve patient-outcomes and clinician skill.[8,9] If this tool is only used for evaluation or assessment, then the benefit of simulation is potentially missed. It is vital that the use of simulation as an evaluation tool shifts to the use of simulation as an educational tool.

Among the barriers to simulation implementation, a commonly identified theme was the lack of educational resources for educators to assist them in facilitating simulation based education. One respondent specifically mentioned that they were unable to get dedicated faculty with specific training on programmable manikins. Additional barriers identified included: a lack of physical space, a lack of time to perform simulations, and cost. These findings again echo findings of McKenna et al. (2015), which surveyed paramedic education programs in the United States, as well as Jeffries (2008) which investigated nursing education programs.[7,10]

Most of these barriers to simulation are based on a technology-centred view of simulation. In general, health care education programs seem to focus on the technology aspect of simulation while ignoring the importance of instructor preparation. Hamstra et al. (2014) suggest that advancing technology should be used as an adjunct to simulation rooted in transfer of learning, learner engagement, and suspension of disbelief.[11] Many of these goals can be accomplished without the use of expensive technology and equipment. Focusing on non-technology based simulation will allow for simulation to be further integrated into paramedic curriculum, while maintaining the same benefits.

An area where most programs seemed to struggle was with environmental fidelity and placing simulations in environments that were similar to actual environments in which patient care takes place.

Many of the programs reported very little use of standardized patients in their education compared to the use of manikins. Standardized patients are important for the development of communication skills in students. Ryoo et al. (2013) demonstrated that communication skills were increased with simulated patient use over high fidelity manikins.[12] Simulated patient interaction is also shown to decrease anxiety in nursing students when entering into clinical environments [13]. Many paramedic patient interactions involve minimal patient care skills interventions, or procedures, but involve a large communication component. By incorporating simulation with standardized patients training can focus on the important communication skills. These interactions can also ease student anxiety helping better prepare them for a transition to "real-life" patients in a clinical setting. The use of simulated patients can however be costly and was a reported barrier to their use in paramedic programs.

LIMITATIONS

The subjects of this study were entirely Canadian paramedic program coordinators, with the mjaority based in the province of Ontario. As there are significant differences between Canadian paramedic education programs and international paramedic education programs, these results may not be generalizable to paramedic training programs in other nations. Additionally there are significant differences in program length, program goals, and resource availability within individual provinces, and between provinces across Canada. Our study only received responses from only 45% of paramedic programs in the country.

Although the survey completion email was sent to the program coordinator of each paramedic program, there is no way to ensure that only program coordinators completed the survey. It is possible that how faculty use simulation equipment is not always communicated to the program coordinator. We did not investigate the use of simulation by base-hospitals or other licensing bodies.

CONCLUSIONS

The majority of Canadian paramedic education programs use simulation throughout the program. The area that most programs seemed to struggle was with environmental fidelity and placing simulations in environments that are similar to where paramedics practice is essential in developing competent graduates.

Even though simulation equipment is often available, many program coordinators feel that significant barriers exist to their ideal use of simulation. Future research should consider further examination of these barriers. Some of these barriers could potentially be addressed with education packages which may help educators to prepare simulation resources before the class that are cost effective, timely, and meet educational objectives.

Future research should also consider investigating simulation use during continuing education, both by certifying bodies and by paramedic services.

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