Impact of acute care physician's age on crisis management performance and learning after simulation-based education

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Abstract

Background: The proportion of ageing acute care physicians (ACP) (critical care, emergency, anesthesia) in North-America has been steadily increasing. Ageing influences some physicians' clinical abilities and patient care. ACP are required to excel in crisis resource management (CRM) and function at a high cognitive level in a rapid paced environment. CRM is an essential skill that can be learned through high-fidelity simulation. However, there is a knowledge gap on the effect of age on CRM skills and simulation learning.

Objective: This study aims to 1) investigate the impact of ACP ageing on CRM skills and 2) assess whether ageing influences CRM learning from high-fidelity simulation. We hypothesize that (i) in ACP, baseline CRM performance will decline with increasing age and that (ii) age will negatively impact CRM learning after simulation-based education.

Methods: This will be a prospective multi-center trial. Seventy participants will individually manage a simulated crisis (pre-test) to assess the baseline effect of age on CRM skills. After an instructor-led debriefing, another simulated crisis (immediate post-test) and a third simulated crisis (retention post-test) three months later. All scenarios will be video-recorded and rated by blinded raters using validated tools. Regression analysis will be performed to determine the effect of ACP's age on baseline performance and learning.

Significance: This study will be the first prospective trial to delineate the effect of ageing on CRM performance and learning in a simulated setting. The results will help shape national policy regarding practice assessment and help tailor continuing medical education.

Background

Physician demographics

The proportion of older acute care physicians (ACP) has been steadily increasing.[1] Within Canada, approximately 32% - 39% of anesthesiologists are over the age of 55. A recent survey of members of the American Society of Anesthesiologists in 2013 revealed that a greater percentage of members are older (>55) in 2013 compared to 2007. These numbers are similar for emergency and critical care physicians where the proportion of the workforce over 55 is also 33-40%.[2] This shift in the demographics may be explained by various factors. It can partially be attributed to the recent economic crisis leading to delayed retirement. Also, in the early 1990s, there was a reduction of residency positions, likely explaining the smaller population of middle aged ACP and hence, increasing demand for the older population to meet the needs of the healthcare system.[3,4] Recent studies have also reported an overall shortage of healthcare providers of all ages with conditions varying by region. This is another reason for a greater number of older ACP currently working, as it calls upon delayed retirement of the older physicians to meet the demands of the healthcare system secondary to this shortage.[5-7]

Consequences of Ageing

Acute care specialties such as critical care, emergency medicine and anesthesia, require for its providers to both excel at technical and non-technical skills and function at a high cognitive level in a fast paced environment that requires quick decision-making and problem solving. Ageing in itself is associated with physiological changes, which in turn can influence a physician's clinical abilities and decision-making. Stress impacts the ageing physician to a greater extent with potential consequences on performance, and the prevalence of stress, illness, fatigue, and dementia increases as one ages.[3,8-11] Manual dexterity can also be affected with the onset of arthritis and alterations in visual acuity.[3,12] Siu et al. looked at anesthesiologists' performance on a simulated airway emergency requiring cricothyroidotomy and found that operator age and years from residency were associated with decreased proficiency.[5] Similarly, the time required for processing information is prolonged and decision-making can be compromised in physicians as they age.[8,10,11,14]

Research investigating how such ageing-related physiological changes affect clinical performance and patient safety is lacking.[12,15] It has been postulated that ageing physicians compensate through experience and pattern recognition of crises they have managed during their practice.[13,14] However, Duclos et al. found that older surgeons had an increased rate of patient complications after thyroid surgery.[16] The litigation data, over 10 years, of Anesthesiologists in British Columbia, Ontario, and Quebec, show that those older than 65 have 1.5 times the risk of being found responsible for litigation compared with those aged less than 51 and the settlement were generally larger.[14,15] Disciplinary incidents involving physicians are likely to occur later in practice, increasing with each 10-year interval since first getting their license.[14,15,17] Moreover, the degree of injury identified in the claims of older physicians was of greater severity.[14]

Crisis resource management and the ageing physician

Crisis Resource Management (CRM) skills are essential clinical skills within acute care specialties, and are vital for patient safety. In addition to technical skills (e.g. defibrillation, drug preparation, intubation), a rapid and organized approach to non-technical, cognitive skills such as decision-making, task management, situational awareness and team management are needed for successful CRM. High-fidelity full body mannequin simulation-based education is effective for learning CRM, including transfer of skills from the simulated setting to the clinical setting and improving patient outcome.[4,18] However, there is a gap in the literature on whether physicians' age influences baseline CRM performance and also learning from simulation-based education.

Simulation and the ageing physician

Although the effectiveness of high-fidelity simulation-based education has been studied extensively in junior learner populations (students, residents, fellows), there are a limited number of studies investigating its effectiveness in teaching CRM in the ageing physician population.[19] In fact, a recent systematic review looking at the role of simulation in continuing medical education in ACP supported that there is limited evidence supporting improved learning.[20] However, it is being recommended as a training, regulation and assessment tool for practicing physicians.[12,21]

Simulation fidelity adds to its effectiveness. Increasing fidelity relies on three components: physical (actual OR environment), functional (how actions and consequences match the real-world) and psychological (how engaged the learners are with the simulation).[22] The first two components can be manipulated by the simulation provider and equipment but the psychological component is highly dependent on the learner. Ageing physicians likely did not train with mannequin-based simulation compared to their younger counterparts and might have a preconceived bias against such technology. In fact, a survey on the barriers of simulation based education found that staff, compared to trainees, had less experience with simulators, found it less relevant for their current training, and perceived more barriers.[23] Hence, older physicians might not be fully committed to, or believe in the practice of mannequin-based simulation, thus reducing fidelity and its effectiveness.

Objectives and hypotheses:

The goals of this study are to:

1) Investigate whether ageing has an effect on baseline CRM skills of ACPs, (emergency, critical care, anesthesia) using simulated crisis scenarios and
2) Assess whether ageing influences learning from high fidelity simulation.

We hypothesize that:

1) ACP baseline simulated CRM performance will decline with increasing age,

2) Although all ACP performance will improve at the immediate post-test, increasing age will be negatively impact the retention of CRM skills 3 months following a high-fidelity simulation-based education session.

Methods

Study Design

This study is a prospective cohort multicenter study. Ethical approval will be sought from the Ottawa Health Science Network Research Ethics Board & Sunnybrook Research Ethics Board (Toronto, Canada). Written informed consent and a confidentiality agreement will be obtained from all participants. ACP from the academic affiliated sites of both universities will be recruited, with data collection being conducted locally in each city.

Recruitment and orientation

Practicing emergency, critical care and anesthesia staff with a minimum 5 years of practice post residency will be approached for participation.

The participants will take part in three 8-minute simulated crisis scenarios based on current Advance Cardiac Life Support (ACLS) guidelines for pulseless electrical activity (PEA) arrests. The scenarios will serve as pre, immediate post and retention tests. These scenarios will be identical for pediatric anesthesiologists, however the "patient" in the scenario will be of 15 years of age, rather than an adult. Although all three scenarios will ultimately result in PEA arrests, each will have a unique inciting event and these will be randomly assigned. Participants will be unaware as to which scenarios they will be asked to manage. All scenarios will be recorded. Confederates will serve as the patient's nurse and respiratory technician to be directed by the participant, but they will not provide tips or guidance in terms of how to manage the crisis.

A standardized structured orientation session will be held for all participants. During this session, the principles of simulation-based education will be discussed and the participants will be exposed to the simulation room, all equipment and simulators. Since participants will likely have various types of previous simulation experience, each participant will be familiarized with the simulator by participating in an introductory non-crisis scenario that will not require crisis resource management skills. The scenario will be an induction of general anesthesia using a rapid sequence induction (a common technique for the three acute care specialties in this study). Participants will also complete two questionnaires collecting demographic data (Appendix A), quantifying previous simulation and crisis management experience, and a life expectancy questionnaire online to calculate their "health age". The online questionnaire consists of questions that evaluate physiological and lifestyle factors contributing to one's "health age" and will calculate a person's "health age" based on responses. The participant will record their health age on the demographic questionnaire (Appendix A).

Scenarios

Each participant will then manage a PEA arrest scenario (pre-test) and then be debriefed on their CRM skills by a trained facilitator for 20 minutes. They will then manage another crisis scenario (PEA arrest once again, but with a different inciting event) as an immediate post-test. Three months after completing the instructional session, participants will return to manage a third PEA arrest scenario, which will serve as a retention post-test in additional to completing a retention questionnaire (Appendix D). The retention post-test can be completed up to 6 months following the initial pre-test. All three scenarios will be designed with the same clinical scenario that is common to all ACPs but the physical simulation environment will be set-up according to their specific specialty (i.e. ICU, OR, and ER) so that they are familiar with their unique layouts. All debrief sessions will be recorded as a quality control measure to ensure that all debriefs are conducted in a consistent manner.

Simulation Scenario Development

The core concepts pertaining to CRM skills and subsequent management of PEA arrest will be consolidated by the principal investigators and then sent out to three faculty acute care physicians (one from each specialty involved) from Universities not involved in the recruitment, who are trained ACLS instructors, for review and revisions. Once core concepts are agreed upon, the three simulation scenarios will be developed. Each scenario will then be piloted before recruitment.

Outcome measures:

As our primary outcome, we will assess the relationship of age with:

A) CRM skills, as measured by (Appendices B & C):

a. Ottawa GRS scale total score (non-technical CRM skills)[24]
b. official ACLS checklist for PEA (technical CRM skills)[25]

B) Learning* from high-fidelity simulation based education, as measured by change in performance (Appendices B & C):

1) official ACLS checklist for PEA[25],
2) Ottawa Global Rating Scale for CRM[24]

** Learning defined as improvement in performance in the simulation based crisis scenarios.*

Two raters blinded to the study hypotheses and the scenarios order (pre vs immediate post vs retention post-test), will evaluate the videos using the above validated tools.

Statistical Analysis and Sample Size Calculation

To test the first hypothesis, a multivariate regression analysis will be performed, with age as a predictor and outcomes A (listed above) as the dependent variables. To test the second hypothesis, a second multivariate regression analysis will be performed with age, pre-test score, post-test scores and their interactions (age x pre-test score, age x

intervention, age x pre-test score x intervention, and pre-test score x intervention) as predictors, and outcomes B on the retention test (listed above) as the dependent variables.

To adequately power our study, we will need at least 10 participants per predictor variable entered into the analysis. In order to collect a meaningful sample, we will aim to recruit 10 participants per 10 year age group (<45, 45-54, 55-64, 65+), equaling 40 ACP. To account for attrition, we will aim to recruit 70 participants total across both sites.

Timeline

This study will run for 2 years:

Ethics Submission:	Months 1-3
Content Development & Pilot Scenarios:	Months 3-4
Data Collection:	Months 5-15
Statistical Analysis:	Months 16-17
Manuscript & Dissemination of results:	Months 18-24

Dissemination Strategy

Upon completion of this study, the results will be presented to educators and clinicians in the local Departments of Anesthesia, Critical Care and Emergency Medicine for further discussion in addition to providing an opportunity for other educators to explore the creation of a continuing education curriculum within their practice groups. Initially, this will be done at a local level during medical rounds presentations and seminars at the Universities of Toronto and Ottawa. We will submit our study for publication in peer reviewed medical education journals to reach a broader audience. If possible, we will publish the manuscript as open access to increase its citations. Applications to regional and international conference presentations will also by entered. Finally, we will approach provincial and federal regulation bodies such as the Royal College of Physicians and Surgeons of Canada to 1) open discussion for further studies building on our results and 2) develop strategies for continuing education.

Implications

This study will be the first prospective trial to delineate the effect of ageing on CRM performance and learning in a simulated clinical setting. As such, the results will help shape not only national policy regarding practice assessment, and help develop continuing education for ageing physicians. The results can also serve as foundation for research in specialties other than acute care. Similarly, in the very least, whether ageing influences CRM skills or not, this study can serve as a template for investigation in non-acute care specialties as well.

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Appendices

Appendix A – Demographic Questionnaire

Appendix B – Ottawa Global Rating Scale

Appendix C – ACLS (PEA) Checklist

Appendix A: Demographic Questionnaire

Age:

Sex:

1. **Number of years practicing your specialty (Anesthesia, Critical Care, Emergency Medicine) since residency**

   0 – 10 11 – 20 21 – 30 31 – 40 41 – 50 >50

2. **Are you, or have you ever been an ACLS Instructor?**

   Yes No

3. **What percentage of time have you managed ACLS crises in your practice?**

   0 – 10 % 11 – 20% 21 – 30% 31 – 40% 41 – 50% >50%

4. **A) How many times have you experienced Full Body Mannequin Simulation (# of Scenarios):**

   0 – 5 6 – 10 11 – 15 16 – 20 >20

   B) Please indicate the type of scenarios managed (check all that apply):

   ACLS Procedural Rare Cases (ie MH) Crisis Resource Management

Please go to www.projectbiglife.ca. to complete the Life Expectancy Questionnaire.

Write the reported Health Age below:

Health Age:

Appendix B - Ottawa Global Rating Scale Evaluation Tool

OVERALL PERFORMANCE

1	2	3	4	5	6	7
Novice; all CM skills require significant improvement		Advanced novice; many CM skills require moderate improvement		Competent; most CM skills require minor improvement		Clearly superior; few, if any CM skills that only require minor improvement

I. LEADERSHIP SKILLS

1	2	3	4	5	6	7
Loses calm and control for most of crisis; unable to make firm decisions; cannot maintain global perspective		Loses calm/control frequently during crisis; delays in making firm decisions (or with cueing); rarely maintains global perspective		Stays calm and in control for most of crisis; makes firm decisions with little delay; usually maintains global perspective		Remains cal m and in control for entire crisis; makes prompt and firm decisions without delay; always maintains global perspective

II. PROBLEM SOLVING SKILLS

1	2	3	4	5	6	7
Cannot implement ABC's assessment without direct cues; uses sequential management despite cues; fails to consider any alternative in crisis		Incomplete or slow ABC assessment; mostly uses sequential management approach unless cued; gives little consideration to alternatives		Satisfactory ABC assessment; without cues; mostly uses concurrent management approach with only minimal cueing; considers some alternatives in crisis		Thorough yet quick ABC without cues; always uses concurrent management approach; considers most likely alternatives in crisis

III. SITUATIONAL AWARENESS SKILLS

1	2	3	4	5	6	7
Becomes fixated easily despite repeated cues; fails to re-assess and re-evaluate situation despite repeated cues; fails to anticipate likely events		Avoids fixation error only with cueing; rarely reassesses and re-evaluates situation without cues; rarely anticipates likely events		Usually avoids fixation error with minimal cueing; reassesses re-evaluates situation frequently with minimal cues; usually anticipates likely events		Avoids any fixation error without cues; constantly reassesses and re-evaluates situation without cues; constantly anticipates likely events

IV. RESOURCE UTILIZATION SKILLS

1	2	3	4	5	6	7
Unable to use resources & staff effectively; does not prioritize tasks or ask for help when required despite cues		Able to use resources with minimal effectiveness; only prioritizes tasks or asks for help when required with cues		Able to use resources with moderate effectiveness; able to prioritize tasks and/or ask for help with minimal cues		Clearly able to utilize resources to maximal effectiveness; sets clear task priority and asks for help early with no cues

V. COMMUNICATION SKILLS

1	2	3	4	5	6	7
Does not communicate with staff; does not acknowledge staff communication, never uses directed verbal/non-verbal communication		Communicates occasionally with staff, but unclear and vague; occasionally listens to but rarely interacts with staff; rarely uses directed verbal/ non-verbal communication		Communicates with staff clearly and concisely most of time; listens to staff feedback; usually uses directed verbal/ non-verbal communication		Communicates clearly and concisely at all times, encourages input and listens to staff feedback; consistently uses directed verbal/ non-verbal communication

Appendix C – ACLS (PEA) Checklist

PEA		
Correct actions		
Assessed rhythm, pulse, and stability	Yes	Subj
Started/continued CPR by 5 cycles (30:2)	Yes	Obj
Stated PEA as dx	No	Obj
Pulse and rhythm check <10 sec	No	Obj
Resumed CPR by 5 cycles	Yes	Obj
Gave epinephrine 1 mg IV	Yes	Obj
Gave atropine 1 mg IV if hear rate (HR) <60 beats per min	No	Obj
Considered H's and T's	Yes	Subj
Possible incorrect actions		
Gave atropine if HR >60 beats per min	No	Obj
Gave amiodarone in this pathway	No	Obj
Gave lidocaine in this pathway	No	Obj
Administered shock(s) in this pathway	Yes	Obj
Gave the wrong dose of a drug indicated in this pathway (ie, atropine 2 mg IV)	No	Obj
Gave adenosine, β-blockers, or CCBs in this pathway	No	Obj
Gave other wrong drug for this pathway	No	Obj

	Critical	**Obj/Sub**
Assessment of CPR (every 5 cycles)		
Correct actions		
Place backboard under patient	Yes	Obj
30:2 ratio	Yes	Obj
Rate of 100–120 compressions per min verified or corrected if improper	Yes	Subj
Compression depth of 1.5–2 in verified or corrected if improper	Yes	Subj
Hand placement: midline, lower half of sternum verified or corrected if improper	Yes	Subj
Possible incorrect actions		
CPR not started within 60 sec of recognizing pulseless state	No	Obj
CPR not started within 180 sec of recognizing pulseless state	Yes	Obj
CPR delayed for >10 sec at pulse and rhythm check	No	Obj

Appendix D – Retention Questionnaire

1. **Since the initial SIM session, have you had to manage an ACLS crisis?**

   Yes No

2. **If yes, how many ACLS crises have you managed since the initial SIM session?**

   N/A 0 – 3 4-9 10-20 >20

3. **Since the initial SIM session, have you received ACLS certification/recertification training?**

   Yes No

4. **If 'No', will you undergo ACLS certification/recertification training soon?**

   N/A Yes No

5. **I enjoyed the SIM experience**

   Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree

6. **SIM is useful for teaching and learning**

   Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree

7. **SIM is useful for assessment and evaluation**

   Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree

8. **I want increased access to SIM**

   Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree