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REFLECTIONS

Retention of cardiopulmonary resuscitation skills in medical students utilizing a high-fidelity patient simulator

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Objective: *To evaluate the difference in retention of cardiopulmonary resuscitation (CPR) skills between first and second year medical students in accordance with American Heart Association (AHA) recommended basic life support (BLS) guidelines from 2005.*

Introduction: *Cardiopulmonary resuscitation has a narrow window of opportunity. It must be started early and followed by defibrillation in a timely manner for maximal benefit. Many studies have demonstrated that health care providers trained in CPR lose their skills quickly. However, little research has been done to evaluate the retention of CPR skills in pre-clinical medical students prior to beginning their clinical training.*

Methods: *22 first-year and 19 second-year medical students were voluntarily enrolled in the prospective cohort study. Participants were queried regarding BLS training, familiarity with the computerized mannequin simulator (SimMan®), and CPR experience. Each participant was then introduced to SimMan® and a standardized cardiac arrest scenario was read to them. Data was collected manually behind a two-way mirror. Participants were scored on their compliance with BLS criteria.*

Results: *Overall, key steps in CPR were omitted by many participants. One out of five subjects began CPR without first checking for a response, two out of three subjects did not request a defibrillator, and an average of 35.9 (0.0, 100.7) seconds elapsed before CPR was initiated. The average compression rate per minute in first-year medical students (MS1s) (22 subjects) was 63.6 (37.2, 90.1) compared to 52.5 (13.4, 91.6) in second-year students (MS2s) (19 subjects) with a BLS recommendation of 100 (*P *=.04). There were 84.2% of MS1s and 68.2% of MS2s that completed an average compressions to two breaths ratio of* $\geq$*27 with BLS recommendation of 30 compressions for every two breaths (*P *=.04).*

Conclusion: *Despite their training and proximity to a health care environment, medical students quickly forget important CPR rates and maneuvers. This deterioration of skills occurs regardless of training latency, a potential problem as they enter the patient care environment. Simulation provides a more real-life scenario in which to both train and evaluate medical student CPR skills.*

Keywords: *CPR; simulation; medical education; medical students; skills retention.*

INTRODUCTION

Cardiopulmonary resuscitation (CPR) is an important link in the chain of survival for the 300,000 people who suffer cardiac arrests annually in the United States.[1] Cardiopulmonary resuscitation has a narrow window of opportunity. It must be started early and followed by defibrillation in a timely manner. With inadequate or delayed CPR, the entire chain of survival is weakened and positive outcomes deteriorate rapidly.[2] However, when performed as recommended by the American Heart Association (AHA) and delivered quickly, CPR can double – even triple – a victim's chance of survival.[3]

Many studies have demonstrated that health care providers, such as registered nurses, trained in CPR have nearly a 50% degradation of their skills and knowledge within 3 months of training.[4,5] However, little research has been done to evaluate the retention of CPR skills in pre-clinical medical students. Prior to entering the hospital wards during their clinical phase of training, it is important to ensure every medical student possesses the skills needed to perform CPR successfully within a real-world environment – often more chaotic and unpredictable than the training environment. Although every medical student at our institution must complete the basic life support (BLS) for Health Care Providers (CPR and AED) course set forth by the AHA, this may not correlate well with resuscitation performance in the hospital setting.

The aim of this study was to evaluate the retention of CPR skills between first and second-year medical students and to identify specific strengths and weaknesses of student performance.

METHODS

Study design

Prospective cohort study.

Population and setting

First and second-year medical students at a large, state medical school in a university setting.

Human subjects committee review

IRB approval was obtained for participants to enroll in this study with a gift card incentive.

Experimental protocol

Twenty-two first-year and 19 second-year medical students at our institution were voluntarily enrolled in this study. Information was gathered prior to simulation by questionnaires regarding if and when the participants were trained in BLS, had previous exposure to SimMan® (a high-fidelity simulator), performed CPR on SimMan®, or performed CPR in a real-life scenario. After completion of the questionnaire, participants were introduced to SimMan®. The simulator's most relevant functions to our study, including a rising chest with inspiration, carotid and radial pulses, and the ability to communicate verbally were demonstrated to every study subject. A simulated cardiac arrest scenario involving a patient suddenly losing responsiveness in a hospital setting was presented to subjects. Twice, subjects were explicitly told to call out for anything they might need that was not provided in their immediate surroundings. Subjects were observed behind a two-way mirror using multiple cameras positioned around the simulation room.

Measurements

Data were collected regarding each subject's compliance with AHA recommended BLS guidelines from 2005. Subjects were qualitatively scored on whether they attempted to elicit a response from SimMan®, checked for pulse and signs of breathing, requested a defibrillator, performed an airway patency maneuver, and gave two rescue breaths. A participant's time to first compression, compression rate, and average compressions to two breaths ratio were also quantitatively recorded. Study coordinators and data collectors were not blinded to subjects' year in medical school.

Statistics

Intragroup comparisons of qualitative parameters for various measures were performed using the Yates corrected chi-square test for two-by-two contingency tables. Use of the Fisher exact test (two-tailed) was necessary when a null-hypothesis expected value was below five occurrences. Continuous quantitative parameters were compared between groups using a two-tailed *t*-test. *P*-values equal to or below .05 were considered significant. All statistical analyses were performed using Microsoft Excel® software.

Table 1. MS1 and MS2 background information.

Survey question	MS1 ($n = 22$)	MS2 ($n = 19$)
(A) AHA BLS certification	20 (90.0%)	19 (100%)
(B) OHSU-sponsored certification	19 (86.4%)	17 (89.5%)
(C) Certification <12 months prior	15 (68.2%)	7 (36.8%)
(D) Previous experience with SimMan®	5 (22.7%)	12 (63.2%)
(E) Performed CPR on SimMan®	2 (9.1%)	3 (15.8%)
(F) Performed CPR on real individual	2 (9.1%)	4 (21.1%)

RESULTS

The characteristics and survey results of the 41 study participants are outlined in Table 1. Previous CPR experience on SimMan® and previous real-life experience did not correlate with statistical differences among performance scores.

Nearly every subject checked for a pulse and breath before initiation of CPR. One out of five subjects began CPR without first checking for a response; two out of three subjects did not request a defibrillator; and an average of 35.9 (0.0, 100.7) seconds elapsed before CPR was initiated (Table 2).

The average compression rate per minute in first-year medical students (MS1s) (22 subjects) was 63.6 (37.2, 90.1) compared to 52.5 (13.4, 91.6) in second-year students (MS2s) (19 subjects) with a BLS recommendation of 100 ($P = .04$). MS1s (84.2%) and MS2s (68.2%) completed average compressions to two breaths ratio of ≥ 27 with a BLS recommendation of 30 compressions for every two breaths ($P = .04$) (Table 2).

There were 94.1% of the subjects who had previous experience with SimMan® (17 subjects) and 54.2% of those who did not (24 subjects) successfully performed an airway patency (head-tilt and chin-lift) maneuver ($P = .02$). Also, 29.4% of those with experience and 66.7% of those without completed an average compressions to two breaths ratio of ≥ 27 ($P = .04$) (Table 3).

DISCUSSION

Skill atrophy is a well-documented phenomenon among health care practitioners of all levels of expertise.[6] Therefore, it comes as no surprise that second-year medical students with a greater time interval since BLS training exhibit greater skill atrophy.

Although the observed differences between first and second-year medical students in this study may be confounded by prior simulation experience, the fact remains that despite training, medical students are unprepared for resuscitation emergencies.

Table 2. Difference in skill retention between MS1s and MS2s.

Procedure	MS1 ($N = 22$)	MS2 ($N = 19$)	P value
Checked for response	77.3%	84.2%	>.50
Requested defibrillator	27.3%	47.4%	>.25
Airway patency maneuver	59.1%	84.2%	.16
Checked for breathing	90.9%	94.7%	>.50
Checked for pulse	95.5%	100.0%	>.50
Average time in seconds to first compression (min, max)	29.1 (0.0, 89.6)	43.7 (0.0, 111.4)	.16
Average compressions per minute (min, max)	63.6 (37.2, 90.1)	52.5 (13.4, 91.6)	.04
Average compressions to two breaths ration ≥27	84.2%	68.2%	.04

Table 3. Difference in skill retention with and without SimMan® experience.

Procedure	Experience ($N = 17$)	No experience ($N = 24$)	P value
Checked for response	94.1%	70.8%	.11
Requested defibrillator	52.9%	25.0%	.13
Airway patency maneuver	94.1%	54.2%	.02
Checked for breathing	100%	87.5%	>.25
Checked for pulse	100%	95.8%	.50
Average time in seconds to first compression (min, max)	47.5 (0.0, 144.8)	27.6 (0.0, 86.6)	.06
Average compressions per minute (min, max)	59.5 (27.6, 91.5)	57.7 (21.1, 94.3)	>.50
Average compressions to two breaths ration ≥27	29.4%	66.7%	.04

Most importantly, both first and second-year medical students failed in some of the most critical aspects of CPR. Use of an AED is the number one predictor of survival,[7,8] but less than one in three students requested one. Cardiopulmonary resuscitation is necessary but not sufficient to save a life; it merely sustains a patient until an AED can be obtained. Additionally, approximately one in five students began CPR without first assessing the patient, potentially increasing the risk of improper compression maneuvers and reducing the benefit of CPR.

Inadequately adhering to AHA guidelines illustrates several key factors. First, recall of BLS protocol may be difficult under stress, as demonstrated by poor CPR performance in both groups. Second, it may be difficult for inexperienced practitioners, such as medical students, to translate proper protocol into actual clinical performance.

The results in this study may not be applicable to all other medical schools due to several reasons. Medical students at our institution interact with patients (take history and perform basic physical exam) starting in the second week of medical school. At the time of this study, the first and second-year medical students have had more than 6 or 18 months of practical clinical experience, respectively. Additionally, they are also observed examining standardized patients in multiple clinical scenarios three times per year as part of their evaluation. Finally, the average age of matriculation at this institution is 27 and may differ significantly from other medical schools. Thus, the interpretation and application of our study results should be made with these possible differences in mind.

LIMITATIONS

The small number of subjects enrolled in our study limits some of the conclusions that can be drawn from our results. Of note, since all study subjects volunteered to participate, there is potential for a selection bias toward students most comfortable with their CPR skills. Thus, our results may have underestimated BLS skill atrophy in medical students in general. The majority of each medical school class cohort were trained within a two week interval; however, a small percentage of students were certified previously (see Table 1). This inconsistency limits the comparisons that can be made between classes. Finally, the authors who assessed the study subjects were all first-year medical students at the time of this study and, therefore, could not be blinded to the study subjects' class level making observer bias inevitable.

To minimize such limitations, future studies should involve larger sample sizes, blinded observers, and control for pre-test confidence levels with pre-enrollment questionnaires. An alternative solution may be to evaluate BLS skills of the same group of medical students

at regular intervals with students serving as their own controls.

CONCLUSIONS

Despite their training and proximity to a health care environment, medical students quickly forget important CPR rates and maneuvers, a potential problem as they enter their clinical rotations. It is our belief that timely and recurrent incorporation of simulation training into medical education may bridge the gap between what is taught in the classroom and what is needed in emergent clinical situations.

We recommend that a BLS certification or recertification course be offered every year in medical school, followed by simulated scenarios within 6 months. We feel strongly that all students must be proficient at this life-prolonging skill upon graduation.

There is much research yet to be done in CPR performance and skill retention among medical students. Simulation offers itself as a model to assess student knowledge and ability, though it requires a significant investment of both time and resources. Recent research has shown video-based self instruction to improve CPR skill retention with less investment a potentially advantageous alternative within a demanding medical school curriculum.[9] Future study possibilities remain endless as more medical schools and residency programs begin to utilize simulation.

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Pregnant patient presenting with syncope and a medulloblastoma: a case report

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Medulloblastoma is a primary cerebellar tumor seen most commonly in the pediatric population. In adults, it represents about 1% of cancer found in the central nervous system. In adult medulloblastoma, only one third of cases occur in women and even less in pregnant women. This case describes a 34-year-old pregnant woman who presented to the emergency department with the syncope, which was found to be secondary to a medulloblastoma.

Keywords: *Adult medulloblastoma; pregnant; syncope.*

INTRODUCTION

Despite the low incidence of cases of adult medulloblastoma, less than 33% of adult cases occur in women. On a hematoxylin and eosin (H&E) stain, medullulobastoma appears as a small blue cell tumor. It usually arises in the midline of the cerebellum in children, but tends to be lateral in adults. Symptoms include nausea, vomiting, loss of coordination, morning headache, seizures, personality changes, and unexplained weight loss or weight gain. Patients who undergo radiation therapy with adjuvant chemotherapy have a 5-year survival rate of about 58–84%.[4]

Medulloblastoma is a cerebellar granule cell tumor, the most common type of cell in the cerebellum, and its robust proliferative capacity is thought to be regulated by the Sonic Hedgehog (SHH) pathway.[5,6] However, data suggests that cerebellar granule cells may be responsive to estrogen receptor stimulation. As such, pharmacologic blockade of estrogen receptors in cell cultures and xenograph models of medulloblastoma have been shown to inhibit the migration and growth of medulloblastoma.[7] These data suggest that the high levels of estrogen observed during pregnancy may be a contributing factor for this tumor in pregnancy.[7]

CASE PRESENTATION

The patient is a previously healthy 34-year-old woman G4 P3013 who presented to the Brooklyn Hospital Center Emergency Department with the chief concern of head trauma following a fall 3 days prior to presentation. Along with her syncopal episode she had dizziness, mild head trauma, and approximately 2 minutes of loss of consciousness. Since the time of the syncopal episode and the fall, she experienced posterior headaches with worsening nausea and vomiting. She denied any fever, chills, abdominal pain, numbness and tingling, and vaginal bleeding. All labs were unremarkable. The patient was then admitted and an MRI and CT scan were ordered (Figures 1–4). The radiologist's impression of the imaging studies included a differential diagnosis of astrocytoma, due to the age of the patient and the associated symptoms. Also noted was a downward tonsillar herniation into the foramen magnum, which suggested an aggressive primary neoplasm. The result of CT scans also suggested astrocytoma based on its location, since it was compressing the fourth ventricle anteriorly and laterally. Also, the radiographic scans revealed some hydrocephalus and edema consistent with obstructive hydrocephalus from the herniation of the tonsils into the foramen magnum. T2 MRI also confirmed a mass in the cerebellum (Figures 3, 4). This patient was then sent to surgery for resection of the mass in the cerebellum.

At the time of surgery, the surgeon's gross impression of the mass was meningioma, since the tumor did not have the typical consistency of medulloblastoma and was firm and circumscribed. Pathology was consulted for frozen section where the diagnosis was initially deferred (Figures 5 and 6). After histological evaluation and review, the slides of the lesion were sent for neuropathology consultation at Memorial Sloan-Kettering Cancer Center where a diagnosis of medulloblastoma consistent with desmoplastic type was rendered.

Postsurgically, the patient experienced complications with persistent hydrocephalus and intense headaches that were treated with the insertion of a ventriculoperitoneal shunt. The patient decided to terminate the pregnancy in her second trimester. Upon receiving her diagnosis and aborting the fetus, the patient received an oncology consult recommending radiation therapy; however, she discharged herself from the hospital against medical advice.

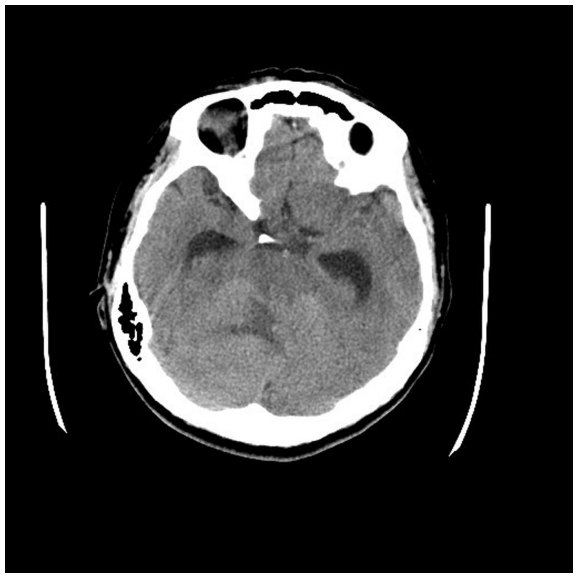

Figure 1. Axial CT scan of the head with contrast showing disruption in the cerebellum. This image is highly indicative of tissue disruption in the cerebellum.

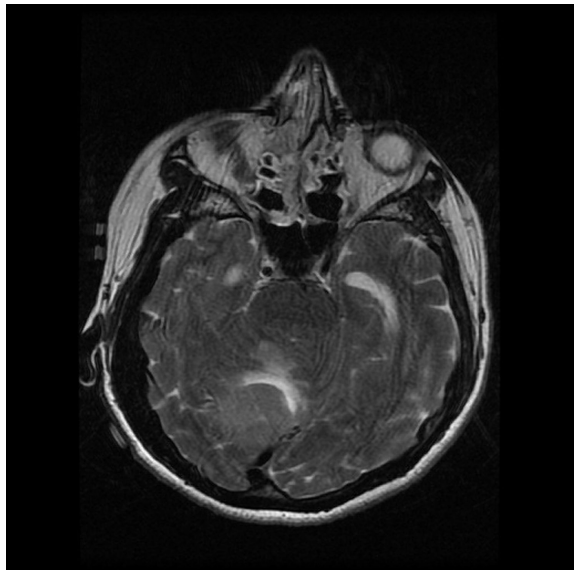

Figure 3. Axial T2MRI with contrast – another image with contrast highlighting the tumor in the posterior brain field. Here, the tumor appears to have a more nodular feature and is more circumscribed.

Figure 2. Axial T1 MRI without contrast showing a mass in the cerebellum. One can see the tumor growing and compressing normal brain tissue in the posterior. The tumor is slightly lighter in color on this film.

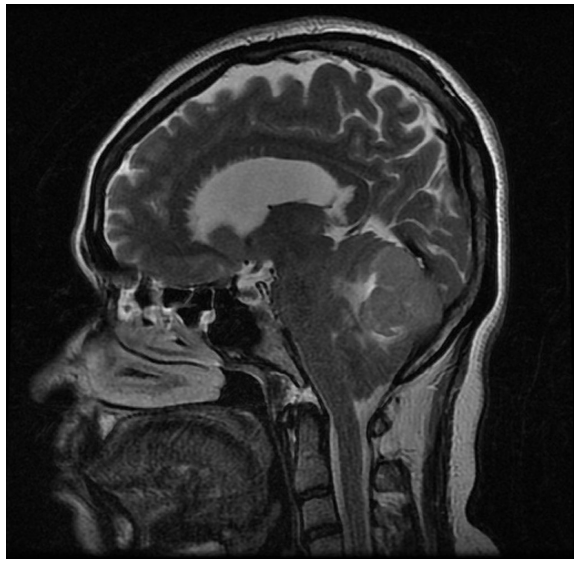

Figure 4. Saggital T2 MRI – the tumor here is growing toward the back and causing herniation into the foramen magnum, which is causing an obstruction of flow of the cerebro-spinal fluid.

CONCLUSION

Considering the presentation of this case and the chief complaint it is easy to see how medulloblastoma could be masked by the symptoms of pregnancy.[8] Some differential diagnoses for syncope during pregnancy include anxiety, atrial fibrillation, hyponatremia, hypoglycemia, pulmonary embolism, orthostatic hypotension, or cardiomyopathy.[9] The complaint of the posterior headaches could be attributed to the trauma sustained from the fall. In addition, the radiological report and gross features of the tumor suggested other types of tumors, particularly astrocytoma and meningioma. Meningiomas may become enlarged during

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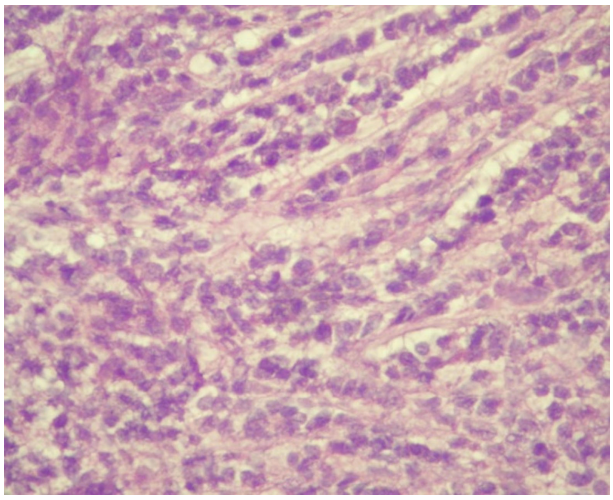

Figure 5. Pathological report: histologically, a small round blue cell tumor composed of sheets of undifferentiated cells with minimal cytoplasm, hyperchromatic, and anaplastic nuclei; frequent mitotic figures; careful examination reveals fibrillar nature of tumor cells; occasional Homer-Wright rosettes. Immunohistochemistry is positive for synaptophysin and expression of neurofilament proteins. Glial fibrillary acidic protein (GFAP) and MIB-1/Ki-67 show high proliferation (Courtesy of Dr. Elmawawi).

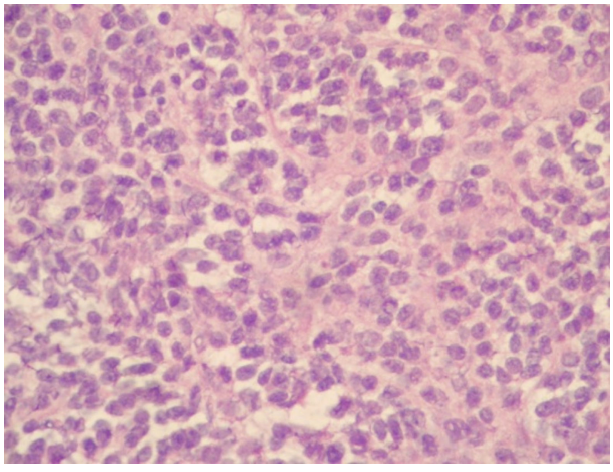

Figure 6. Histological section of excised tumor.

pregnancy, and based on the gross features of the tumor at surgery that included its firmness; this lesion gave the impression of meningioma.[10] In this case, the firmness was due to desmoplasia. In conclusion, this is a rare case of medulloblastoma with desmoplastic and nodular features presenting in a 34-year-old pregnant female.

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10 Minutes with Paul Hebert, Editor-in-chief of the *Canadian Medical Association Journal*

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Background: *Most medical students, at some point in their career, aspire to publish a research paper of enough significance to join the pages of the major international medical journals. At the helm of these journals are physicians renowned for their academic and research acumen; in Canada, one of these physicians is Dr. Paul Hebert. We sat down with Dr. Hebert to talk about submission tips, becoming a journal editor, and how he got the job.*

This feature is part of Editors in Medicine, an ongoing series within student medical journals. Other interviews will be published periodically in various student journals internationally.

HOW DID YOU GET INTO EDITING?

I guess my skill set for the job is largely because I was a senior researcher. There was a significant shortage of trained editors in this country and they had to find someone who wasn't of that category. My background is that of a critical care physician and clinical researcher, and I've basically become the editor of the *CMAJ* by default, I guess. It sounded like a great thing at the time.

WHERE DO YOU SEE THE *CMAJ* GOING?

Well, we've just written an editorial on that very issue and there are substantial challenges for all journals right now. The financial challenges are quite real, most print mass media have huge challenges because of diminishing advertising budgets, which is our lifeblood and funding. Our greatest threat is the financial one. My view is that most major medical journals will be primarily electronic in the future. Your generation is really looking to better electronic means of reading. So the question becomes, will we have a print journal at all? Will our journals be electronic only? I think we'll have a bridging period, but I think that's where we'll be in 10 or 15 years.

AND IN TERMS OF THE TONE AND THE CONTENT OF THE *CMAJ*, WHERE DO YOU SEE THAT GOING?

I think ideally what we want to do is to become far more international in our scope. Our goal is to disseminate 'medical knowledge that matters' – that's our tagline and we believe it – to the broadest possible audience, ideally to: physicians, decision-makers, policy-makers, and to a general audience. We've democratised health information and knowledge in many ways, and my view is that it's a good thing. I see us communicating to an ever wider circle of readers including the general public.

HOW CAN WE IMPROVE INTERNATIONAL REPRESENTATION IN PUBLISHING?

There are a lot of possible answers to that question. One, there's no question that the leading medical journals publish primarily research of their own interest and in their own sphere. I think a lot more of it was based on pharmaceutical drug studies than possibly needed, that's largely because that's where the money comes from. Our revenue models do influence what we publish, whether we say it or not, in terms of broad agendas. I'm not saying we publish a study because it's funded by a drug company or not. I'm saying research of interest to the global health issues – we publish studies that are of far more relevance to our local audience. Frankly we all do it, with the possible exception of the *Lancet*. So when we compare the burden of disease globally to what we publish, there is usually a substantial disconnect. How to fix it? Well, acknowledge that it exists, first and foremost, actively seek to fix the problem, and start to solicit from other countries. But cost is a major driver right now.

WHERE ARE THE GAPS IN TRAINING EDITORS RIGHT NOW?

Well, the North American model for [recruiting] senior editors and editors-in-chief is typically distinguished scientists or distinguished academics going into the role of the editor. That's true at *NEJM*, it's true at *JAMA*, it's not true currently at *Annals* [*of Internal Medicine*],

but it's true for me as well. So the reason for that in part is because that's what brings prestige to the journal. The downside of course is that the editor may or may not have the required training to actually assume the role when he or she starts. The British model is quite different; the editors are trained editors and they usually take on their roles after a long and distinguished career of editing. So that's the usual approach – they're full-time trained editors. Both have their advantages and disadvantages. For me, I'm far more at ease than most in the peer review process and in understanding how to fix and do research because I know how to do it; most of [the other editors] know how to report research. So it's a skill set that's far different, which is fine. But I have major deficiencies because of what I am. Pretty much anything to do with editing, I'm at a disadvantage with respect to others. The way that we make up for it is that we hire the best trained editors we can find ... and I get trained vicariously through them.

WHAT ADVICE DO YOU HAVE FOR STUDENTS INTERESTED IN MEDICAL EDITING?

It's like anything else – it's a skill you have to learn! Get involved in major medical journals, network with editors, take advantage of workshops. Medical editing is a small community. Working at a student journal is also a great way to get exposure.

Editors Comment: Since the composition of this article, Paul Hebert has announced that he will be stepping down from his position as Editor-in-chief of the CMAJ in December 2011.

PET PEEVES – WHAT IS ONE THING ABOUT A SUBMISSION THAT DRIVES YOU CRAZY?

I don't know if there's one – I think there's about 50!

OK, MAYBE YOUR TOP THREE.

I don't know if there's anything that drives me crazy. What struck me when I became an editor – I was rather appalled by the quality of writing and the disconnect between what we publish and what we get initially. I was shocked by the degree of change that's required. You know, before I became an editor, I didn't know the difference between this and that. In part because our [research] group spent a fair bit of time getting stuff right before we submit. But I was shocked at how others don't. And that surprised me. I thought we were unique, and then I went to several other journals, and I realized we weren't. I just find it interesting or illuminating, I don't know if it's a pet peeve or not. I guess the one thing more than anything is how arrogant some people are. When you provide feedback for the betterment of their work and they just whine about it continuously.

THREE WORDS TO DESCRIBE YOURSELF?

Most people would say I'm quite energetic, relatively creative, and a reasonably good problem-solver.

ANY REASON FOR THOSE WORDS?

Those are kind of things other people say about me, I guess.