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COMMENTARY
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Collaboratively leveraging our potential

Andrew West, EdD(c), RRT, FCSRT

It has been my experience that respiratory therapists, as evidence-informed practitioners, tend to seek out high-quality information sources to guide what we do. As we all know, there are an immense number of venues from which we can seek out information today. Perhaps paradoxically, it is becoming increasingly challenging to navigate the overwhelming magnitude of information sources available to us. One might therefore be forgiven for assuming that staying up to date in the knowledge of our craft should be an easy task. What many of us discover, however, is that it is often unclear where and how to find such information.

In the first instance, the ability to discern “quality” sources requires a certain degree of information literacy skill, and it is reported by many of us, at times, to be overwhelming [1]. Furthermore, we are often faced with questions regarding whether the vast amount of information we adopt from those disciplines with which our practice intersects is enough. Is knowledge developed by respiratory therapists for respiratory therapists necessary to enhance and advance our practice? Focusing on this debate from a practical perspective, I would suggest that the difficulty in applying information sources that focus on respiratory therapy is one of supply rather than of demand. As a profession we need to be cognisant of both of these unique and interrelated obstacles to evidence-informed practice and to be diligent in mobilizing our efforts to address each.

Our world is moving fast, and sustained advancement of knowledge is often described as being fundamental to ongoing social progress [2]. The knowledge society in which we now live often requires us to change course in our day-to-day lives and in our professional practice. As a collective—a community of practitioners—this new reality requires us to both reflect on our progress and to push ourselves to innovate and renew. In doing so we need to find ways of translating what we do and know into something more meaningful—those “things” that can perpetuate our profession in service to our patients and to society. In response, I see the Canadian Journal of Respiratory Therapy as more than an information source—it is an important way through which we inform our evolving practice, which is embedded within this new knowledge society. As the new Editor-in-Chief, I have reflected on how my role and that of the Editorial Board is to facilitate one important way of addressing these information-related challenges. In particular, I feel we are tasked with supporting the way in which practitioners can overcome some of the everyday challenges related to accessing and sharing respiratory therapy-specific knowledge.

While the journal plays a crucial role in connecting practitioners and the community to the information they need, collectively, we each need to be more than just consumers of knowledge—we are now also charged with being the builders of knowledge. Knowledge building comprises not only developing and maintaining important competencies, but also coming to see ourselves as contributors to society’s efforts to advance knowledge [3]. At its core, a knowledge-building society is predicated on the idea that knowledge is a social product, created by members of a community, and that it adds some type of value to that community [3]. To move forward in collaboratively building knowledge as respiratory therapists we require a platform for exchange of ideas and a culture that sparks ideas, collaboration, and innovation.

I envision the future of the Canadian Journal of Respiratory Therapy as one of a continuing role in providing a platform from which respiratory therapists can be knowledge builders. The journal can be one place for respiratory therapists to exchange “information,” engage in critical discourse, and debate, spark ideas, innovate, and co-create the ideas that will support our informed practice. Ultimately, the journal can be a venue for fostering a culture of knowledge sharing that drives our practice forward and helps us to leverage the enormous capacity that exists with our profession.

As I embark on this journey with you I would like to take the opportunity to acknowledge the journal’s Editorial Board, under whose sagacious tutelage I have become acquainted with the editorial world. As the journal moves forward, its momentum is a direct result of the countless hours of hard work and the wise leadership of the board, both past and present. A special thank you to Dr. Jason Nickerson, whose dedication energizes A special thank you to Dr. Jason Nickerson, whose dedication energizes and whose expertise pushes its boundaries. He has provided exemplary leadership in his previous role of Editor-in-Chief.

I am both honored and thrilled to have this opportunity to contribute to our profession as part of the Canadian Journal of Respiratory Therapy. I look forward to our ongoing efforts to leverage our community’s tremendous capacity and advance of our profession.

REFERENCES

TRANSFORMING CLINICAL RESEARCH INTO EVERYDAY PRACTICE: ARE RESPIRATORY CARE PRACTITIONERS PROACTIVE OR REACTIVE?

Kenneth Brake, RRT

In 1949 Davies and Mackinnon examined the neurological effects of carbon dioxide (CO₂) in the presence of heart and lung disease [1]. They hypothesized that hyper-oxygenation could lead to CO₂ retention in individuals with chronic obstructive pulmonary disease (COPD). In their published findings they described “hypoxic drive” and cautioned physicians on using oxygen with COPD patients. Their work captured the attention of the medical community and other investigators [2]. Many in the medical community continued to fear oxygen administration in the presence of COPD, despite ongoing investigation in the field of oxygen therapy in the 1960s and 1970s. Those investigations include the exceptional work of Dr. Tom Petty, considered the father of home oxygen therapy [3]. Thinking began to change slowly following a significant finding by Aubier et al [4, 5] who were investigating oxygen administration in COPD with a new hypothesis; they were looking for a different mechanism as the cause of elevated CO₂ levels in the blood. They found that mechanism in the form of “hypoxic pulmonary vasoconstriction” which, like hypoxic drive, is a protective mechanism [5].

In 1988 Neff [6] explored the use of pulse oximetry in clinical practice. Neff suggested that oxygen saturation, via pulse oximetry, be considered the fifth vital sign that clinicians monitor and record routinely. At the time, as a new practitioner, I tried to integrate my knowledge of respiratory physiology, pathophysiology, arterial blood gases (ABGs), hypoxic drive, and hypoxic pulmonary vasoconstriction with the use of multicoloured oxygen venturi devices that I carried in my pocket. I would have greatly appreciated understanding how oxygen delivery devices (i.e., the open oxygen mask) used together with bedside oximetry could have facilitated prompt, safe, and effective oxygen therapy. Unfortunately, there was poor knowledge of Neff’s work in the general clinical setting, and though many clinicians had access to pulse oximetry, we had little appreciation for its value. Had I recognized that value, I could have been a pioneer in clinical practice, rather than discouraging the use of pulse oximetry simply because it was new, foreign, and suspect. Respiratory therapists practiced with the belief that ABGs were the gold standard in monitoring oxygen therapy.

In 1995, the American Thoracic Society (ATS) published its consensus guidelines for the diagnosis and treatment of COPD [7]. In that document the society addressed oxygen administration and arterial oxygen saturation. Decades of research and peer-reviewed clinical evidence were required before a consensus paper could be drafted by such a prestigious body. The ATS advised clinicians not to withhold oxygen for fear of hypoxic drive; the potential harm associated with not effectively treating hypoxemia was far greater than the risk posed by hypoxic drive. Current best practice in the management of acute exacerbations of chronic obstructive pulmonary disease (AECOPD) supports the use of pulse oximetry to achieve safe and effective oxygen saturation, in the range of 88%–92% [8]. Available evidence supports that conservative use of oxygen therapy, guided by oximetry, is associated with less respiratory acidosis and better patient outcomes [8]. It is not, however, a safeguard to protect the hypoxic drive mechanism.

Some readers are probably asking, “why use old COPD issues to demonstrate delays in practice implementation?” There are far more exciting and frequently contested issues in critical respiratory care such as lung protection strategies in mechanical ventilation. Yet the case of AECOPD provides decades of observation and evidence. AECOPD is the leading cause of emergency room visits in Canada and is a leading cause of death globally [9]. After decades of evidence and practice it appears that the accurate diagnosis and management of COPD is often a topic of little interest and poor engagement for most respiratory therapists and other primary care providers.

Today, the rate of healthcare innovation exceeds the rate of implementation [10]. That brings us to another growing field of study and publication, evidence-based research on the implementation of evidence-based science. Claude Lenfant was the longest serving director of the U.S. National Heart, Lung, and Blood Institute, ending his 21-year term in 2003. Lenfant published a compelling article in the New England Journal of Medicine, “Clinical Research to Clinical Practice – Lost in Translation?” [11]. He identified that it may take up to 15 years for proven interventions to make their way into general, not complete, clinical practice. In fact, Lenfant noted that some important interventions never make their way into practice. Evidence suggests that the gap between investigation and implementation is growing and that extensive obstacles to progress exist such as budget restraint, multiple decision makers, knowledge translation, layers of bureaucracy, and heavy workloads to name a few [11, 12].

If as a profession we fail to adopt new practices that are safer, faster, easier, and cheaper we may have a problem in our practice areas. Apathy is perhaps the most dangerous obstacle to change in the practice setting. Failure to keep pace with evidence-informed practice and best practices might even be considered neglect. Practicing in the past is more dangerous today than ever. We must use our clinical experience to guide practice and drive innovation. There is a great need to promote communication and build connections between clinical research, educational institutions, the healthcare industry, and clinical practice. If it takes on average 15 years for evidence to make its way into practice, have we yet to implement evidence available from as far back as 2001? As a concrete example, are we consistently following best practice guidelines for the diagnosis and management of AECOPD? If not, what have we missed?

I have always guided my practice on the principle of patient- and family-focused care, as well as my personal quest for service excellence. That commitment to quality dictates that I stay current in my practice while engaging others in the practice setting. There are countless opportunities for clinicians in quality improvement. There also exists a role for bedside practitioners in closing the gap between clinical research and clinical practice. Some practice settings struggle with implementing changes in practice. If this sounds like you, I invite you to ask your community of practice this question: “Are we practicing in this century or the last?”

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REFERENCES


Debunking myths in pulmonary function testing

Jeffrey M Haynes, RRT, RPFT, FAARC

INTRODUCTION
The goal of evidence-based medicine is to move away from practices based on theory and replace them with practices based on robust scientific evidence. Unfortunately, many clinicians performing and interpreting pulmonary function tests dogmatically adhere to ideas based on theory despite evidence to the contrary. This paper will highlight examples of myths dressed up as science in the realm of pulmonary function testing. The goal of this paper is not just to inform but to also stimulate healthy debate and introspection about what we believe to be true and how these beliefs impact our practice and patient care.

MYTHS IN PULMONARY FUNCTION TESTING
Caffeine should be withheld prior to pulmonary function testing
As a member of the methylxanthine family, caffeine has been thought to possess bronchodilator properties. Because of this, the 1999 American Thoracic Society (ATS) guideline for methacholine and exercise testing recommended that caffeine-containing products be withheld on the day of testing [1]. While the 2005 ATS/European Respiratory Society guidelines for pulmonary function testing do not prohibit caffeine prior to testing [2], many laboratories continue to prohibit caffeine use prior to testing. It has been my experience that many patients are unhappy that they must withhold their morning coffee or tea prior to testing. Yurach et al [3] assessed the effect of caffeinated coffee on patients undergoing spirometry, methacholine challenge, and exhaled nitric oxide testing. The investigators found that a 16-ounce cup of coffee (~330 mg caffeine) had no effect on FEV1, methacholine responsiveness, or mean exhaled nitric oxide (Table 1). Precluding patients from ingesting usual amounts of caffeine prior to pulmonary function testing is unwarranted.

Patients are usually the cause of poor quality data
Numerous studies have documented a high prevalence of poor-quality spirometry testing in both the pulmonary function laboratory and office settings [4, 5]. This has occurred at a time when spirometer accuracy and reliability appears to be much better than in the past [6]. It is therefore not surprising that most technologists can be expected to blame poor patient effort and cooperation for poor test quality [7]. However, the literature clearly indicates that most patients, even children [8] and the elderly [9], are capable of producing high-quality pulmonary function data. The key to higher quality pulmonary function data is technologist performance monitoring and feedback [7]. In the Lung Health Study, Enright et al [10] documented a reduction in spirometry test quality after initial technologist training, which improved with retraining, but could only be sustained with a program of ongoing technologist performance monitoring. Berg et al [4] evaluated the effect of technologist monitoring and feedback in two clinical pulmonary function laboratories. Prior to the intervention, lab #1 and lab #2 had poor test acceptability and reproducibility rates, 61% and 59%, respectively. Lab #1 implemented a technologist performance monitoring and feedback program and lab #2 did not. In response to the intervention, lab #1’s test quality rates rose to 92% while the quality of lab #2 remained poor at 65% (Figure 1). The unfortunate truth is that it is the technologist, and not the patient, who is usually the cause of poor quality testing. Pulmonary function laboratories should include technologist training and performance monitoring in their quality assurance programs.

Only high-quality spirometry tests are meaningful
As stated above, high-quality test results should be the goal of every pulmonary function laboratory. However, there are always going to be some patients, albeit a minority, that will not be able to produce high-quality spirometry. When spirometry quality is not perfect, many technologists reject sub-optimal tests to avoid reporting spurious data. While the practice of discarding less-than-perfect spirometry data is well intentioned, it may frequently discard clinically useful data. Using an A-B-C-D-F scoring strategy, Hankinson et al [11] found that only quality scores of D or F affected test interpretation. While we must always strive for maximum quality, technologists and physicians should exercise caution when discarding data.

Technologists must scream at patients to obtain quality spirometry results
A typical lesson in spirometry testing includes stressing the importance of using a loud voice, to the point of yelling or screaming test instructions, to obtain maximum effort and quality data. This practice has no basis in science and in most situations is completely unnecessary. Yelling or screaming spirometry instructions can be frightening to children, annoying to teens, and less audible to those with hearing deficits. Demonstrating the maneuver to the patient prior to testing and using suggestive body language during testing is more effective than yelling or screaming instructions at the patient. Studies should be conducted to investigate the best way to communicate pulmonary function test instructions to patients.

TABLE 1
The effect of caffeinated coffee on pulmonary function

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pre-coffee</th>
<th>Post-coffee*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1 (L)</td>
<td>3.31 (0.75)</td>
<td>3.36 (0.74)*</td>
</tr>
<tr>
<td>PC20 (mg/mL)</td>
<td>1.38†</td>
<td>1.35†</td>
</tr>
<tr>
<td>FEF25–75 (ppb)</td>
<td>31.2 (19.6)</td>
<td>31.5 (20.4)</td>
</tr>
</tbody>
</table>

Note: Data are expressed as mean with standard deviation. FEV1 = forced expiratory volume in the first second; PC20 = provocative concentration of methacholine causing a 20% decline in FEV1; FEF25–75 = fraction of expired nitric oxide; ppb, parts per billion. Table produced with data from Yurach et al [3].

*Measured after decaffeinated coffee.
Gender. As previously mentioned, after age 70 years, an FEF25% less than 50% of predicted and still be above the 5th percentile [13]. Quanjer et al [13] examined the impact of FEF25–75% on test interpretation, they found the incidence of FEF25–75% falling below the lower limit of normal as an isolated finding (i.e., normal FVC, FEV1, and FEV1/FVC) was only 2.75%. FEF25–75% adds virtually nothing to the information provided by FVC, FEV1, and FEV1/FVC.

DLCO/VA can normalize an abnormal DLCO

For many clinicians, the interpretation of diffusing capacity (DLCO) is based on both DLCO and the DLCO to alveolar volume ratio (DLCO/VA). While it is undeniable that DLCO and lung volume are directly related, this relationship is both complicated and difficult to predict [14, 15]. A common mistake is to declare an abnormal DLCO normal if the DLCO/VA is within the normal range. This implies that the DLCO is low due exclusively to a lack of lung volume, not alveolar–capillary pathology. A recently published study by Pastre et al [16] shows that DLCO/VA can often be within the normal range even in patients with significant parenchymal lung disease. Therefore, DLCO/VA is not a reliable parameter for inverse modeling (i.e., predicting structure from function) [17].

80% of predicted is a reliable lower limit of normal

The interpretation of pulmonary function data requires knowledge of expected values in subjects without respiratory disease. To this end, reference or “predicted” equations are generated. The mean or median value for a pulmonary function value is referred to as the “predicted value.” If the measured value is identical to the predicted value, the measured value is declared “100% of predicted.” If the data are normally distributed, the predicted value will be found at the center of a symmetrical bell curve. In other words, there are an equal number of normal values above and below the predicted value. A longstanding and fundamentally flawed technique to define the lower limit of normal (LLN) of pulmonary function values is to multiply the predicted value by 0.80. The so-called “80% of predicted” rule declares any value below 80% as abnormal and vice versa. In 1979, Sobol and Sobol [18] commented that “nowhere else in medicine is such a naïve view taken of the limit of normal.” The “80% rule” is statistically invalid for a number of reasons. Firstly, the normal ranges for different pulmonary function values are not identical. In addition, the normal variance around any value is affected by age, race, and gender [19]. As previously mentioned, after age 70 years, an FEF25–75% value less than 50% of predicted can still be normal [13]. Quanjer et al [20] found that using the “80% of predicted” rule and 0.70 as the LLN for FEV1/FVC misclassified >20% of patients. Wesolowski et al [21] documented that 14% of surgical lung cancer patients had pulmonary function values which were both <80% of predicted and above the LLN. This difference proved to be clinically important because having lung function below the LLN was a better predictor for perioperative complications than lung function <80% predicted but also ≥ LLN. Pulmonary function data should not be interpreted using 80% of predicted as the LLN (Figure 2, [22]).

A positive methacholine challenge confirms asthma

Methacholine challenge tests (MCT) are performed to test for the presence or absence of airway hyper-responsiveness (AHR) [23]. AHR is clearly a feature of asthma; however, AHR is not exclusive to asthma. For example, Leone et al [24] found that 46% of patients with non-allergic rhinitis with eosinophilia syndrome demonstrated asthma. AHR is also a feature of COPD [25], sarcoidosis [26], and allergic rhinitis [27]. In addition, some subjects with no signs or symptoms of asthma demonstrate AHR to methacholine (asymptomatic AHR) [28, 29]. In patients with an intermediate pre-test probability of asthma, AHR in response to MCT may significantly increase the post-test probability of asthma. When the post-test probability of asthma is higher than the pre-test probability of asthma, a working diagnosis can be made. However, it is prudent to document an improvement in symptoms and lung function in response to therapy before making a working diagnosis of asthma official.

A negative methacholine challenge excludes asthma

As mentioned above, MCTs are performed to test for the presence or absence of AHR [23]. A lack of demonstrable AHR in response to MCT may significantly decrease the post-test probability of asthma; however, the sensitivity of MCT is not 100%. Indeed, Anderson et al [30] found that 45% of children with a positive exercise challenge had a negative methacholine challenge. In a study of elite athletes, the sensitivity of MCT to identify a positive response to eucapnic voluntary hyperventilation was only 36% [31]. The failure of MCT to identify asthma with
perfect sensitivity is multi-factorial including both physiologic and technological considerations.

From a physiologic standpoint, phenotypic differences among asthmatics may affect the response to MCT [32]. In addition, the response to methacholine may be affected by seasonal variations in AHR. For example, Sposato et al [33] found a greater prevalence of AHR to methacholine in the spring and fall than during the summer months. Fruchter and Yigla [34] also found a higher incidence of AHR to methacholine in winter and spring when compared to summer. It is probably not uncommon for a patient to experience respiratory symptoms during the height of spring pollen season but not have their MCT scheduled until months later, after their allergen exposure has waned.

There are also technologic and methodological factors that can affect the results of a MCT. Methacholine dose, nebulizer type, inhalation method (e.g., dosimeter versus tidal breathing), and the threshold for a "positive test" can all affect MCT interpretation [1].

The impact of the bronchodilatory and bronchoprotective effect of deep inhalation on MCT has received a lot of attention. Cockcroft and Davis [35] have shown that using the full inhalation dosimeter method can significantly reduce the response to MCT and may result in false negative tests in patients with mild AHR.

In addition, relying solely on FEV1 as a MCT outcome measure may reduce MCT sensitivity for AHR. An example of a patient with respiratory symptoms, markedly reduced specific conductance (sGaw), yet little to no change in FEV1 during MCT is shown in Figure 3 [36]. Khalid et al [37] evaluated sGaw and FEV1 in 138 patients undergoing a MCT. The researchers found that a 51–52% reduction in sGaw was a more appropriate cutoff point for a positive MCT than the 45% reduction recommended by the ATS [1]. A remarkable finding was that 32 patients with an FEV1 decline <20% had a reduction in sGaw >50% (Figure 4).

In a similar study, Parker and McCool [38] measured FEV1 and sGaw following MCT in 248 consecutive patients with asthma-like symptoms. Forty patients showed a response to methacholine as assessed by sGaw (≥40% reduction) without a significant decline in FEV1 (<20%). A negative MCT reduces the post-test probability of asthma; however, clinicians should be mindful that a negative MCT cannot rule out asthma with 100% certainty.

A negative exercise challenge test excludes exercise-induced bronchospasm

Exercise challenge tests are commonly performed to identify or exclude exercise-induced bronchospasm as the source of exercise limitation and symptomatology [1, 39]. An obvious limitation of exercise challenge tests is that they are not performed under the same circumstances as those from where the patient’s symptoms originate. This is perhaps no more true than patients involved in cold-weather athletics. Rundell et al [40] performed field exercise challenge testing in elite cold-weather athletes; 78% of athletes with a positive field exercise challenge test had a negative exercise challenge test in a clinical laboratory. Differences between field and laboratory testing may be due to differences in exercise pattern and intensity as well as environmental factors such as ambient humidity and air quality. Anderson et al [41] performed two exercise challenge tests within four days in 373 subjects with asthma-like symptoms associated with exercise. While most subjects had either two positive or two negative tests, 23.9% of subjects had conflicting results (i.e., one positive, one negative). Exercise intensity could not explain the differences in test outcome. For these reasons, a single negative exercise challenge test cannot by itself exclude the possibility of exercise-induced bronchoconstriction.

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Normal spirometry excludes emphysema

An irreversible obstructive spirometry test in a patient with COPD risk factors defines the disease [42]. However, over the past several years it has become known that COPD has many phenotypes [43]. Some of these phenotypes refute the paradigm that normal spirometry precludes
COPD pathology. For example, the COPDGene investigators found that 24% of current or former smokers with normal spirometry and a GOLD 0 classification had computed tomography evidence of emphysema [43]. Another poorly appreciated syndrome associated with cigarette smoking is combined pulmonary fibrosis emphysema (CPFE). Patients with CPFE have radiologic evidence of upper lobe emphysema and lower lobe fibrosis [44]. Patients with CPFE typically have a low diffusing capacity, elevated alveolar–arterial oxygen gradient, but normal spirometry and lung volumes [45]. Relying solely on spirometry to diagnose or exclude disease in symptomatic smokers can be expected to misdiagnose many patients with emphysema and CPFE.

Delta FEV1 effectively assesses bronchodilator response in COPD

As mentioned above, spirometric indices such as FEV1 are widely relied upon to make a diagnosis of COPD. As a consequence, many clinicians use ΔFEV1 to assess bronchodilator response/benefit in COPD patients. While patients with COPD can demonstrate significant increases in FEV1 after bronchodilator, many do not. A not so uncommon COPD patients. While patients with COPD can demonstrate significant pulmonary function laboratories.

should be on the forefront of incorporating evidence-based practices in data and unproven expert opinions. Pulmonary function technologists mistaken beliefs borne of myth and unproven theory. Indeed, pulmonary pulmonary function laboratories immune from policies, procedures, and therapies. However, the age of evidence-based medicine has not made pul-

monary function testing: It is time to face the music. Respir Care 2010;55(3):355-7.

SUMMARY

Evidence-based medicine has revolutionized both diagnostics and thera-

peutics. However, the age of evidence-based medicine has not made pul-

monary function laboratories immune from policies, procedures, and mis-

taken beliefs borne of myth and unproven theory. Indeed, pulmonary function guidelines contain recommendations based on both scientific data and unproven expert opinion. Pulmonary function technologists should be on the forefront of incorporating evidence-based practices in pulmonary function laboratories.

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The practice of simulation-based assessment in respiratory therapy education

Andrew J West, EdD(c), RRT, FCSRT¹, Gale Parchoma, PhD²

Clinical simulation has gained prominence as an educational approach in many Canadian respiratory therapy programs and is strongly associated with improved learning, clinical and nonclinical skill, future performance, and patient outcomes. Traditionally, the primary assessment approach employed in clinical simulation has been formative debriefing for learning. Contextual factors, such as limited opportunities for learning in clinical practice and technologically oriented perspectives on learning in clinical simulation, are converging to prompt a move from using formative debriefing sessions that support learning in simulation to employing high-stakes testing intended to measure entry-to-practice competencies. We adopt the perspective that these factors are intricately linked to the profession’s regulatory environment, which may strongly influence how simulation practices become embedded within respiratory therapy educational programs. Through this discussion we challenge the profession to consider how environmental factors, including externally derived requirements, may ultimately impact the effectiveness of simulation-based learning environments.

Key Words: clinical simulation; assessment; competency; respiratory therapy education

BACKGROUND

During the mid-twentieth century increasingly complex respiratory technologies and procedures, such as patient interfaces for therapeutic gas delivery and mechanical ventilation, were being introduced into the Canadian healthcare system [1]. It was during that time that the profession of respiratory therapy emerged from a need in the medical and anesthesia communities for appropriately trained individuals to support these new technologies and therapeutic procedures [1, 2]. Since that time respiratory therapists have evolved from being primarily technical healthcare workers trained in hospital-based programs to highly educated and skilled professionals who function as part of an interdisciplinary team of health professionals [3]. While Canadian respiratory therapists now work in a wide variety of health-related settings, providing a broad range of service from hospital-based to community and primary care, their practice remains largely centered in acute care settings [3].

Respiratory therapy has also evolved over time and entry-to-practice education is now provided by institutes of higher education across Canada through 3-year diploma and 4-year degree programs [4]. Because respiratory therapy is a competency-based profession, where practice occurs in clinical settings, respiratory therapy education necessarily occurs in both the classroom and clinical practice environments. Respiratory therapy students are required to engage in learning the skills, attitudes, and behaviours of professional practice in authentic environments. Clinical simulation-based education has, in part, been rapidly adopted by respiratory therapy educational programs, and by those of other health professions, because it offers a safe environment in which learners can develop professional skills without the risk of causing harm to actual patients [5].

WHY HAS RESPIRATORY THERAPY ADOPTED SIMULATION-BASED EDUCATION?

In recent years, a growing interest in assuring patient safety has been fuelled in large part by an Institute of Medicine report documenting the magnitude of medical errors in US hospitals [6]. The report determined that at least 44,000 people, and perhaps as many as 98,000, die in hospital each year due to medical errors [6]. The report was particularly alarming to the respiratory therapy community given that its primary practice contexts occur in both the classroom and clinical practice environments. Respiratory therapy is a competency-based profession, where practice remains largely centered in acute care settings [3].

The practice of simulation-based assessment in respiratory therapy education has been identified as an educational tool that enables learning experiences for health professionals in an environment that does not compromise patient safety [7].

Compounding the impacts that concerns over patient safety have had on health professions’ education programs, limited access to adequate and appropriate opportunities for learning in clinical environments has made ensuring sufficient experiential learning opportunities for health professional students increasingly challenging [8]. This limitation appears to be particularly evident in specialty practice areas (e.g., critical care and pediatrics), which also typify the primary practice environments of respiratory therapists. As is the case in the educational contexts of other health professions, clinical simulation-based education in respiratory therapy has thus also emerged as a technique that is said to facilitate learners to “engage in the same critical thinking and clinical decision-making skills required in actual clinical practice” [9]. It is suggested, therefore, that clinical simulation can offer a means of ensuring learners are optimally prepared to safely begin practice in real settings, while at once helping to address the resource shortcomings of the clinical education context.

THE FOUNDATIONS OF SIMULATION-BASED EDUCATIONAL PRACTICE

Clinical simulation education has long had its medical and technical roots in the aviation industry, from which health professions’ education has adopted many of its early simulation-based educational practices [10]. The past two decades have witnessed an expansive growth in the use of clinical simulation in the education of healthcare professionals to address issues of patient safety and quality care and to enhance the traditional apprenticeship model of medical education [10, 11]. When employed with a well-designed formative feedback mechanism, clinical simulation in this context has been shown to be useful in supporting student learning needs [7, 12].

There also exists a move to ensuring support for higher ordered learning in health professional education for practice in increasingly complex environments.
environments [5]. For example, to meet the regulatory requirements for licensure and subsequent entry-to-practice for the profession of respiratory therapy, graduates must “perform continuous self-evaluation,” “demonstrate critical judgement in professional practice,” “demonstrate problem-solving skills,” and “demonstrate decision-making skills,” among other competencies [13]. “The concepts of meta-cognition and self-directed learning provide the theoretical mechanism for designing and implementing meaningful and worthwhile educational practice. That is, they describe the processes by which higher-ordered learning occurs” [14]. Simulation is seen as one solution to this educational need [5].

Simulations encompass very carefully crafted reconstructions of realistic scenarios, or they may simply replicate a component or group of components of a clinical context to provide a degree of reality [5]. Chiniara et al [11] delineated a variety of simulation modalities along technological lines including: computer-based simulation, simulated patients, simulated clinical immersion, and procedural simulation. Cook et al [15] defined clinical simulation as “an educational tool or device with which the learner physically interacts to mimic an aspect of clinical care for the purpose of teaching or assessment.” In prefacing their instructional design framework for clinical simulation, Chiniara et al [11] problematized simulation technologies as often considered an educational method, noting that the use of any particular technology may vary widely.

Indeed, concerns with persistent technological-centric approaches to clinical-simulation practice surface regularly in the literature and they are responded to with calls for greater educational theorization in the field and recognition of clinical simulation as a social practice [8, 16]. In doing so, the utility of clinical simulation as an educational approach may be understood as resting in the interactions that occur between many elements of this complex learning system, including those elements that can be designed for (e.g., assigned tasks, the technology, choice of participants) and those which cannot be designed for (e.g., sense of community, emergent activity) [17, 18]. In particular, the social aspects of the learning environment (e.g., factors which might affect learners’ emotional or psychological status or which may impact their sense of safety and trust) represent those non-designable elements of clinical simulation that underlie the effectiveness of the learning environment [16, 18].

**ASSESSMENT PRACTICES IN SIMULATION-BASED EDUCATION**

Clinical simulation is now a well-established practice in health professional education, and formative debriefing for learning has traditionally been employed as the primary assessment strategy in that practice [10, 19, 20]. However, having first acknowledged that engaging learners in a debriefing practice that focuses on multiple forms of feedback is the most important and frequently cited assessment practice through which to promote effective learning; a review by McGaghie et al [20] also identified the opportunities for increasing the application of simulation in high-stakes examinations, such as those used to evaluate readiness of health professionals for licensure.

The use of debriefing in the clinical simulation context is associated with improvements in various areas including: learning, clinical and non-clinical skills, future performance, and patient outcomes [8, 19, 21]. The methods of debriefing performance that have been examined in relation to their impact on learning generally include facilitators’ provisions of critically constructive and empathetic feedback, and providing opportunities for learners to engage in self- [22] and peer-assessments [8]. Eppich and Cheng [23] further differentiated these formative debriefing approaches into three broad categories: (i) learner self-assessment, (ii) focused facilitation to promote critical reflection and deeper understanding of events, and (iii) directive performance feedback. Contending that each approach can at times be useful as an educational approach, Eppich and Cheng [23] have advocated for a blended approach to debriefing that can respond flexibly to specific educational goals. While the existence of a variety of approaches to debriefing are evident in the literature [23, 24], the practice of debriefing in simulation-based education remains predominantly formative in nature.

The movement towards using simulation for competency-based evaluation for certification or licensure in health professions, as noted by McGaghie et al [20], is echoed throughout the literature [25–27], though existing practices amongst health professions in Canada vary with respect to the use of simulation for assessment of practice readiness. This growing trend, both in research and application, appears to be primarily occurring in the areas of procedural specialties in medicine [20, 28, 29]. Within the professions of respiratory therapy and nursing in Canada, clinical simulation-based examinations for entry-to-practice have not yet been implemented [30, 31].

**RESPIRATORY THERAPY REGULATORY ENVIRONMENT: EDUCATIONAL IMPLICATIONS**

The potential influences of a regulatory environment on respiratory education programmatic decisions, including assessment approaches, can be critically examined through a social practice theory lens. Social practice theory provides a structure for examining what people do, what they value, and which meanings they derive from participating in a shared, situated practice [32]. By adopting a social practice theory perspective—one that acknowledges the influences that socio-cultural environments may have on the activities of a community of practitioners—a previous exploration of assessment practices in health professional education contexts exposed the professional regulatory environments as an influential factor [18]. Building on this understanding, there is value in exploring the regulatory environment that exists within the profession of respiratory therapy as an important contextual factor that may influence the practices of its educational programs.

In 2003 the profession of respiratory therapy was amongst the first health professions in Canada to adopt competency-based entry-to-practice requirements [33]. The National Competency Profile for Respiratory Therapists in Canada dictates the competencies that an entry-level respiratory therapist is expected to be able to perform in the workplace, and it identifies the outcomes that must be achieved by the conclusion of educational programs in respiratory therapy in Canada [13]. In response, Canadian institutions offering respiratory therapy education programs have implemented curricula founded on the principles of competency-based education that comply with the discipline’s accreditation requirements [34]. Frank et al [35] defined competency-based education as an approach to preparing health professionals “for practice that is fundamentally oriented to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs.” Given that the clinical simulation-based education technique aligns well with the achievement of objectives mandated by competency-based education, it is not surprising that uptake of simulation-based education has grown since implementation of the first National Competency Profile for Respiratory Therapy in Canada.

In response to growing interest in the use of clinical simulation to support development of professional competencies in respiratory therapy, the 2011 iteration of the national competency profile identified specific competencies that could be assessed for entry-to-practice in clinical simulation environments. Many of the competencies that the regulatory bodies have determined may be assessed using simulated environments consist primarily of procedural skills. A representative example is pediatric endotracheal intubation [13]. In the case of those competencies in which clinical simulation may be used to assess competency, the profile further delineates that characteristics of the clinical-simulation technologies that can be employed to assess specific competencies (i.e., either high or low fidelity) [13].

Low-fidelity simulation technologies have been defined as having the capacity to replicate “an aspect of a task” [36], e.g., arterial cannulation; therefore, they are commonly referred to as “part-task trainers.” High-fidelity simulation technologies have been defined as having the capacity to recreate “an entire working environment such as the operating theatre.” [36]. Linkages have been made among use of specific simulation devices and influences on learning outcomes [37] as well as between competencies learned and practiced in high-fidelity environments and positive transfer between differing levels of simulation and, more importantly,
from the simulator to the clinical environment [36]. Simultaneously, calls have been made to increase research emphasis on “techniques used to facilitate learning during simulation” [37] and to explicitly focus attention on the “educational processes that underpin simulator training [to ensure] deliberate practice, reflection and feedback” [36].

Within the 2011 Respiratory Therapy National Competency Profile there is no literature cited, or currently available, to validate the effectiveness of fidelity standards in assuring respiratory therapy educational outcomes, such as competency at the entry-to-practice level [38]. Nevertheless, respiratory therapy educational programs must comply with the minimum standards set by Canadian regulatory bodies to maintain their accreditation standards and to ensure their graduates are eligible for professional licensure upon graduation [34]. It is plausible that these standards play a role in encouraging educational programs to employ clinical simulation for high-stakes assessment of competencies in place of formative assessment techniques traditionally used. Moreover, the distinction between educational approaches (i.e., high vs. low fidelity) and the identification of competencies which may or may not be developed through simulation exemplify some prevailing perspectives on simulation that exist within the profession. The need to examine emerging approaches to simulation-based education within the profession is underscored by these technologically centric perspectives on simulation identifiable both in practice and within the literature.

THE FUTURE OF SIMULATION-BASED EDUCATION IN RESPIRATORY THERAPY

The previous issue of the Canadian Journal of Respiratory Therapy shared the recommendations of a national advisory group on the use of clinical simulation that was struck by the National Alliance of Respiratory Therapy Regulatory Bodies (NARTRB) [38]. The role of the advisory group was to inform the NARTRB on issues relating to attainment and demonstration of competency using clinical simulation, in particular relating to its use to supplement and/or replace clinical practice to attain and demonstrate competence. The working group offered the NARTRB a range of literature- and practice-informed recommendations on the use of clinical simulation [38]. One of the final recommendations of the report speaks to concerns that exist within the community regarding clinical simulation-based assessment practices:

Several environmental factors have been identified as essential in creating an effective debriefing environment in clinical simulation, including: fostering a supportive learning environment, ensuring participants feel comfortable, and establishment of trust within the circle of participants. In light of the importance of fostering a debriefing environment that supports learning, there is value for educators and regulatory bodies to carefully consider that including high-stakes examination of [respiratory therapy] learners may impact those essential environmental factors. We need to ensure that any move towards employing high-stakes examinations in [respiratory therapy] education does not threaten to undermine the effectiveness of the clinical simulation learning environment. [38]

This recommendation illustrates some of the tensions emerging within the discipline’s discourse relative to the use of clinical simulation as an assessment strategy. It challenges policies that may ultimately impact clinical simulation-based environments and encourages the profession’s educational programs to engage in practices that foster learning in these environments.

CONCLUSION

Clinical simulation practice and research are often times characterized by techno-centric perspectives on clinical simulation that is educationally undertheorized. In the past, an organizational culture amongst Canadian respiratory therapy regulatory bodies emerged where the technological aspects of clinical simulation, such as high-fidelity manikins and low-fidelity part-task trainers, were promoted as fundamental tools for achieving learning outcomes. Currently, it is commonplace that clinical simulation is used in the curricula of Canadian respiratory therapy education programs. Moreover, the observation has been made that the use of high-stakes clinical simulation-based assessments that occur throughout respiratory therapy program curriculum are becoming increasingly prevalent. The literature supports that the use of debriefing as an assessment strategy in the clinical simulation context is associated with improvements in various areas including: learning, clinical and non-clinical skill, future performance, and patient outcomes. As has been explored here, a variety of pressures, including concerns for the safety of patients, limited opportunities for learning in clinical practice, and the professional regulatory environment, are converging to prompt a move towards the use of clinical simulation for high-stakes assessment of learners in entry-to-practice respiratory therapy educational programs. In response, it is incumbent upon the respiratory therapy community to carefully consider how clinical simulation learning designs, including approaches to assessment, may impact environmental factors that are fundamental to learning in this context (e.g., the sense of support, trust, and comfort that participants may experience in clinical simulation). Discourse and reflection on those factors that influence educational practices, including the professional regulatory environment, may prove instrumental to informing future practice.

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Optimizing learner assessment in a respiratory therapy clinical simulation course

Yvonne Drasovean, MEd, RRT, FCSRT

The purpose of this participatory action research project was to evaluate the effectiveness and objectiveness of learner evaluation methods used in a clinical simulation course offered at a community college as part of the 3-year Respiratory Therapy advanced diploma program. A mixed-method approach to data collection was used. A paper-based questionnaire was completed by 47 participants and was utilized to identify learner satisfaction with the simulation experience. An online questionnaire was completed by 16 participants and used to identify learner satisfaction with the evaluation methods used in the course, as well as to gather suggestions for improvement of those methods. Two focus groups further explored participants’ impressions of how evaluation in the course affected their learning process and competence in preparation for formal assessment. Data analysis found that the majority of participants were generally satisfied with the current evaluation process considering the practice objective and found that it was effective in helping learners achieve their learning goals. Areas identified for improvement included practice improvement, such as team and communication skills assessment; student self-reflection assessment; and changing the grading system from a numerical grade system to a pass/fail system. The project offers suggestions for future research, including the development of a standard evaluation rubric in high-fidelity simulation in respiratory therapy in Canada based on the national competency profile for entry to practice.

Key Words: simulation-based education; evaluation; respiratory therapy; evaluation in clinical simulation; evaluation in adult education; program evaluation

INTRODUCTION

The purpose of simulation-based education in respiratory therapy is to help learners combine knowledge and practical skills gained in previous courses in preparation for real-world clinical practice. Simulation-based education uses computerized manikins that can be programmed to simulate real scenarios that are safe and controlled. This type of educational activity offers a unique opportunity for learners to make mistakes and to learn from them while developing and improving critical thinking skills [1]. The traditional apprentice-learning model in medical education, respiratory therapy included, is undergoing a pedagogical shift to a simulation-based, experiential learning model. Although not intended to replace clinical experience, experiential learning and the ability to provide immediate feedback on performance are advantages of simulation-based learning in preclinical education of respiratory therapy students [2].

An important aspect of any learning process is learner assessment, including the measurement methods and strategies employed to ensure that learning actually happens. Learner assessment is a systematic process that allows instructors to identify how much and how well students have learned and how, and to assess what needs to be changed or improved. This type of assessment tool is essential to the learning process [3]. On that premise, it is important that learner assessment is consistent with the curriculum being taught and that learner expectations are clear to ensure that measurement tools do not cause anxiety, thereby restricting learning.

Currently, there is no gold standard in assessment methods in simulation-based education in respiratory therapy. Farell et al [4] suggested designing program evaluation processes to include a needs assessment, a framework describing who, why, when, and how process evaluation should be approached, stating that “Process evaluations are ongoing and help program providers to understand what is being done and how, and to assess what needs to be changed or improved.” Learning in clinical simulation requires a flexible formative and summative assessment process [5]. Formative learner assessment is a low-stake assessment that helps learners identify their strengths and weaknesses and provides means for instructors to identify opportunities to correct or enhance skills as needed. Summative learner assessment is a high-stake assessment intended to evaluate learning at the end of an instructional unit.

Assessment methods must include strategies to provide useful feedback that directs learner behaviour towards learning and adapting based on that feedback. In the course being evaluated, debriefing each simulation scenario was intended as such a strategy. Another important element to consider is that during stressful situations (such as summative assessment) learners can make errors in judgement, leading to lower than expected performance. Is there a better way to provide learners with tools for learning while at the same time evaluating their performance? It may be worth building on Petson’s [5] idea of using both formative and summative assessment of learners, because it may increase the quality of performance and improve learner engagement in learning during the practice simulation. For instance, formative assessment as applied to a clinical simulation course could be done in the weeks leading up to the main evaluation, which is the summative evaluation. Petson [5] states: “The assessment process must be designed so that we can provide the teams with feedback that is useful and also directs their behaviour towards learning and adapting based on the feedback.”

Simulation-based education assessment strategies employed using global rating scales and checklists have limitations. Kim et al [6] provided a comparison of global rating scales and checklists for the validation of an assessment tool used in performance assessment in simulation of high-crisis medical situations. They concluded that construct validity, the degree to which a test measures what it claims to be measuring, is seen in both tools. Both tools have the ability to discriminate between participants of different skill levels. There seems to be poor inter-rater reliability in certain categories in both tools, indicating that future design revisions for both instruments are necessary. An interesting observation from this study was that users indicated a strong preference for the Ottawa global rating scale due to the ease of scoring, presence of an overall score, and potential use as a tool for formative evaluation.


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competition. Miller’s prism of clinical competence suggests a hierarchical assessment of performance along a learning journey from novice to expert status. Miller’s model emphasizes that while simulation can be very realistic, it is still a simulation, and learners may not necessarily perform as in real life [7]. Taking into consideration learners’ level of preparedness is also an important element in the designing process of an assessment tool.

While simulation is without a doubt a powerful educational tool, it is important that educators clearly identify the impact of appropriate evaluation on the learning process. Moreover, the lack of research on assessment practices in clinical simulation specific to respiratory therapy in Canada makes it difficult to assess how objective and how effective current evaluation practices are in supporting learners to achieve a satisfactory level of competency and knowledge prior to entering clinical practice. The purpose of this study was to examine the learner assessment processes used by instructors in the respiratory therapy clinical simulation course offered at an Ontario College. A participatory action research approach was undertaken employing both qualitative and quantitative methods guided by the following research questions:

1. What constitutes objective and effective learner evaluation in the respiratory therapy clinical simulation course?
2. How can improving evaluation practices in the clinical simulation course enhance student success?

Description of the project
Since its implementation, the clinical simulation course in this respiratory therapy program has proven to be an effective educational tool in preparing students for clinical practice. When discussing the importance of this course in the program curriculum, the developer of the course says that “As educators we need to adapt to the learning continuum of learners, high-fidelity simulation is an educational tool that can afford us the ability to purposefully design an experience that can make meaning for an individual” [8].

Similar to other courses with a practical skill learning component, the clinical simulation course must provide measurements of student learning outcomes; specifically, the assessment of clinical practice skills. Students in the course examined by this study were provided with the opportunity to take the role of team leader in at least one of the weekly scenarios, prior to being assessed. Scenarios were facilitated by course instructors and simulation technical staff. This researcher played an active role in the delivery of the course, including formative and summative assessment of students. A typical simulated clinical scenario consisted of a patient (manikin) presenting in cardio-pulmonary distress. Learners were required to assess the situation and the patient, make decisions regarding the plan of action, suggest interventions to help the patient using previously gained knowledge and critical thinking skills and, ultimately, to act on these decisions. Simulations were videotaped each week and students were provided the opportunity to review their performance to enhance the learning process. At the end of each simulated scenario instructors facilitated a debriefing session where students had the opportunity to express concerns, offer feedback to each other, prompt critical thinking, and discuss all positive and negative aspects of their skill performance.

Due to scheduling issues and instructor time limitations, students were divided into three instructional groups, each led by a different instructor. As one of the instructors assigned to the course, this researcher chose to provide learners in their group with formative evaluations each week at the end of their practice simulation exercise. To do this, the instructor used the same evaluation rubric used for summative evaluation in all three groups during practice simulations. The intent of using the rubric as a formative tool was to provide learners with feedback structured the same way they would be expected to perform during summative evaluation. Although learners received a score during the practice sessions, the scores did not count toward the final grade. The instructors of the remaining two learner groups used the rubric for summative evaluation purposes only. Those 22 learners received general feedback on their performance during the weekly practice sessions without the use of the evaluation rubric. The assessment rubric used in the study course was a global rating scale with a 5-point scale for performance in six categories and an overall performance score.

The course involved three simulation sessions (three weeks per session) with three practice scenarios (one scenario each week) followed by summative evaluation of individual students at the end of each session based on the summative assessment rubric. To pass the course, learners must have achieved a minimum score of 60% on each of the three individual evaluations. Learners scoring below the minimum grade were provided with the opportunity to perform one comprehensive assessment for upgrading purposes prior to the end of the semester, provided that the overall course grade was 60% or greater. Learners were also expected to complete a reflection assignment with the purpose of identifying areas for improvement and clearly finding and creating strategies that would enable them to obtain improvement in those areas.

METHODS
A participatory action research design was used for this project because it sought to engage processes of inquiry that are democratic and empowering [9]. The intent was to involve all stakeholders, including students, instructors, and technical staff, in the process to generate knowledge about the existing assessment methods (three individual summative evaluations, percentage scale used) and ideas for potential changes and improvement. Jackson and Kassam [10] suggested extending the concept of participatory action research to participatory evaluation (as cited in Benson et al [11]). Jackson and Kassam [10] defined participatory evaluation as the process of self-reflection, assessment, and collective knowledge production. Through collective work, stakeholders contributed to identification of issues in assessment practices through data collection and analysis. This type of collaboration led to an overall improved outcome as a result of actions taken based on evaluation findings.

In line with action research definitions [12] this study was conducted from the inside, as this researcher was part of the instructors team, in an attempt to develop and improve practice in evaluating students in this course. Various methods of inquiry were used to triangulate sources: listening to stakeholders as they described their experience and perspectives, observing and participating in events, and reading reports of similar events and activities [9]. In this study, mixed research methods enhanced the strength and validity of research findings and helped overcome some of the limitations of the project [12]. In particular, data from two surveys were corroborated with data from the focus groups. Laws et al. [13] stated that “the key to triangulation is to see the same thing from different perspectives and thus to be able to confirm or challenge the findings of one method with those of another” [14]. The data collection goal was to critically analyze information received via different channels to paint a clear picture of the stakeholders’ perspective on the evaluation process and to confirm similar findings or identify discrepancies that would further guide the research process.

Data were collected through two surveys and three focus groups, and they were supported by reflective journaling, review of course documents such as student grades, and course evaluation rubrics. Recognizing that some of the research study participants might not have been comfortable speaking in the presence of others, the surveys offered anonymity and potentially more flexibility in terms of participation time. Interviewing stakeholders offered a means of more deeply understanding participant experiences and perspectives. Focus groups unearthed valuable information and ideas that might have potentially been overlooked with surveys. Descriptive statistical analysis was performed on the data collected from Likert scale survey questions. The qualitative data collected through open-ended survey questions and through focus group interviews were transcribed, coded, and analysed for emergent themes.

Because the inquiry process generated through action research parallels the experiential learning cycle (in which practice improves as experiences build upon experiences) [15], personal journaling and reflection on this researcher’s own practice as an assessor provided insight on the
impact of assessment on learning process. Furthermore, learner assessment rubrics were mapped to course learning objectives for examination of their utility as assessment tools. Student outcomes, such as the average grade of the group on each assessment, were used to evaluate overall achievement of learning outcomes.

Participants
An invitation to participate in this research study was sent via email to the class of learners who most recently completed the simulation course and were currently enrolled in the clinical placement year of the program, as well as to the instructors of the course and the technical staff involved in the preparation of the course setting. Participants were given the opportunity to provide free and informed consent to take part in this research study. This research project was conducted in compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans [16] and received the approval of the Research Ethics Board of Yorkville University and Fanshawe College Research Ethics Board (Protocol # 1509-24-1).

A total of 51 participants agreed to be a part of the project. Of those 51, 47 were learners, two were simulation technical staff, and three were instructors in the course. This researcher was also a participant in the study as one of the three instructors who actively participated in the course delivery. Forty-seven learners completed a paper-based survey and 16 learners completed an online survey. Eight individuals, including three learners, three instructors, and two simulation staff participated in three different focus groups.

With large classroom sizes, the three instructors of the simulation course were somewhat isolated in terms of teaching and assessment practices, often only seeing each other in passing at the end of one’s session and the beginning of the other’s. School structure and schedule reduced the available time for collaborative relationships and activities with peers. This is particularly important in a simulation course where the same standards for teaching and assessment must be applied to all learners [5]. It is human nature for each individual instructor to use personal views and practices, even when standard methods of teaching and evaluation are being used. While instructor personal experience and approach can positively shape the learning process of a group of learners, in this case it was important that standards were given appropriate attention.

The technical staff routinely provide support to various healthcare professions and programs, including respiratory therapy. This placed them in a unique position of being able to see different teaching practices and evaluation methods. Although each profession has its own specific requirements and standards, there is opportunity to learn from one another through inter-professional collaboration. Considering that it is the efforts of a complex healthcare team that leads to successful patient outcome in real clinical practice, there is potential for future research on evaluation methods.

Paper-based survey
An anonymous, paper-based questionnaire on the evaluation of simulation activity was offered to participants who provided feedback and rated the simulation activities based on their overall experience with the course. The survey contained ten questions and provided the researcher with the opportunity to understand the groups’ perception of the support received during the course in preparation for evaluation. The survey also stood as a message to learners that their opinion and feedback are important to the teaching, learning, and evaluation process for the creation of a true collaborative environment.

Web-based survey
In a second survey, eight questions were used to identify elements of the evaluation process that may benefit from improvement or change in practice as perceived by learners. The survey was administered using an online survey platform (SurveyMonkey). Survey questions employed a Likert scoring system, which Bell and Waters [14] described as “scales are devices to discover strength of feeling or attitude.” The questions were also designed to investigate learner perception of the objectivity and effectiveness of the evaluation methods format in helping them achieve their learning goals.

Focus groups
There were three focus group interviews completed: with the instructors directly involved in learner assessment, with simulation technical staff, and with learners who had been assessed in the simulation course. The interviews provided a means of better understanding human emotions and perspectives that accompany any assessment process. It offered insights into the experience of both the assessing instructor and learner, experience that is a complex collection of actions related to the learning processes in preparations for assessment. The same open-ended questions were asked in all three focus groups. This researcher chose focus groups as part of the methods of collecting data because of the interactive aspect, where group opinion was as important as individual opinions [12]. The interviews were held face-to-face in an interview room on campus, with one participant joining the learner’s group conversation online via video conferencing. To avoid researcher bias, interviews were facilitated by an unaffiliated research assistant. An audio recorder was used for data collection and to ensure verbatim transcription of data.

RESULTS
Based on participants’ qualitative feedback in the paper-based survey, learner assessment was considered generally fair and objective. Table 1 provides a selection of participant comments collected through the survey. Table 2 shows the results of the online survey on learners’ perception of assessment methods used in the simulation course. A total of 16 learners accepted the invitation to participate in this survey.

### TABLE 1

*Selected learners’ comments on the simulation (SIM) experience and evaluation collected by paper-based survey*

<table>
<thead>
<tr>
<th>Comment</th>
<th>Learner Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>“It was good but the exams were scary.”</td>
<td></td>
</tr>
<tr>
<td>“I felt that as an RT student, having the simulation course is essential to my learning because I had the opportunity to apply my theoretical knowledge in a clinical setting. The feedback and skills I have learned during simulation will help prepare me to transfer to my clinical placement.”</td>
<td></td>
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<tr>
<td>“I would prefer if we had a chance to go back into the SIM room for debriefing to go through proper procedures.”</td>
<td></td>
</tr>
<tr>
<td>“As a student, simulation can be a very valuable experience although I felt some weeks were a little overwhelming. I personally feel I would have benefited more from SIM lab if our other lab courses had the same intensity with regards to hands on experience.”</td>
<td></td>
</tr>
<tr>
<td>“This course is by far the most beneficial in preparing us for clinical placement. It is very stressful at times, but I love it.”</td>
<td></td>
</tr>
<tr>
<td>“Discussing the pre-brief before starting the scenarios may be helpful.”</td>
<td></td>
</tr>
<tr>
<td>“Clinical simulation would be a great idea to simulate actual scenarios for a graduate RT. It puts students in a situation that is high stress with no preceptor with experience to help guide our interventions. The course however gets us ready for basic interventions.”</td>
<td></td>
</tr>
<tr>
<td>“I have learned the most about this program in SIM. I have been able to become more confident in my skills because of SIM.”</td>
<td></td>
</tr>
<tr>
<td>“I would like more constructive feedback on the SIM evaluations.”</td>
<td></td>
</tr>
<tr>
<td>“This course is a good way to continually reinforce the skills we’ve learned over the last 2 years. More prep beforehand would be nice.”</td>
<td></td>
</tr>
<tr>
<td>“Overall it was a helpful experience to apply what we learned. The only thing I thought could be improved was that during the first SIM evaluation, the patients were both trached and we hadn’t had any trach scenarios up to that point. It would have been helpful to review that heading into the evaluation.”</td>
<td></td>
</tr>
</tbody>
</table>
Five themes that relate to the assessment tools used in the simulation course emerged from the qualitative data collected through the three focus group interviews: authentic evaluation, learners’ satisfaction with evaluation methods, evaluation and learning objectives, evaluation and learning outcomes, and evaluation and learner self-reflection.

**DISCUSSION**

**Authentic evaluation**

The paper-based survey of the simulation experience provided information about the overall learner satisfaction with the course, including the assessment methods used. The survey questions investigated topics such as the impact of the amount of information received by learners prior to each simulation session and the meaningfulness of simulation scenario in relation to learning outcome. Input from the paper-based survey shows that 53% of the 47 learners were satisfied with the information received prior to weekly practice sessions. This topic was further discussed in the learners’ focus group where three participants stated that background information on the scenario prior to each simulation was insufficient and sometimes useful in creating a plan of action for the simulation. This speaks to the authenticity of the evaluation process. The course design and format provided learners with multiple opportunities to practice their critical thinking skills in various situations, making these skills predictable for future situations. These skills became useful indicators of learning. Authentic evaluation also provided diagnostic information and feedback to learners so that they know how and where to make improvements [17] (as cited in Svinicki [18]).

**Learners’ satisfaction with evaluation methods**

Data from the paper-based survey indicated that 75% of the 47 participants were satisfied with their experience in the simulation course, including the methods of evaluation used in the course. Nineteen percent of participants were neutral, and 6% of participants were dissatisfied. The inconsistency in practice between instructors, where only one instructor provided formative assessment based on the course rubric, led to some learners’ dissatisfaction with the support received in the course in preparation for summative assessment.

The latter group expressed some of the reasons for their dissatisfaction with evaluation methods such as: being evaluated individually, insufficient practice time, insufficient information received prior to simulation, and the exercise being too stressful for inexperienced second-year learners.

**Evaluation and learning objectives**

The course learning objectives as listed in the course information document were mapped to the course evaluation rubric to assess how learning objectives have been addressed in evaluation. This activity indicated that learning objectives had been fully captured in the evaluation rubric. The goal of this course is to ensure that learners achieve learning objectives that we as instructors expect them to. When assessing outcomes of the learning process it is important that instructional practice not only aligns with learning objectives but also with evaluation practice [3].

Discussions in the learners’ focus group revealed that learners agreed the evaluation process was fair and objective. When discussing the fairness of the evaluation process, the majority of participants, including learners, simulation staff, and instructors, expressed concern over the confidentiality of the simulation scenario during evaluation. Due to the large number of learners, evaluations are scheduled over two days. From discussions with the learners’ focus group it was found that some of the learners being evaluated on the first day breached the confidentiality of scenarios by disclosing the information to learners being evaluated on the second day. Unfortunately, instructors have no control over this process and it is difficult to identify the individuals responsible for this breach of confidentiality. For future practice this researcher suggests changing the scenarios for the second day of assessment, while still maintaining objectivity by assessing skills and scenarios that have been practiced.

Lack of objectivity and effectiveness in evaluating teamwork and communication as stated in the evaluation rubric is another topic that was brought up in the learners’ focus group discussions. During weekly simulations, even though learners were given an opportunity to lead they worked as a group, whereas during evaluation they worked individually. They felt that this discrepancy and the evaluation rubric did not address teamwork effectively. This is an important finding that needs attention, because team communication is a key element in healthcare. Participants were also asked if they found the frequency of evaluations adequate. Data from both the online survey and focus groups suggest that more than three evaluations as well as more practice sessions are perceived as potential elements that can help in achieving learning objectives. One learner stated:

“A few more evaluations with lower weighting would allow for a more relaxed and competency-focused approach for the students. High weighted evaluations prove to be unrealistically stressful and cause some of the students to perform poorly regardless of actual clinical knowledge.”

**Evaluation and learning outcomes**

To assess the effectiveness of the assessment format in achieving learning outcomes, this researcher looked at the quality of learners’ work, specifically, class results on each of the three evaluations offered during the duration of the course. Over the duration of the semester, the class average improved progressively, from 67.67% in the first evaluation to 73.77% and 75.53% in subsequent evaluations, suggesting that learners improved their critical thinking skills and knowledge. Further discussions with the learners’ focus groups shows that most learners were also satisfied with the support received in preparation for evaluation. One learner from the group receiving weekly feedback based on the evaluation rubric stated:

“Seeing the evaluation rubrics every week was effective in achieving my learning goal. Instructor comments were also effective in my learning; we came out every week with clear learning objectives achieved.” (personal communication, November 27, 2015)

This was an interesting observation because input from the instructors indicated similar preference for the rating scale-based rubric. In their comparison of global rating scale and checklist scores, Kim et al [6] found that both tools have the ability to evaluate performance based on level of training; however, the rating scale appears superior in providing the opportunity to rate overall performance. The rating scale was also preferred by all raters involved in this study due to ease of administration and scoring. Data collected indicates that 75% of participants were
satisfied with the effectiveness of evaluation methods in assessing their skills. This suggests that most learners’ needs in achieving their learning outcomes were met. The assessment rubric used in this course addressed communication skills; however, the concern around the effectiveness of the assessment tool in assessing teamwork should be addressed in the future as there may be a more efficient way for assessing this skill.

An unexpected yet interesting observation was the difference in the practice of individual instructors and its impact on students’ perception of learning. Learners who received weekly formative assessment of their performance based on the summative assessment rubric felt that this practice, in combination with the background information received prior to simulation, was very helpful in preparing for class, including developing a plan of action, compared with students who did not receive weekly evaluations. The latter said that they did not pay much attention to the evaluation rubric until it was used for summative evaluation. They also did not prepare an action plan prior to weekly practice simulations. This perceived difference in preparation did not appear to have a significant impact on learner summative evaluation outcome, as demonstrated by the consistency noted in between group evaluation scores. These results also implied that there exists a high degree of agreement between instructors in assessing learners. The same assessment rubric was used each time, even though the three assessments included a different scenario, reflective of a different clinical setting (intensive care/unit, emergency room, and wards). These findings were reassuring that evaluation is fair and objective for all learners since the three instructors are in tune, aware of each other’s practice, and are similar in their observations and assessment of learners. Consistent use of the standard assessment rubric and clear guidelines for the assessment process strengthened the inter-rater reliability and demonstrated objectivity in assessment practice.

Evaluation and learner self-reflection

Each of the three evaluations also included a self-reflective component assessed based on criteria listed in the self-reflection assessment rubric. This researcher found self-reflection a very important tool in the learning process, though it was questioned if it was a useful tool when used only for summative assessment purposes. Emotions were high during summative evaluations; often, learners felt overwhelmed and in a hurry to leave the school premises. This raised the questions: Were learners truly reflecting on their performance immediately after being assessed? Were they using the reflective moment as a learning opportunity? The information received from the learner’s focus group suggested that in this course, reflection was not necessarily used as a learning tool. One learner said that it made her stress about her performance even more, which caused her a lot of anxiety. Another learner said that other than during evaluation when it was required, she did not reflect on her weekly performances because feedback from the instructor was given to her.

Discussions during the focus groups with the instructors and simulation technical staff highlighted the idea of encouraging learners to practice self-reflection during the practice simulations preceding the evaluation rather than as a post-evaluative reflection. In this manner they will be able to build on each simulation experience, leading to evaluation further enhancing the learning process.

CONCLUSIONS

The Canadian Society of Respiratory Therapists and the provincial respiratory therapy regulatory bodies outline the standard of practice of the Respiratory Therapy profession via a national competency profile document for entry to practice. This document is used across the country for curriculum development in colleges offering respiratory therapy programs. Standardization of requirements for entry to practice across the profession suggests that consideration that similarly standardized strategies for evaluation may be warranted. The findings of the current action research project may provide a foundation for future research that may seek to identify best practices in simulation-based evaluation methods that could be generalizable to all accredited respiratory therapy programs.

Evaluation in the clinical simulation course appears to be objective and fair as perceived by the majority of the project participants. Valid concerns and valuable suggestions from project participants will be taken into consideration in regards to the research question: how can improving evaluation practices ensure learner success? The outcomes of this project have led to several recommendations for the simulation course at this College, including:

- the introduction of an evaluation of learner self-reflection during the practice simulations preceding the formal evaluation to enhance independent learning and critical thinking;
- the introduction of peer evaluation/peer feedback to promote development of assessment skills for quality in their own and others’ performance, as well as to set their own standard;
- the introduction of teamwork assessment during practice simulation and individual assessment during formal evaluation; and
- to request learner feedback on overall satisfaction with the course sooner than the end of the course so practice can be changed to meet learners’ needs.

If not an art, learner assessment is a skill that requires practice leading to experience and, eventually, mastery. This research found that examining learner assessment was a challenging, thought-provoking, yet educational and rewarding task. The findings of this study have the potential to be of influence for other respiratory therapy programs offered at Canadian colleges and universities, and in other programs offering clinical simulation training. The project also has the potential to provide groundwork for future research on incorporating learner assessment in inter-professional practice in clinical simulation.

REFERENCES

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