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Celebrating 50 years / 50 ans, c’est à célébrer

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REVIEW

Improving survival outcomes in lung transplant recipients through early detection of bronchiolitis obliterans:
Daily home spirometry versus standard pulmonary function testing
Kevin S Robson, Andrew J West

Bronchiolitis obliterans syndrome (BOS) is a fibrotic inflammatory process that manifests in a significant number of lung transplant recipients within five years of transplant. Left unchecked, the disease process, which has been linked to almost all chronic rejections, leads to irreversible damage, progressing to long-term sequelae and, eventually, respiratory failure. This systematic review examined the outcomes of eight randomized controlled trials that fulfilled specific selection criteria to determine whether home spirometry could be used as a BOS detection tool.

ORIGINAL ARTICLES

A retrospective analysis of airway management in patients with obstructive sleep apnea and its effects on postanesthesia care unit length of stay
Claire A Brousseau, Gregory R Dobson, Andrew D Milne

The development of obstructive sleep apnea (OSA), an increasingly prevalent condition in modern-day society and, especially, in the surgical population, is contingent on several risk factors including pharyngeal anatomy, obesity and genetics, among others. Therefore, recognizing OSA in perioperative settings and postdischarge planning is especially relevant. This study examined airway management techniques and difficulty of intubation in 91 adult surgical patients, the majority of whom had formally diagnosed OSA.

Complementary and alternative medicine: A survey of its use in children with chronic respiratory illness
Ellison Richmond, Denise Adams, Simon Dagenais, Tammy Clifford, Lola Baydala, W James King, Sunita Vohra

The high prevalence of chronic illness has prompted many to seek treatment alternatives outside of conventional medicine. Many health care providers, however, may be dangerously unaware of CAM use in their patients due, in part, to nondisclosure or because CAM use is not specifically addressed in the clinic or office. Prompted by the lack of data from Canada, this study investigated pediatric CAM use in respiratory clinics in Edmonton (Alberta) and Ottawa (Ontario).

DEPARTMENTS

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Celebrating 50 years

50 years ago, what would soon evolve to become the profession of respiratory therapy emerged as the Canadian Society of Inhalation Therapy Technicians. One year following the inception of the Society, Canadian Inhalation Therapy published its first issue. From the outset of the profession, research, evaluation and knowledge translation have been fundamental to advancing our understanding of respiratory therapy and improving the care that we provide to our patients.

Today, we continue to work toward these same goals of advancing a global understanding of effective clinical interventions and ways of improving care for patients with respiratory diseases. Looking back, we have pioneered and cultivated innovative ideas, research and commentary that have led to meaningful improvements in how respiratory therapists work and how respiratory therapy departments integrate themselves into the Canadian health care system. There are many achievements that we should be proud of, and these achievements should propel us to continue to pursue the highest standards of biomedical research and innovation and the sharing of important ideas.

Our work is far from over. There are a growing number of respiratory therapists pursuing advanced degrees and research opportunities and, most importantly, there is a growing population of respiratory therapists who are asking important questions of the things that we do, the ways in which we do them and the contexts in which we operate. The role of the Journal is to provide space for each of the areas to be explored rigorously and systematically, offering new ideas and new findings to a community of clinicians and inquisitive minds. In many ways, the role of the Journal is to disrupt the status quo. Tackling such broad topics necessarily requires an editorial team that is open to new ideas, yet focused on quality; one that is generous in their editorial insight, yet protective of the integrity of the research that we publish.

Most practically, the Journal exists because of the efforts of the authors who conduct important work and submit their findings or their commentaries for publication. Without this commitment, not only would the Journal cease to exist, but so too would the advancement of the profession and important developments in the provision of safe, competent and effective respiratory care.

The Journal that exists today is the culmination of all of these things. The efforts of the profession as a whole, the editorial board as a team, and the individual authors who contribute their works have culminated in an impressive and important contribution to the science and practice of respiratory therapy and respiratory medicine. The next 50 years should compel us to build on this foundation that has been laid, and the annual educational conference in Montreal (Quebec) should be the starting point.

Every year, the quality and the complexity of the work presented at the conference increases, and this event provides a unique opportunity for the sharing of ideas and the genesis of new programs and innovative ways of providing care. The most visible artefact of this is the trade show, des inhalothérapeutes et à l’intégration des services d’inhalothérapie au système de santé canadien. Nous avons de quoi être fiers de nombreuses réalisations, qui devraient nous inciter à continuer de chercher à atteindre les normes les plus élevées en recherche médicale, en innovation et en partage d’idées importantes.

Notre travail est loin d’être terminé. De plus en plus d’inhalothérapeutes font des études supérieures et de la recherche. Qui plus est, une population croissante d’inhalothérapeutes pose des questions importantes sur ce que nous faisons, la façon dont nous le faisons et le contexte dans lequel nous fonctionnons. Le Journal permet l’exploration rigoureuse et systématique de chaque secteur et la présentation de nouvelles idées et observations à un groupe de cliniciens et d’esprits inquisiteurs. De bien des façons, le Journal vise à briser le statu quo. Pour aborder des sujets aussi vastes, il faut nécessairement une équipe éditoriale ouverte à de nouvelles idées, mais axée sur la qualité, généreuse dans ses indications éditoriales tout en étant protectrice de l’intégrité de la recherche publiée.

Sur un plan plus pratique, le Journal existe grâce aux efforts des auteurs qui font des travaux importants et soumettent leurs résultats ou leurs observations à la publication. Sans leur engagement, non seulement le Journal mettrait la clé sous la porte, mais la profession et la prestation de soins en santé respiratoire sécuritaires, compétents et efficaces ne pourraient évoluer.

Le Journal d’aujourd’hui est la culmination de tous ces volets. Les efforts de l’ensemble de la profession, du comité de rédaction et des collaborateurs contribuent de manière impressionnante et importante à la science et à l’exercice de l’inhalothérapie et de la médecine respiratoire. Au cours des 50 prochaines années, nous devrons poursuivre dans cette voie, et le congrès annuel à Montréal, au Québec, devrait en être le point de départ.

Chaque année, la qualité et la complexité des travaux présentés au congrès augmentent. Cet événement est une occasion unique de partager des idées et la genèse de nouveaux programmes et de modes de soins novateurs. Le salon des exposants, où sont présentés les progrès...
where new developments in medical devices and pharmaceuticals are on display; however, the academic program highlights equally innovative contributions to the health care system. While the conference is an opportunity to connect and share, this needs to be the launching point for sharing these ideas with the world through the publication of pilot studies, case reports, health technology assessments, clinical trials, and important commentary on all of these and more. As with previous years, the Journal will publish the abstracts of the posters presented, but we do so not as a final product, but as an incentive for the authors to contribute a full-length manuscript to share the intricacies of their work and their findings.

Beyond publishing research, the Journal needs to cultivate an environment that engages respiratory therapists in meaningful commentary on the profession, the science that underlies it, and the politics of health care delivery in Canada and around the world. There are important critiques of the work that we publish that need to be heard, and aspects of health for which there has been too little exploration in our field. As the profession and the Journal continues to grow, we must devote greater attention to the social determinants of health, global health and fostering health equity to ensure that not only do we improve the quality of care we provide, but that we improve care in a way that is equitable, comprehensive, and to the benefit of all patients in Canada and around the world.

To achieve these and more, we need to continue to work to build the community of researchers and thoughtful clinicians that led the development of the initial Society and journal in Canada, and we must strive to find ways of engaging respiratory therapists in the profession. The Journal is designed to be open and independent, allowing for frank analysis and commentary on the profession, the state of research, and health care ethics and policy issues. Contributing to this discussion can be in the form of a detailed research project or a letter to the editor – we give appropriate weight to every submission that we receive and work hard to support the development of individual respiratory therapists and the science of the profession.

The next 50 years require continued growth and support from the community of Canadian and international respiratory therapists to ensure that we continue to play an important role in the care of patients with respiratory diseases. From the perspective of the Journal, this most importantly requires respiratory therapists to contribute to the discussion through the publication of important research and commentary. We are here to give you a voice and to encourage the development of individuals and the community. We look forward to what is to come.

Jason Nickerson RRT FCSRT PhD
Editor-in-Chief

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Beyond the business case: How to make your idea a reality

Kevin Taylor RRT MBA

Ever have a great idea? If you do and you want to translate that idea into reality, you’re inevitably going to have to convince someone else to support that idea. Maybe you work in a hospital and you need the support of a manager or someone more senior in your organization. Maybe you need someone to give you the resources to support your initiative. In either case, a good idea rarely ‘sells itself’. You typically have to present a business case or a convincing argument that gives the decision maker the information they need to make an informed choice... but even that is rarely enough. Every decision maker has their own range of factors to consider when reviewing your proposal, and understanding those factors will ultimately help you to build a better business case. It may even help you to address some of those considerations beforehand, making it easier for the decision maker to say ‘yes’. But you are not done yet. Even if your proposal is supported, you will still have to successfully implement your idea... and most decision makers will want to know how you intend to do that before they lend their support.

So while there is obviously much to consider when building your argument, you can approach it systematically. The model that follows breaks down the overall process into three steps: building the business case; paving the way; and winning the decision (Figure 1). The goal is to use all three to identify and address everything that could affect the success of your idea... and you can use this for tackling any decision, big or small. The steps intentionally overlap with one another – you will be discovering new information all the time, so be prepared to go back and revise.

Figure 1) Three key steps for moving your argument forward

STEP 1: BUILD THE BUSINESS CASE
Developing your idea
A good place to start is to spell out exactly what it is that you are proposing. You will want to explain why your idea is needed, perhaps by providing a description of the current state. You will need to determine how much it will cost, in terms of both dollars and human resources; the timelines involved; and, if you have any codependencies (ie, are you doing this by yourself or does someone else have to do something as well?). Let’s hit that again... the financials matter. It does not hurt you doing this by yourself or does someone else have to do something about the timelines involved; and, if you have any codependencies (ie, are you doing this by yourself or does someone else have to do something as well?). Let’s hit that again... the financials matter. It does not hurt

STEP 2: PAVE THE WAY
Now that you have a strong business case, you can start gathering additional information, consider other perspectives and build support to pave the way for a successful decision.

Understand how the decision is made
It is important to understand who is making the decision on your idea. Is it a single person or is it a committee? If it is a committee, you will need to know the mandate of that committee. This will help you refine your framing of the idea – make it match the mandate. Who is on that committee and how will each person vote? Be systematic about mapping your support and take the time to connect with each person before the discussion of your item. If they have any concerns, this will only serve to undermine the credibility of your idea. It is also important to put the benefits in the language of the decision maker. That perspective will be different than your own so do your homework. Talk to people who have similar positions or even ask your decision maker what they need to hear in your proposal. Better to get it right than to bring forward a proposal that does not cover the things that your decision maker is really concerned about.

What is your power position?
This is often overlooked, but where do you sit in terms of positional power compared with the decision maker(s)? Are you a direct report to the decision maker? Are the committee members reporting to you? Is the decision maker in another portfolio... and where does that person

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fit relative to you or your supervisor? Power and politics are prevalent in every large organization and often have a significant impact on which ideas move forward and those that do not. Determining the answers to these questions will help you to leverage your own power and, perhaps, that of your supporters.

**Should someone else take it forward?**

After contemplating your power position, does it appear that you are a little fish with a big idea? Perhaps you need a bigger fish to bring your idea forward. For example, if you need an executive vice president to sign off and you are a staff respiratory therapist, that often represents a span of three to four organizational levels in a large hospital, and the first question the executive vice president would likely ask is where your manager or director sits on the issue. You will have more success if you engage your manager or director and leverage their support when bringing it forward.

**Relationships matter**

You will have a much easier time moving your idea forward if you have a relationship with the people that you need support from — if they happen to like you, even better. This underscores the importance of networking within your organization and reinforces the value of meeting with the members of a committee one-on-one while ‘paving the way’.

**STEP 3: WIN THE DECISION**

After you have completed your homework, built support and are confident on how the decision will go, you are now ready to present your proposal. There are a couple of final points to consider.

**Presenting your case**

Obviously, preparing your presentation beforehand is of key importance. You will want to keep your presentation simple, factual and concise. You can include the answers to the questions that you have already identified and you will want to avoid letting the conversation stray from your main points. Run it by a trusted person to get honest critique; the more removed they are from the issue and the more objective the better. As always, how you say something is often more important than what you say; therefore, tone, body language and style all matter. Then, run through your presentation enough times that if you are asked some questions midway through, it will not throw you.

**Identify your best alternative to a negotiated agreement (aka ‘Plan B’)**

The ‘best alternative to a negotiated agreement’ is an expression from the world of negotiations but it essentially means ‘Plan B’. When someone says ‘No’, there is often a possibility of winning some concession or finding a compromise. So, plan ahead for this and try to be as prepared with the details on the alternatives as you were with your original idea. If the discussion is starting to erode support for your proposal, you may be able to win support for part of your idea or even win a reasonable alternative. Either way, it is still a step forward and you can always use that as a new starting point to try again later.

**STEP 4: BUILD A REPUTATION BY IMPLEMENTATION**

Congratulations, you won the decision! Now what? Well, your next idea’s success begins right now. People who build a reputation as ‘someone who delivers’ are the ones that decision makers support the most. You definitely do not want to be seen as that person who always brings ideas forward but never actually does anything about them. Therefore, make a point of reporting back to the decision maker(s) on your progress and absolutely share your success with others.

**BUSINESS CASE TEMPLATE**

There is no better way to track your progress than by writing it down. The business case template presented in Figure 2 captures all the above and will help you develop your idea, pave the way and to win the decision.

**DISCLOSURE:** Kevin Taylor is the CEO and Registrar at the College of Respiratory Therapists of Ontario (CRTO) – the regulatory body for Respiratory Therapy in Ontario, Canada – and is a member of the National Alliance of Respiratory Therapy Regulatory Bodies (NARTRB). This article is adapted from a presentation at the CSRT Educational Conference and Trade Show 2013.

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How do we measure the quality of a respiratory therapy education program?

Sandra Biesheuvel BSc RRT

At the beginning of a new academic year, respiratory therapy education programs across the country welcome new students into the program and welcome returning students into their next year of study. The faculty returns to teaching feeling relaxed and refreshed after a break from the classroom. We dust off our lectures and prepare to do the same thing that we did last year. Or do we?

Is it sufficient to continue doing what we did last year because it appeared to work? The course objectives were met and the students all fared well on the examinations and laboratory evaluations. Does this mean that we did a good job? How do we know if we delivered a course that was of sufficient quality? Whether we are working at the bedside, in management, sales or education, every respiratory therapist (RT) should ask, ‘Am I doing my job right? Am I doing the right thing?’ These questions are extremely important to the RT clinician whose job it is to provide safe, quality, client-centred care. These questions are important to those who work in the field of respiratory therapy education because we are responsible for educating and training future generations of RTs. How do we know if we are doing a good job in educating and training our students? How do we measure the quality of a respiratory therapy education program? To answer that, we must first ask what is it that we want to achieve. The respiratory therapy education program at the University of Manitoba (Winnipeg, Manitoba) developed a five-year strategic plan that would answer the ‘what’. Our mission – and thereby our ‘what’ – is “to create, disseminate and provide knowledge in health and Respiratory Therapy through research, education and service, in collaboration with our stakeholders” (1). Our goal is to produce degree-RTs who can work effectively in any setting, delivering collaborative, evidence-based care, and who can advance the profession through research and advocacy (1). Through the strategic plan, we have identified the needs of the university and students, our community and our stakeholders, and have developed four strategic initiatives. In achieving these initiatives, we will answer what it is that we wish to achieve:

1. A quality entry-to-practice RT education program
2. Scholarship that advances the profession
3. Administrative and operational excellence
4. Community engagement and service (1)

The next questions we must ask are how are we going to achieve these initiatives, and how will we know if we have achieved them? Mission and vision and values statements look great on paper, but the key to successfully achieving the goals of a strategic plan is to measure the actions of implementing the plan. This requires the development of a quality roadmap. Each strategic initiative becomes a quality issue on the roadmap. A total of 12 objectives, each linked to several actions, were developed to measure how we will achieve our strategic initiatives. The actions are measured over a period of time, and results are collated and analyzed. This process thereby forms our indicators and measurements of success or lack thereof. The quality plan can be modified as goals are achieved or as indicators require alteration. In our quality roadmap, the first strategic initiative has been developed as follows:

STRATEGIC ISSUE: QUALITY ENTRY-TO-PRACTICE RT EDUCATION PROGRAM

Objectives
- To deliver a national calibre, cutting-edge curriculum
- Enhance and develop relevant faculty breadth of experience
- Recruit and retain highly qualified and diverse student cohorts (1)

From these objectives, we developed specific actions that will be measured over a period of time, with most measurements occurring on an annual basis. Expanding on the first objective, our actions are the following:

- Develop a new Bachelor of Medical Rehabilitation in Respiratory Therapy (BMR-RT) curriculum
- Increase stakeholder and clinical community involvement
- Enhance simulation delivery within the academic portion of the program

Each action has several performance measures with subsequent outcomes. The outcomes are the descriptors of success. The remaining three strategic initiatives were mapped in a similar manner to complete the quality roadmap for the RT education program. Strategic plans look impressive on paper and can be intimidating, but if the plan is analyzed one strategic initiative at a time, it becomes manageable and feasible in the time frame allotted.

I believe that a strategic plan tells you where you are going, it becomes your destination, and the quality roadmap tells you how you are going to get there. Goals of the organization or program are identified and, when the goals are achieved, you have reached your destination. The actions that you take to reach those goals become the directions that you follow along the map.

Actions produce outcomes and, with many health care profession education programs providing Bachelor’s or Master’s degrees as entry-to-practice, our educational institutions need to ask, ‘What is the best possible outcome that we can provide for our students?’ The Canadian Society of Respiratory Therapists has created a position statement advocating for a degree as entry-to-practice for RTs in Canada (2). This is not about ‘keeping up with the Joneses’, but about keeping up with the changing face of health care. “The graduate RT must be prepared to enter the workforce as the expert on respiratory care and be prepared to consult on the provision of care” (3). This requires our students not only to be competent in using respiratory therapy equipment, but also to be able to apply evidence-based knowledge to manage and treat patients. We are teaching our students what it means to promote a culture of client-centred care, in which clients, patients, family members and all members of the health care team have a voice in what care is delivered and how it is delivered. In addition to ensuring that all components of the national competency profile are incorporated and measured in our curriculum, we must teach what it means to be a health care professional in the 21st century. We want our students to learn to deliver respiratory therapy services using different models of care in diverse settings. We want them to develop leadership skills that will aid them in decision making and navigating team dynamics and conflict.

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In spring 2011, the University of Manitoba RT program began the process of curriculum renewal. We deconstructed each course and matched the objectives to the national competency profile. This enabled us to identify redundancies between courses as well as areas that needed more clearly defined objectives. Two such areas are interprofessional education and patient safety. In 2008, the University of Manitoba Interprofessional Education Initiative was formed by administrators, faculty and students from 13 academic units with the belief that interprofessional education for collaborative patient-centred practice is fundamental in building a stronger health care system (4).

These learning opportunities enable students to learn ‘from, with and about each other’ (5). The interprofessional curricula framework has been mapped into the new RT curriculum so that our students will learn and practice how to collaborate with other health professions to promote optimal health outcomes for individuals and communities, increase satisfaction with care for both individuals and health care providers, and improve efficiencies within the health care system (5).

Another area of competencies that we addressed is related to patient safety. The Canadian Patient Safety Institute (CPSI) has developed a framework of safety competencies required by health professionals to promote a culture of safety. The intent of these competencies is to “raise the bar for health care education in Canada, and possibly around the world” (6). The CPSI competencies have been mapped into the respiratory therapy curriculum, and our students will be provided with interprofessional learning opportunities to practice their role and collaborate with other health profession students in providing safe, quality care.

We are preparing our students to graduate with the skills to further their careers in research related to respiratory therapy, to continue to grow as collaborative health care practitioners and become leaders in the field. Similar to all respiratory therapy practitioners, managers and educators in any sector, we are dedicated to preparing the future of our profession.

It is our intent that the strategic plan and quality roadmap of the respiratory therapy program at the University of Manitoba will keep us on track to deliver a quality education program. We will be able to measure our progress and make changes as needed so that we can, in fact, measure the quality of our respiratory therapy education program. Now that I am in my fourth year of teaching, and 20th year in the profession, I continue to ask myself the same questions I have asked since graduating: Am I doing my job right? Am I doing the right thing?

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Improving survival outcomes in lung transplant recipients through early detection of bronchiolitis obliterans: Daily home spirometry versus standard pulmonary function testing

Kevin S Robson BMR RRT1-2, Andrew J West MAppSc DipPH RRT1

BACKGROUND: Long-term lung transplant success is limited by bronchiolitis obliterans syndrome (BOS), a form of chronic allograft rejection that manifests in the majority of patients by five years post-transplant. Frequent monitoring of pulmonary function measurements through the use of daily home spirometry may have the capability to detect the onset of BOS sooner than standard pulmonary function testing. Early detection of BOS would confer a treatment advantage that may improve survival outcomes for lung transplant recipients.

METHODS: A systematic review of current evidence was used to determine the effectiveness of daily home spirometry as a BOS detection tool, in addition to its impact and survival outcomes. Articles were included in the present systematic review if they were randomized control studies and if their purpose(s) included investigation of spirometry as a BOS detection tool in lung transplant patients.

RESULTS: A primary search of databases yielded 115 unique citations, with an additional four citations identified through a secondary review of the reference lists of retrieved articles. After application of all inclusion and exclusion criteria through abstract and full-text review, eight randomized controlled trials were included in the review.

DISCUSSION: Forced expiratory volume in 1 s (FEV1) has been identified as the most reliable diagnostic tool for detecting the onset of BOS. Two studies compared the use of traditionally scheduled pulmonary function testing with daily home spirometry and found BOS stage 1 to appear 341 days earlier with home spirometry (P<0.001). Other studies that investigated the impact early detection had on survival showed a positive trend toward freedom from BOS and reduced rates of retransplantation.

Early detection of BOS would confer a treatment advantage that may improve survival outcomes for lung transplant recipients.

CONCLUSION: Daily home spirometry has been shown to lead to earlier detection and staging of BOS when compared with standard pulmonary function testing. Although FEV1 has been shown to be the most sensitive and reliable marker of BOS onset, the impact of earlier staging via home spirometry on survival has not been reliably determined.

Key Words: Bronchiolitis obliterans; Forced expiratory volume; Home monitoring; Lung transplantation; Rejection; Spirometry

Patients diagnosed with advanced lung disease remain significantly symptomatic despite medical therapy and experience statistically high short-term mortality (1). Many of these patients desperately seek symptomatic relief and would consider undergoing lung transplantation to improve their quality of life. Since the first successful heart-lung transplant was performed in 1981 by Dr Bruce Reitz (2), an accepted intervention has emerged for patients with end-stage cardio-pulmonary disease. An estimate by the Global Observatory on Donations & Transplantation in 2011 reported an average of 3200 lung transplants performed each year from 2006 to 2010 worldwide (3), increasing to 3972 in 2012 (4). Although many patients live longer with an improved quality of life after lung transplantation, a significant proportion experience adverse effects and comorbidities, often leading to death sooner after transplant than predicted without (1).

The need for investigation is a result of notably poor survival outcomes for lung transplant recipients specifically. According to a 2008 publication from the Registry of the International Society for Heart & Lung Transplantation (ISHLT) (5), lung transplant recipients had an overall median survival of 5.3 years. The registry described long-term survival rates after lung transplantation of 79% at one year, 63% at...
The relative lack of improvement in lung transplant rejection rates is a concern for an ageing population in which the burden of chronic lung disease is increasing. The present article systematically reviews current research regarding the use of spirometry as a tool for BOS detection in lung transplant recipients, particularly through FEV1 values, and the role home spirometry can play in monitoring for FEV1 changes sooner. A secondary outcome of interest in the present analysis was the impact of early detection using spirometry on survival.

### METHODS

#### Search strategy
A primary search of computerized databases (PubMed, Scopus and MedlinePlus) was conducted in January 2014. Key terms for the search included “bronchiolitis obliterator”, “lung transplantation”, “rejection”, “spirometry”, “forced expiratory volume”, “home monitoring” and “mortality”. A secondary search using the reference lists of all retrieved articles was conducted to identify additional studies. Both searches were limited to human studies in English that were published between 1993 and 2014. No age, sex or race limitations were applied to the search.

#### Study selection
Articles were included in the present systematic review if they were randomized controlled studies and their purpose(s) included investigation of spirometry as a BOS detection tool in lung transplant patients. Articles were excluded from the systematic review if they exhibited any one of the following criteria: methodologies other than randomized clinical trials, including reviews, observational studies or commentaries; inadequate randomization methods; failure to report on a standardized outcome related to the purpose (ie, decrease in FEV1, retransplantation or mortality); and the use of spirometry as a detection tool for pathologies other than BOS.

#### Systematic review process
The review team consisted of a clinical respiratory therapist (KSR) and a research respiratory therapist (AJW). Initial abstract review of all citations retrieved was performed by one investigator (KSR) and articles were chosen for further review based on the inclusion criteria (KSR). Full-text review of those articles was performed independently by both team members to determine potentially relevant studies for final inclusion. Any disagreement between the reviewers was resolved by consensus.

The Cochrane risk of bias framework for randomized controlled trials (20) was used to determine the risk of bias. Each study was independently critically appraised by the two researchers, and any disagreement between reviewers was resolved by consensus.

### RESULTS

The primary search of the databases yielded 115 unique citations, with an additional four citations identified through a secondary review of the reference lists of retrieved articles. After application of all inclusion and exclusion criteria through abstract and full-text review, eight randomized controlled trials were included in the review. Each of the eight studies was determined to exhibit a low risk of bias. Figure 1 provides an overview of the trial flow.

The trials identified for inclusion in the present review are summarized in Table 1. All included trials used either a measured FEV1 <20% of baseline predicted values or transbronchial biopsy (TBB), or a combination of the two, as criteria for diagnosing BOS. The primary outcomes of each trial were measured using spirometry to evaluate the utility of FEV1 values as a staging tool for BOS (confirmed with TBB as the control), or to evaluate the detection capabilities of home spirometry versus routine clinical testing. In all studies, pulmonary function testing was performed following the standards established by the American Thoracic Society at each clinic visit.

### DISCUSSION

The early identification of chronic rejection following lung transplantation is problematic due to the lack of reliable diagnostic testing. The once commonly used method of TBB to detect BOS is now rarely performed due to its low sensitivity (17). Therefore, the diagnosis of chronic airways rejection is generally based on changes in pulmonary function, specifically FEV1. BOS has been commonly defined as a decline in FEV1 of >20% from the post-transplant baseline in the absence of acute rejection or active infection (11,13-16). The terms ‘BOS’ and ‘chronic rejection’ have become synonymous with one
another when considering lung transplant, and the use of monitoring declines in FEV<sub>1</sub> has been shown to be a reliable diagnostic tool. However, whether the use of spirometry to monitor FEV<sub>1</sub> changes is the best test for early detection of BOS is yet to be established. It is, therefore, necessary to consider other detection strategies to determine what will show signs of BOS in its earliest and most treatable stages.

### Survival outcomes in lung transplant

<table>
<thead>
<tr>
<th>Method of BOS identification</th>
<th>Comparison</th>
<th>Outcomes evaluated</th>
<th>Primary findings</th>
</tr>
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<tbody>
<tr>
<td>Average maximal FEV&lt;sub&gt;1&lt;/sub&gt; obtained through spirometry &gt;3 weeks apart</td>
<td>Maximal baseline FEV&lt;sub&gt;1&lt;/sub&gt; obtained post-transplant</td>
<td>BOS grade 1 identified as a sustained FEV&lt;sub&gt;1&lt;/sub&gt; &lt;80% relative to baseline</td>
<td>Baseline FEV&lt;sub&gt;1&lt;/sub&gt; values to be strongly associated with freedom from BOS stage 1, and long-duration BOS-free survival</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &lt;20% from baseline (determined from the average of 2 measurements made at least 3 weeks apart)</td>
<td>Maximal baseline FEV&lt;sub&gt;1&lt;/sub&gt; and FEF&lt;sub&gt;25%-75%&lt;/sub&gt; obtained post-transplant</td>
<td>Potential BOS (stage BOS 0-p) defined by an FEV&lt;sub&gt;1&lt;/sub&gt; &lt;10% to 19% baseline and/or &gt;25% decrease in FEF&lt;sub&gt;25%-75%&lt;/sub&gt;</td>
<td>BOS 0-p was associated with higher sensitivity, specificity, and positive predictive values over FEF&lt;sub&gt;25%-75%&lt;/sub&gt; criterion. Of patients who met BOS 0-p criterion, 81% developed BOS stage 1 or died within 3 years</td>
</tr>
<tr>
<td>TBB performed routinely at follow-up and when respiratory symptoms arose*</td>
<td>Persistent (&gt;2 days) decrease in FVC or FEV&lt;sub&gt;1&lt;/sub&gt; &gt;10% over a 7-day average</td>
<td>Acute cellular rejection and/or chronic rejection confirmed through TBB</td>
<td>In 16 of 23 confirmed rejections, FEV&lt;sub&gt;1&lt;/sub&gt; and FVC decreased significantly (P&lt;0.001), with a &gt;10% decrease in the 7-day average before TBB</td>
</tr>
<tr>
<td>TBB performed routinely or post-clinical suspicion of an acute process†</td>
<td>Best baseline FVC, FEV&lt;sub&gt;1&lt;/sub&gt;, FEF&lt;sub&gt;25%-75%&lt;/sub&gt; obtained postoperatively</td>
<td>The magnitude in the drop of FVC, FEV&lt;sub&gt;1&lt;/sub&gt; and FEF&lt;sub&gt;25%-75%&lt;/sub&gt; at the time of an abnormal biopsy when compared with baseline</td>
<td>A mean drop in FVC from 71% to 62% predicted (P&lt;0.00001), and FEV&lt;sub&gt;1&lt;/sub&gt; from 66% to 58% predicted (P&lt;0.0001) compared with baseline. A statistically significant change was not apparent in FEF&lt;sub&gt;25%-75%&lt;/sub&gt; (P=0.13)</td>
</tr>
<tr>
<td>Clinical staging of BOS using the ISHLT algorithm based on FEV&lt;sub&gt;1&lt;/sub&gt; changes relative to baseline obtained clinically</td>
<td>The average of 3 FVC manoeuvres performed once daily</td>
<td>Number of days from date of transplant to the first detection of any stage BOS (calculate from both clinical and home FEV&lt;sub&gt;1&lt;/sub&gt; measurements)</td>
<td>Staging based on home measurements detected a decline to stage 1 an average of 341 days earlier than clinic measures (P&lt;0.001), and further declines to stage 2 and stage 3 were detected an average of 144 days (P&lt;0.05) and 159 days earlier than clinic-based staging</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &lt;20% predicted baseline post-transplant</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; % predicted at 0, 6, 12 and 18 months after BOS onset</td>
<td>Decline of FEV&lt;sub&gt;1&lt;/sub&gt; after BOS stage 1 onset</td>
<td>The rate of decline of FEV&lt;sub&gt;1&lt;/sub&gt; % predicted changed significantly during the first 2 years after BOS onset (P&lt;0.0001). The steepest decline in FEV&lt;sub&gt;1&lt;/sub&gt; % predicted was apparent in the first 6 months and was highly statistically significant (12% decline; P&lt;0.0001)</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &lt;20% predicted baseline values</td>
<td>The average of 3 FVC manoeuvres performed once daily</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; declines measured from daily spirometry at home</td>
<td>Using home spirometry, the onset of decline began an average of 284 days before diagnosis of chronic rejection, which was significantly earlier (P&lt;0.05) than the decline observed with clinic pulmonary function testing</td>
</tr>
<tr>
<td>Home spirometry-based FEV&lt;sub&gt;1&lt;/sub&gt; &lt;20% baseline predicted value</td>
<td>Home spirometry with data transfer equipped bluetooth</td>
<td>Time from onset of symptoms to physician consultation during the first 6 months after lung transplantation</td>
<td>Median time to first consultation (P=0.60) and frequency of consultation (P=0.06) did not differ significantly in the 2 groups</td>
</tr>
</tbody>
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*All subjects underwent surveillance bronchoscopy with bronchoalveolar lavage and transbronchial biopsies one and two months after transplantation, and every two months during the remainder of the first post-transplant year. After one year, bronchoscopic examinations were continued every three months until the subject had 12 consecutive rejection-free months. In addition, the subjects underwent bronchoscopy with lavage and transbronchial biopsies whenever signs or symptoms suggestive of respiratory infection occurred, or when clinical forced expiratory volume in 1 s (FEV<sub>1</sub>) decreased >15% compared with previous clinic visits; †All patients were screened for rejection with bronchoscopy and transbronchial biopsy (TBB) performed at three and six weeks, and at three, six, nine and 12 months, and every six months after the first year. BOS Bronchiolitis obliterans syndrome; DLT Double-lung transplant; FEF<sub>25%-75%</sub> Forced expiratory flow between 25% and 75% of forced vital capacity (FVC); FEV<sub>1</sub> Forced expiratory volume in 1 s; HLT Heart-lung transplant; ISHLT The International Society for Heart & Lung Transplantation; LT Lung transplant; SLT Single-lung transplant.
TABLE 2
International Society for Heart & Lung Transplantation staging system for bronchiolitis obliterans syndrome (BOS)

<table>
<thead>
<tr>
<th>BOS stage</th>
<th>1993 grading system</th>
<th>2002 revised classification system</th>
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<tbody>
<tr>
<td>BOS 0</td>
<td>FEV1 &gt;80% of baseline</td>
<td>FEV1 &gt;90% and FEF25%-75% &gt;75% of baseline</td>
</tr>
<tr>
<td>BOS 0-p</td>
<td>Not applicable</td>
<td>FEV1, 81% – 90% and/or FEF25%-75% ≤75% of baseline</td>
</tr>
<tr>
<td>BOS 1</td>
<td>FEV1 66% – 80% of baseline</td>
<td>FEV1, 66% – 80% of baseline</td>
</tr>
<tr>
<td>BOS 2</td>
<td>FEV1 51% – 65% of baseline</td>
<td>FEV1, 51% – 65% of baseline</td>
</tr>
<tr>
<td>BOS 3</td>
<td>FEV1 ≤50% of baseline</td>
<td>FEV1, &lt;50% of baseline</td>
</tr>
</tbody>
</table>

Adapted from reference 21. FEV1, Forced expiratory volume in 1 s; FEF25%-75%, Forced expiratory flow between 25% and 75% of vital capacity.

Comparison of BOS detection strategies

A study by Cook et al (21) examined 22 transplant recipients at two points in time, one or two years after the procedure. The inclusion of post-transplant patients who did not have BOS at either occasion acted as effective study controls. For the purpose of the study, they defined BOS as a 20% drop in FEV1 in the post-transplant period. At the first examination, five of the 22 patients had BOS and, at the second examination, 10 of 22. These outcomes allowed the authors to examine the sensitivity and specificity of various other diagnostic tests at each point in time. The tests they studied included maximum mid-expiratory flow (MMEF), indexes of maldistribution of ventilation and perfusion derived from radioiso-topo scans (V/Q scan), and high-resolution computed tomography scans to examine air trapping, perfusion patterns and bronchial dilatation (21).

Several of the studies included in the review examined the capacity and efficacy of different tests to detect BOS. Comparing the findings of Cook et al (21) with those whose focus was on BOS diagnostic testing, similar conclusions emerged throughout. Collectively, it was found that patients with BOS (based on low FEV1) also had significantly lower than predicted MMEF (55.8%) (16,17,22). However, Cook et al (21) found that a significant portion of their subjects without BOS also had low MMEF (39.5%). V/Q scans showed somewhat less abnormality compared with MMEF, but often more in those without BOS. Overall, V/Q scan abnormalities at first examination did not predict the presence of BOS at second examination with any reliability (P=0.016). Computed tomography scanning was shown to be useful in relation to the severity of subsequent BOS (ie, subjects with severe BOS at the second examination were likely to have had abnormal perfusion and air trapping at the first examination) (21,22). However, the focus is not on detecting the severity of BOS, but rather on the detection of onset. Hence, it is evident that other forms of BOS detection show no strong evidence in being more useful or reliable than monitoring the decline in FEV1 values.

BOS staging using spirometric measures

TBB was once considered to be the ‘gold standard’ for the diagnosis of BOS; however, the sensitivity for diagnosis varied from 15% to 78% (17). Due to poor sensitivity, and the associated morbidity and mortality, the BOS staging system was established by the ISHLT in 1993 (18,19). This staging system is based on airflow limitation (a percentage change from a baseline post-transplant FEV1 obtained on formal clinical spirometry) with or without the diagnostic histological finding of BOS. The ISHLT concluded that FEV1 was the most reliable and consistent clinical pulmonary function test parameter that could provide an indication of graft function (18,19). A staging algorithm based on FEV1 was developed to classify the levels of dysfunction in BOS. Stage 0 is reserved for FEV1 >80% of maximum baseline value and implies no significant abnormality. Stages 1 to 3 indicate a worsening condition, with 66% to 80%, 51% to 63% and ≤50% of maximum baseline values, respectively. The 1993 and revised 2002 ISHLT BOS stages are outlined in Table 2 (19).

Implementation of the ISHLT algorithm has been adopted worldwide by transplant and pulmonary function clinics as a means of monitoring BOS. Clinically, FEV1 results are gathered through spirometry and are generally measured at monthly, quarterly or yearly intervals depending on the length of time since transplant. Results are interpreted based on declines in FEV1 from the maximum FEV1 levels attained since transplant (23). These maximum FEV1 values define the FEV1 baseline, and are determined based on the average of the two previous highest consecutive FEV1 measurements obtained in clinic at least three to six weeks apart. Declines are determined as percent decreases in FEV1 from previously established baseline values (23,24). While the staging of BOS is primarily based on a decline in FEV1, several studies have indicated that a decrease in forced expiratory flow between 25% and 75% of vital capacity (FEF25%-75%) is also a sensitive marker for the onset of BOS (14,16,23).

In 2002, the ISHLT consensus panel proposed a new stage, designated ‘potential BOS’ or ‘BOS 0-p’, defined as an FEV1 of 81% to 90% of baseline or a FEF25%-75% ≤75% of baseline (14). This new stage (described in Table 2) is meant to alert the clinician to the increased risk for subsequent BOS among patients with slight declines in lung function, and to indicate the need for close functional monitoring. Spirometric measurements at regular intervals are critically important to detect evidence of airflow obstruction before the development of clinical symptoms. Thus, pulmonary function testing is strongly relied on as one of the earliest tests for detection of a graft complications such as BOS.

During the first year post-transplant, it is common practice that lung transplant recipients undergo biweekly or monthly spirometric testing. Monthly testing is deemed the minimum frequency in accordance with American Thoracic Society criteria for acceptability and reproducibility (25). At later points in time, measurements every two or three months are often performed instead (25). BOS, as a form of chronic graft rejection, is not often encountered before the first year post-transplant. The problem arises from less frequent monitoring occurring when the disease process is most likely to develop. More frequent monitoring via home spirometry may be an optimal solution. Daily home spirometry may detect a decline in pulmonary functional parameters earlier than regularly scheduled outpatient clinic visits, and may be invaluable as a regular component of follow-up for lung transplant recipients (25,26).

The effectiveness of home spirometry

The concept of home spirometry is not a new one in the field of lung transplantation. That is, patients are typically advised to record home spirometry measurements once or twice per day. They are instructed to report persistent decrements in values to their lung transplant centres or pulmonologist (25-27). There are inherent problems with home spirometry measurements once or twice per day. They are instructed to report persistent decrements in values to their lung transplant centres or pulmonologist (25-27). There are inherent problems with home spirometry measurements once or twice per day. They are instructed to report persistent decrements in values to their lung transplant centres or pulmonologist (25-27).
Persistence values of one to seven days were considered. The difference in the time to each stage using clinic and home BOS staging was evaluated using the paired t test, and the results are summarized in Table 3 (24).

Finkelstein et al (19) performed a follow-up retrospective analysis involving 45 lung transplant recipients participating in a home spirometry monitoring program. The subjects in that study served as their own control because clinical and home spirometry measurements were collected concurrently. The determinants of BOS staging were based on home and clinical FEV1 values. Seventeen of the 45 subjects developed lung decline of at least BOS stage 1, at which time detection was an average of 341 to 276 days earlier with home spirometry.

These studies found that home spirometry may detect a decline in pulmonary function significantly earlier than clinic spirometry reflected by BOS detection times that were statistically significant for both persistence requirement studies (P<0.001) (18, 19). What can be concluded is that home spirometry may be a reliable and safe alternative to frequent clinic-based pulmonary function testing in lung transplant recipients. Unfortunately, the study did not address the impact of early detection on survival outcomes.

The use of home spirometry for detection of BOS does not immediately diagnose the condition and still requires the lung transplant recipient to undergo bronchoscopy to exclude alternative diagnoses. It does allow for the steps toward diagnosing BOS to be made earlier and more conveniently for patients living great distances from transplant centres. It would stand to reason that this may have an impact on graft and patient survival.

Impact on survival

A secondary outcome of interest investigated by the present review was whether the interventions to date have improved the survival outcomes for lung transplant recipients. No randomized controlled trials were identified that described this outcome, with the exception of one observational study that was eliminated from the formal review (28). The authors of a prospective cohort study, completed through the University of Minnesota (Minnesota, USA), collected a total of 132,822 daily spirometry readings from January 27, 2002 to January 23, 2009 (28). The study involved 246 patients whose records were included for analysis. The mean (± SD) age of the subjects was 49.3±11.8 years and there were 146 (59.4%) deaths on or before January 23, 2007. To determine the effect of home monitoring on pulmonary-related death, a competing risks analysis was performed. The results yielded a risk ratio of 0.416 (95% CI 0.123 to 1.407) among pulmonary-related mortality and a risk ratio of 1.347 (95% CI 0.508 to 3.572) for non-pulmonary-related mortality (28).

These findings suggest that risk was reduced in subjects with good spirometry adherence, but subsequently died from pulmonary-related causes. The adherence to home monitoring in the early years of the post-transplant period resulted in a trend toward improved survival. The competing risk regression analysis showed that the benefit came largely in the group that subsequently died from pulmonary-related causes (28). This was to be expected because monitoring pulmonary function would be most helpful in alerting a disease condition, similar to BOS, that has direct bearing on the lung.

The present study showed that home monitoring for post-lung transplantation patients has a positive impact on survival. Kaplan-Meier event-free analysis showed decreased freedom from BOS time in nonadherers (30%) compared with good (43%) or moderate (19%) adherers (P<0.014), and a tendency toward lower retransplantation rates (P<0.07), although this did not reach statistical significance (28). Further analysis of mortality causes showed a trend in greater reduction of pulmonary-related mortality but this also did not reach statistical significance.

CONCLUSIONS

Pulmonary function testing is the cornerstone of lung transplant recipient monitoring. It has the advantage of being noninvasive, reproducible, may be performed frequently and daily by patients at home and, in some cases, may be automatically transmitted by telephone or electronic means to a hospital. It is a useful procedure for early detection of preclinical allograft complications and consecutive early treatment. The FEV1 is a sensitive measure of allograft function and has been considered to be the most useful spirometric indicator for diagnosing and staging the extent of BOS. The ISHLT proposed that a persistent decrease in FEV1 >20% of its baseline value be diagnostic criteria for BOS. The ISHLT staging system for assessing the extent of BOS is now widely accepted. However, BOS primarily affects the distal airways and FEV1 is considered to reflect an already advanced obliterative process. For this reason, other functional parameters that show small airways dysfunction better than FEV1—such as FEF25%-75%—were proposed to be an earlier marker of BOS. The ISHLT was revised in 2002 to include FEF25%-75% measurements as a potential BOS marker.

Supportive evidence from several studies has led to the conclusion that FEV1 was the most reliable and consistent clinical pulmonary functional parameter that provided an indication of graft function. The problem with detecting BOS using FEV1 is that therapy seldom improves lung function, which is interpreted to indicate that the pathological process is irreversibly established. After examining the use of home spirometry in the largest study to date, it was found that BOS staging was detected notably sooner compared with clinic spirometry testing. Nonadherers did show decreased freedom from BOS, but it did not impact survival. Overall, home monitoring was shown to have a positive impact on survival, but was not statistically significant.

Whether the use of home spirometry for the detection of BOS achieves widespread use in the lung transplantation community is yet to be determined. Future investigations should consider evaluating the usage patterns of and barriers to widespread implementation of home spirometry in this context (29, 30). Effort should also be made to identify the most effective means of treating BOS once an early diagnosis has been established (30). Currently, it remains to be seen whether a several-month lead time in the diagnosis of BOS will translate to earlier stabilization of pulmonary function, a less limited patient and improved survival.

DISCLOSURES: The authors have no financial disclosures or conflicts of interest to declare.
REFERENCES
A retrospective analysis of airway management in patients with obstructive sleep apnea and its effects on postanesthesia care unit length of stay

Claire A Brousseau BSc, Gregory R Dobson MD FRCPC, Andrew D Milne MD MSc FRCP(C) PEng

Obstructive sleep apnea (OSA) is a form of sleep-disordered breathing characterized by periods of partial or complete obstruction of the upper airway during sleep, resulting in oxygen desaturations. Symptoms and risk factors for OSA are of particular importance in the management of OSA patients in the perioperative setting. The present study collected data regarding the intraoperative airway management of OSA patients and their course in the postanesthesia care unit (PACU) over a six-month period. A total of 86 patients underwent general anesthesia, 63 of whom were intubated by direct laryngoscopy. Of these, 43% were classified as a grade 1 view by direct laryngoscopy; 43% were grade 2 and 14% were classified as grade 3. Apnea events or periods of desaturation in the PACU were observed in 27% of cases. Length of stay was significantly longer for cases in which PACU nurses had indicated that OSA had affected the individuals’ postoperative course of treatment. Overall, OSA patients had an increased frequency of grade 3 views compared with the general population, and adjuncts were commonly used to help secure the airway in OSA patients. Symptomatic OSA patients placed increased demands on the PACU in terms of length of stay and hospital resources.

Key Words: Difficult airway; PACU complications; Sleep apnea

Obstructive sleep apnea (OSA) is a form of sleep-disordered breathing that has become increasingly prevalent in contemporary society. OSA is characterized by periods of partial or complete obstruction of the upper airway during sleep, resulting in oxygen desaturations (1), which can lead to angina, cardiac arrhythmias, and both systemic and pulmonary hypertension (2). Various daytime symptoms are also associated with OSA, including excessive daytime sleepiness, morning headaches, fatigue, irritability and personality changes (3). Although the pathophysiology of OSA depends primarily on pharyngeal anatomy and stage of sleep (4), there are several factors that can contribute to the development of OSA. Obesity, craniofacial and upper airway structure, older age, sex (hormonal differences) and genetics can all contribute to the likelihood of an individual developing OSA (5). These risk factors and symptoms are of particular importance when preparing to manage OSA patients in the perioperative setting in terms of securing the airway, as well as in postoperative discharge planning. The prevalence of OSA in the general surgical population is reported to be 20% to 24%, of which 90% is undiagnosed (6), highlighting the importance of recognizing the common symptoms and risk factors in these patients.

During general anesthesia, definitive airway management is crucial to maintain ventilation and oxygenation throughout the surgical procedure. The combination of physical properties, such as obesity, craniofacial and pharyngeal abnormalities, along with a decreased airway patency and increased obstructive response to anesthetics and analgesic medications can all contribute to making OSA patients potentially more difficult to intubate and manage (7,8). The Cormack-Lehane (CL) score is a common grading system used to quantify the ease or difficulty of intubation based on the extent of glottic structures apparent on direct laryngoscopy. Typically, grade 3 (only the epiglottis visible) or grade 4 (no glottic structures visible) views are considered to be ‘difficult’ intubations (9,10). Considering the loss of elasticity in the airway anatomy and excess adipose tissue around the neck that is characteristic of OSA patients, it is plausible that these patients can be more difficult to intubate (11).

Previous studies have shown an association between OSA and difficult intubation (7,8,11-14). Hiremath et al (7) observed 15 patients who were difficult to intubate and found that eight (53.3%) had OSA compared with only two (13.3%) in the control group. Chung et al (12) also investigated a cohort of patients who were unexpectedly difficult intubate and found that 66% had OSA. Similarly, Siyam and Benhamou (13) found that difficult intubation occurred in 21.9% of OSA patients compared with 2.6% of control patients, and Bolden et al (14) reported that 15% of their OSA cohort experienced difficult intubations. However, Neligan et al (15) reported that OSA was not linked to CL airway grade nor difficult intubation in bariatric patients.

The present study examined the airway management techniques and relative difficulty of intubation of OSA patients in a large teaching institution. As a secondary outcome, the postanesthesia care unit (PACU) data for these patients were analyzed for PACU length of stay (LOS), apneas or related complications observed, and the effect of OSA on the PACU LOS.
TABLE 1
Demographic data of postoperative obstructive sleep apnea patients

<table>
<thead>
<tr>
<th></th>
<th>Male (n=66)</th>
<th>Female (n=25)</th>
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<tbody>
<tr>
<td>Age, years</td>
<td>56.9±12.5</td>
<td>54.8±8.7</td>
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</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>34.3±7.1</td>
<td>39.2±9.9*</td>
<td>0.01*</td>
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</tbody>
</table>

Data presented as mean ± SD unless otherwise indicated. *Statistically significant

TABLE 2
Admission status, surgical type and anesthetic method of postoperative obstructive sleep apnea patients

<table>
<thead>
<tr>
<th>Surgical details</th>
<th>n/n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outpatient</td>
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<tr>
<td>Same-day admission</td>
<td>57/91 (63)</td>
</tr>
<tr>
<td>Inpatient</td>
<td>13/91 (14)</td>
</tr>
<tr>
<td>Airway related</td>
<td>14/91 (15)</td>
</tr>
<tr>
<td>Intra-abdominal/thoracic</td>
<td>32/91 (35)</td>
</tr>
<tr>
<td>Major joint/arthroplasty</td>
<td>7/91 (8)</td>
</tr>
<tr>
<td>Minor/peripheral surgery</td>
<td>38/91 (42)</td>
</tr>
<tr>
<td>General anesthetic</td>
<td>86/91 (95)</td>
</tr>
<tr>
<td>Spinal/regional anesthetic</td>
<td>5/91 (5)</td>
</tr>
</tbody>
</table>

TABLE 3
Method used to secure and manage the airway in surgical obstructive sleep apnea patients undergoing general anesthesia

<table>
<thead>
<tr>
<th>Airway method</th>
<th>n/n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct laryngoscopy</td>
<td>63/86 (73)</td>
</tr>
<tr>
<td>Cormack-Lehane grade 1</td>
<td>27/86 (33)</td>
</tr>
<tr>
<td>Cormack-Lehane grade 2</td>
<td>27/86 (33)</td>
</tr>
<tr>
<td>Cormack-Lehane grade 3</td>
<td>9/86 (11)</td>
</tr>
<tr>
<td>Cormack-Lehane grade 4</td>
<td>0/86 (0)</td>
</tr>
<tr>
<td>Laryngeal mask airway</td>
<td>15/86 (17)</td>
</tr>
<tr>
<td>Glidescope (Verathon Inc, USA)</td>
<td>5/86 (6)</td>
</tr>
<tr>
<td>Laryngoscope</td>
<td>2/86 (2)</td>
</tr>
<tr>
<td>Awake fiberoptic bronchoscope</td>
<td>1/86 (1)</td>
</tr>
</tbody>
</table>

METHODS

Research ethics board approval was obtained for the present study. The demographic and postoperative PACU LOS data were collected prospectively as a part of a quality control bed utilization project, and the intraoperative airway management data were extracted retrospectively from an anesthesia intraoperative management system (Saturn Information System, Draeger Medical, USA). Data collection occurred over a six-month period (July to December 2009) at the Queen Elizabeth II Health Centre (Halifax, Nova Scotia). During this time period, nurses in the PACU monitored postoperative patients with either sleep testing-confirmed or suspected OSA (based on the patients’ history and clinical symptoms) (16). For these patients, intraoperative information regarding airway management and anesthetic strategies were collected in addition to any available OSA history. A standardized form was used for documentation of patient demographics, ambulatory and admission status, PACU admission and discharge times, desaturation or apnea events in the PACU, and continuous positive airway pressure (CPAP) use, if applicable, and if reported by the patient. PACU nurses were asked to indicate on the data collection form whether the patients’ OSA had affected their postoperative LOS and course of treatment. Nursing staff were also allowed to write in any comments that they believed were pertinent to the patients’ OSA and PACU stay. Intraoperative data were analyzed for ease of intubation and airway grade obtained, as well as airway management issues encountered and techniques used.

Statistical analyses were performed using ANOVA with Holm-Sidak post hoc comparisons. All statistical calculations were performed using SigmaPlot version 12.0 (Systat Software Inc, USA). Interval data were expressed as mean ± SD; the level of significance was set at P<0.05.

RESULTS

A total of 91 adult patients were included in the study over the six-month period (66 men, 25 women [Table 1]). The majority of patients had a formal diagnosis of OSA confirmed by testing (63% [n=57]) versus highly suspected OSA (37% [n=34]) based on clinical symptoms. Women had a significantly higher body mass index (BMI) compared with men (Table 1). Most patients underwent an outpatient or same-day surgical procedure, and the majority underwent general anesthesia (Table 2).

Only two cases of difficult bag-mask ventilation (BMV) were documented, whereas 45 (of the 86 total general anesthesia cases) were reported as ‘easy’ to bag-mask ventilate. Airway management data were extracted for 86 of the patients (Table 3). Intubation by direct laryngoscopy was the most common method of airway management for patients undergoing general anesthesia. A supraglottic airway device (laryngeal mask airway) was used in 17% of cases, and alternative intubation techniques, such as a Glidescope (Verthon Inc, USA) or laryngoscope, were used in 8% of cases. There was one awake fiberoptic bronchoscope-assisted intubation.

Overall, mean (± SD) PACU LOS for men was 187±118 min, and 156±90 min for women. Apnea events or periods of desaturation in the PACU were observed in 27% of cases. When these events were observed, the PACU LOS was significantly increased compared with individuals without documented desaturation or apnea events (LOS with apnea/desaturation = 270±135 min versus LOS without apnea/desaturation = 143±78 min; P<0.002). For cases in which the PACU nurses had indicated that the patient’s OSA status had impacted their course in PACU, the LOS was also significantly longer (OSA did impact LOS = 253±111 min versus OSA did not impact LOS = 148±98 min; P<0.024). However, PACU LOS was not significantly different between the confirmed and suspected OSA groups (confirmed OSA = 159±101 min versus suspected OSA = 210±123 min; P=0.27). For patients with confirmed OSA, 13% used their CPAP machines postoperatively in the PACU, while 6% left their CPAP machine at home. Finally, there were no immediate deaths or severe complications noted in any cases.

DISCUSSION

A total of 91 patients were included in the present study, the majority of whom were men (Table 1). This is consistent with the ratio of men and women with OSA that has been previously reported in the general surgical population (17).

Previous studies have shown that OSA patients are more difficult to intubate (7,8,11-13,14), while other studies have reported no correlation between OSA and difficult intubation or postoperative complications (15,18). The present study attempted to clarify, and further classify the methods and difficulty of OSA airway management in a large teaching hospital. For the general surgical population, the overall reported frequencies of each CL airway grade are: grade 1 – 99%; grade 2 – 1%; grade 3 – 1 per 2000; grade 4 – <1 per 100,000 (10). The results of the present study yielded 43% of patients with a grade 1 view, 43% with grade 2, 14% with grade 3 and no grade 4 views. The increased prevalence of grade 3 views, as found in the present cohort, supports previous work suggesting that OSA patients can be more difficult to intubate. Borden et al (14) found that 15% of their OSA cohort was reported to be difficult intubations, which correlates well with the findings from our study, which had 14% of patients with a grade 3 airway view. A more limited view of the airway due to excess fat or excess soft tissue resulting in more difficulty or even failed attempts at intubation (11).
Furthermore, 9% of patients in our cohort required some other adjunct or airway method to facilitate intubation (GlideScope, lightwand, awake fibreoptic bronchoscope).

The relationship between obesity and OSA has often been discussed in the literature. O’Keefe and Patterson (19) found that OSA occurs independently of BMI. Generally, however, the consensus is that patients with OSA have a higher BMI, on average, than individuals without OSA (20,21). According to Chung et al (22), a BMI >35kg/m² is the screening cut-off for OSA patients when using the STOP questionnaire. Both the male and female OSA groups in the present study approached or exceeded a BMI of 35 kg/m², which would be considered obese, and with both upper limits of the CIs reaching >40 kg/m², which is considered to be clinically severe obesity (2).

Difficult BMV has also been reported in obese patients due to excessive adipose tissue, and restricted chest and lung anatomy (5). In some patients, difficult BMV could further compound airway management in the setting of a predicted difficult intubation. A previous study by Plunkett et al (23) found that difficult BMV was suggestive of undiagnosed OSA. Our study found only two documented cases of ‘difficult’ BMV, and 45 of the 86 general anesthetic cases (52%) were reported to be ‘easy’ to BMV. However, some patients may not have had any BMV performed as part of their induction (ie, rapid sequence induction intubations or direct laryngeal mask airway insertion without BMV), and the documentation of ease of BMV is inconsistent among anesthesia staff when describing the airway method in our institutional anesthesia information management system. Despite this, it is interesting to note the frequency of ‘easy’ BMV in our cohort, given the reported difficulty in laryngoscopy, and may be an area for future investigation.

The secondary outcomes of the present study relating to postoperative PACU events are in agreement with the previous literature. It has been shown that OSA patients experience more frequent postoperative complications (21). The present study was able to provide even more insight into the immediate postoperative period in the PACU and how OSA may adversely affect LOS. In particular, the results showed that LOS was significantly increased in cases for which the nurses reported that OSA had, in some form, impacted the LOS and course of treatment in the PACU. The PACU stay may have been negatively impacted by OSA through various different mechanisms, including delayed discharge due to limited intermediate care bed availability for overnight monitoring, delayed home discharge due to apnea events or lack of a home CPAP machine, variability in analgesic and opioid administration for concerns over apnea or desaturation events, and delays awaiting CPAP delivery in patients who left their machines at home. This may direct how OSA patients are handled with regard to PACU care, discharge planning versus overnight admission and in preparation for surgical procedures. For example, only 13% of patients used their CPAP machines postoperatively, and 6% of patients had not brought their CPAP machines with them (despite the institutional policy that all patients are to bring their own CPAP, even for ambulatory procedures). However, we were unable to quantify through the present retrospective study how many patients diagnosed with OSA actually owned and used CPAP machines at home. Postoperative CPAP use is an area in which potential changes could be made to improve the course of PACU results for OSA patients.

Apnea and desaturation events were noted in 27% of the present cohort, and have been previously reported as a common adverse event for postoperative OSA patients (21). Although the recording of apnea and desaturation events were left to the clinical discretion of the PACU nursing staff, they routinely assess postoperative patients for apnea or desaturations, and typically consider a desaturation as reading ≤90%. This reference level is generally accepted in the OSA literature (14,24). These adverse respiratory events resulted in significantly longer PACU stays than in patients who did not experience apnea or desaturations. The current institutional guideline for PACU monitoring of ambulatory OSA patients at the QEII Health Centre is 4 h (240 min). Patients who experienced apnea and desaturations, and patients whose course in the PACU were noted by nursing staff to have been adversely affected, both had PACU stays beyond the institutional guidelines (270±135 min and 253±111 min, respectively). This is a considerable issue because OSA patients are placing increased and prolonged demands on PACU beds and staff. Again, use of CPAP postoperatively in the PACU could be beneficial in reducing LOS and additional stress on hospital resources. In addition, close monitoring and careful anesthetic management of these patients may help reduce the number of apnea and desaturation events in the PACU.

One other significant concern surrounding OSA in the literature relates to the need for preoperative diagnosis (19,20). The present study, however, found that a confirmed diagnosis of OSA had no effect on the PACU LOS compared with the suspected OSA group without a confirmed diagnosis. Although no significant difference was found, a confirmed diagnosis of OSA – or careful preoperative screening – may help in preparation for potentially difficult intubation or airway management and postoperative management and, therefore, should still be taken into consideration.

The present study had some potential limitations. First, it is possible that there was an incomplete capture of all OSA patients processed through the PACU within the study time frame. Although measures were taken to create as complete a dataset as possible, there may have been some cases that were missed if a confirmed or suspected OSA diagnosis had not been elicited by the anesthesiologist or nurse. Further research in this area with larger study groups would help to support the findings of the present study. In addition, there may be an unintentional bias in delaying PACU discharge due to a known or suspected OSA diagnosis. There may be a tendency to retain OSA patients in the PACU for longer periods of time, especially because the potential for an adverse event is common.

CONCLUSION

The present study observed surgical OSA patients in terms of method and ease of airway management, as well as PACU LOS and OSA-related adverse events. OSA patients had more difficult airway views compared with the rates reported for the general population. Symptomatic OSA patients placed increased demands on the PACU in terms of LOS and hospital resources. Postoperative CPAP use was limited and apnea or desaturation in the PACU was common. This resulted in increased PACU LOS, often beyond the institutional guideline of 4 h (240 min).

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REFERENCES
18. Loadsman JA. Preoperative screening for obstructive sleep apnea – are we losing sleep over nothing? Anaesthesia Intensive Care 2009;37:697.
Complementary and alternative medicine: A survey of its use in children with chronic respiratory illness

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BACKGROUND: The use of complementary and alternative medicine (CAM) has increased in recent years, with especially high prevalence in individuals with chronic illnesses. In the United States, the prevalence of CAM use in pediatric asthma patients is as high as 89%.

OBJECTIVE: To investigate the epidemiology of pediatric CAM use in respiratory subspecialty clinics.

METHODS: A survey was conducted at two hospital-based respiratory clinics in Edmonton (Alberta) and Ottawa (Ontario). Caregivers (most often parents) of children <18 years of age were asked questions regarding child and caregiver use of CAM, including products and practices used, beliefs about CAM, trust in information sources about CAM and characteristics of the respondents themselves.

RESULTS: A total of 202 survey questionnaires were completed (151 from Edmonton and 51 from Ottawa). Pediatric CAM use in Edmonton was 68% compared with 45% in Ottawa, and was associated with caregiver CAM use, poorer health and health insurance coverage for CAM. The majority (67%) of children using CAM had taken prescription drugs concurrently and 58% of caregivers had discussed this with their doctor.

DISCUSSION: Lifetime use of CAM at these pediatric clinics was higher than reported for children who do not have chronic diseases. CAM practices that are popular are likely of further research to evaluate their effectiveness and safety profile with regard to drug interactions. Health care providers should be encouraged to discuss CAM use at every visit, and explore their patient's health-related beliefs, behaviors and treatment preferences.

Key Words: Asthma, Complementary medicine; Cystic fibrosis; Pediatrics; Respiratory illness; Survey

Complementary and alternative medicine (CAM) is broadly defined as healing ideas and practices separate from and complementary to ‘conventional’ medicine (1). Examples include natural health products (also known as dietary supplements), massage and acupuncture. CAM use has been shown to be increasing in both adult and pediatric populations (2,3). CAM use has been variably linked to ethnicity/race, income and education, and severity of health concerns (3).

In Canada, a nationwide survey in 2006 found that 15% of children had used CAM in the previous year. (4). Similarly, a recent United States study reported that 12% of children had used CAM in the previous year (3); however, use appears to be much higher in children with chronic health concerns (5). CAM use was reported by 54% of patients of a general pediatric clinic (6) and by 64% of a pediatric rheumatology clinic (7). As the most common chronic disease among children, asthma appears to be associated with significant CAM use (6). While no major Canadian study investigating the epidemiology of CAM use in pediatric asthma has been published, American surveys of CAM use in pediatric asthma has been published, American surveys of CAM use in pediatric asthma has been published, American surveys of CAM use in pediatric asthma has been published, American surveys of CAM use in pediatric asthma has been published, American surveys of CAM use in pediatric asthma has been published.
METHODS
The present article describes part of a larger study that was performed at the Stollery Children’s Hospital (Stollery) in Edmonton, Alberta, and the Children’s Hospital of Eastern Ontario (CHEO) in Ottawa, Ontario. Five pediatric subspecialty clinics (cardiology, gastroenterology, neurology, oncology and respiratory) were selected as sites for the larger study and patients in these clinics were surveyed at each of the two hospitals.

Pediatric patients and their families were eligible to participate if they were <18 years of age and could read French or English. All families were approached in the waiting room of each participating clinic before their appointment. Research assistants remained in the waiting room to answer questions and collect the completed questionnaires. Surveys were anonymous and, to prevent duplicate surveys, participants were asked by the research assistant if they had previously completed a survey for the present study.

At the time of the present study, no standard survey tool existed for assessing pediatric CAM use and, therefore, the authors’ team developed a survey for use by all participants regardless of specialty or setting. The final version contained 19 questions that addressed patient and family demographics, health status, current and lifetime use of specific CAM products and therapies, reasons for use, use of CAM concurrently with conventional medicine, satisfaction with conventional care, adverse effects and disclosure about CAM use. Questions were informed by previous CAM use surveys and literature reviews of CAM products and practices commonly used by children, and were intended to address gaps in knowledge of CAM use in children. The survey was piloted for concept validity and revised as needed. The final English-language survey was translated into French and then back translated into English to verify the translation. The French version of the survey was also pilot tested.

Data were entered into SPSS version 11 (IBM Corporation, USA). Descriptive statistics were tabulated as means ± SD or medians (interquartile range) for continuous variables, and frequencies and percentages for categorical variables. The following participant variables were compared according to centre (Stollery versus CHEO) using Wilcoxon rank-sum tests, independent t tests and χ² tests as appropriate: demographics, general health and use of specific CAM products and practices, satisfaction with care and opinions/beliefs about CAM including helpfulness of CAM, information needs and trust in information sources, and reasons for not using CAM.

Comparison of CAM use between the centres was modelled by univariate and multivariable logistic regression; predictor variables included child’s age, ethnicity, sex, health status, time since diagnosis as well as family’s use of CAM, family’s CAM insurance, parent’s education and income, and discussion of CAM with conventional medical practitioner. Regression diagnostics and measures for detecting outliers and influential observations were performed. The full methods are described in Adams et al (14).

Ethics approval was granted by the CHEO and Stollery Research Ethics Boards.

RESULTS
Completed surveys were obtained for 202 pediatric respiratory patients (n=151 from Edmonton and n=51 from Ottawa). Of the 215 families approached, only 12 declined; one survey was excluded because the respondent completed the survey for multiple children rather than one per child. The most common reasons for visiting the respiratory clinics were asthma (n=84 [41.6%]), cystic fibrosis (n=24 [11.9%]) and other respiratory disorders (n=31 [15.3%]).

Population characteristics
Pediatric patients sampled were 42.1% female, with a mean age of 7.3 years (6.9 years in Edmonton; 8.5 years in Ottawa; P=0.049) (Table 1). More than one-half reported their ethnicity as Caucasian (55.2%) with others identifying as French Canadian (30.9%), First Nations/Inuit/Métis (11.9%), South Asian (3.1%), East Asian (4.6%), Black (2.6%), Middle Eastern/Arabic (1.5%) and Latin American/Mexican (1.0%).

Child CAM use was 61.9% (Edmonton 67.5%; Ottawa 45.1%; P=0.004). The questionnaire was administered >12 months after the patient’s diagnosis (58.1%) and most (61.0%) were at the clinic for a routine follow-up without treatment or ongoing treatment (26.2%). Child health was positive (‘excellent’ [12.4%], ‘very good’ [34.2%] and ‘good’ [40.6%]) compared with ‘fair’ (10.4%) and ‘poor’ (2.5%).

Mean parent/caregiver age was 36.2 years in Edmonton and 39.9 years in Ottawa (P=0.024) (Table 1). Respondents were predominantly female (85.1%), 97.5% were the primary caregiver and 80.5% were the mother of the patient. Most described their health as ‘excellent’ (32.8%), ‘very good’ (46.2%) or ‘good’ (20.3%). Significantly more caregivers in Ottawa than Edmonton had a university degree (34.7% versus 17.6%; P=0.012), but household incomes did not differ, with most (75.8%) respondents earning >$40,000 annually. Most (91.9%) caregivers said they would know if the child had used CAM. Fewer than one-half (42.3%) said the child’s CAM costs could be reimbursed by a private health insurance plan, 33.8% said they could not and 23.9% said they were not sure. Most caregivers reported “don’t know enough about CAM” (60.3%) as a reason for the child not using CAM, or “don’t think CAM is necessary” (20.5%) and “worried about side effects from mixing CAM with other treatments from my doctor” (10.3%). Caregiver CAM use was 67.0% and was not significantly different between Edmonton and Ottawa. Reasons for lack of use were similar to those reported for pediatric use.

In Edmonton, multivariable models showed that patients with ‘poor’ or ‘fair’ health status had higher odds of using CAM as those with ‘good’ to ‘excellent’ health (adjusted OR 5.2 [95% CI 1.3 to 20.4]; P=0.02). Edmonton patients with health insurance coverage for CAM had 3.4 (1.4 to 8.3; P=0.009) times greater odds of using CAM than those without coverage, while adjusting for other factors in the model.

In Edmonton, children of caregivers who used CAM themselves had 4.2 (95% CI 1.8 to 9.5; P<0.001) increased odds of using CAM compared with children whose caregivers do not use CAM. In Ottawa, models showed that children of caregivers who use CAM had 11.4 (95% CI 2.7 to 48.2; P<0.001) times greater odds of using CAM than children whose caregivers do not use CAM. No other variables were predictive of CAM use in Ottawa patients.

Products and practices
Most respondents reported pediatric use of some type of vitamin or mineral-type CAM products (85.6%), with more Edmonton than Ottawa patients having ever used multivitamins (80.2% versus 59.1%; P=0.036) (Table 2). Calculation of overall CAM use excluding multivitamins/minerals decreased CAM use rate from 61.9% to 52.5%.

Fewer Edmonton than Ottawa patients had ever used herbal-type CAM products (22.9% versus 50.0%; P=0.011) including echinacea (11.5 versus 45.5%; P<0.001), probiotics (acidophilus) (20.8% versus 45.5%; P=0.017), fish oil/omega 3s (14.6% versus 40.9%; P=0.014), flax oil (6.3% versus 31.8%; P=0.003) and green food powder (2.1% versus 18.2%; P=0.011). Slightly more than one-third (38.1%) of all respondents had ever used homeopathic products. Regarding current use, approximately three-quarters (75.9%) of patients were currently using some type of vitamin and mineral-type CAM product, especially multivitamins (64.6%), herbal products (13.9%) and homeopathy (7.6%) (Table 2).

While the most common CAM practices ever used by patients included chiropractic (45.7%), massage (34.3%), aromatherapy (28.6%), faith healing (18.6%), relaxation (14.3%), homeopathy (12.9%) and acupuncture (10.0%), CAM practices currently used by patients included massage (40.0%), aromatherapy (37.1%), chiropractic (22.9%), faith healing (17.1%), relaxation (14.3%) and energy healing (11.4%). Most of the identified CAM products and practices were perceived to be helpful by the respondents and very few reported receiving no help from them (Table 2).

Ethics approval was granted by the CHEO and Stollery Research Ethics Boards.

Can J Respir Ther Vol 50 No 1 Spring 2014
Safety issues: Concurrent medication use, side effects

Most (66.7%) patients who used CAM products had done so while concurrently taking prescription medications (Edmonton 62.6% versus Ottawa 85.7%; P=0.042). Slightly more than one-half (57.0%) of caregivers said this was discussed with a doctor, 22.8% with a pharmacist and 15.2% with other individuals; 22.8% did not report talking to anyone about this.

More than one-half of respondents used some form of CAM (product or practice) at the same time as conventional medicine (54.6%) as opposed to before (8.3%) or after conventional medicine was successful (2.8%), or was not successful (6.5%). One-fifth (21.3%) of respondents reported that the timing of use depended on the type of CAM or reason for use. Of those using CAM and conventional medicine concurrently, 53.6% were using more than one prescription drug at a time, while 34.8% reported using more than one type of CAM at a time. CAM products most commonly used concurrently with prescribed conventional therapeutics were vitamins and minerals (65.2%), herbs (24.6%) and homeopathic remedies (10.1%). Concurrent CAM-drug use was most common for anti-asthmatic agents (52.2%), antibiotics (34.8%) and nasal corticosteroids (21.7%) (Table 3).

Few side effects of CAM products or practices were reported. Six minor side effects were reported, in association with calcium, garlic, cold remedies and chiropractic. Two moderate side effects were reported in association with chiropractic and one severe harm was reported in association with the use of magnets. Details of the side effects were not reported by participants.

### Table 1

<table>
<thead>
<tr>
<th>Demographic information</th>
<th>Edmonton, Alberta</th>
<th>Ottawa, Ontario</th>
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<td>1 (1.5)</td>
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<tr>
<td>0–3</td>
<td>6 (11.8)</td>
<td>7 (13.7)</td>
<td>25 (12.6)</td>
</tr>
<tr>
<td>3–6</td>
<td>4 (7.8)</td>
<td>2 (3.9)</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>&gt;12</td>
<td>26 (45.1)</td>
<td>43 (21.8)</td>
<td>79 (40.6)</td>
</tr>
<tr>
<td>Reason for clinic visit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine follow-up</td>
<td>87 (59.6)</td>
<td>32 (65.3)</td>
<td>119 (61.0)</td>
</tr>
<tr>
<td>Diagnostic testing</td>
<td>9 (6.2)</td>
<td>3 (6.1)</td>
<td>12 (6.2)</td>
</tr>
<tr>
<td>Ongoing treatment</td>
<td>40 (27.4)</td>
<td>11 (22.4)</td>
<td>51 (26.2)</td>
</tr>
<tr>
<td>New condition</td>
<td>2 (1.4)</td>
<td>2 (4.1)</td>
<td>4 (2.1)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (5.5)</td>
<td>1 (2.0)</td>
<td>9 (4.6%)</td>
</tr>
<tr>
<td>Health status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>16 (10.6)</td>
<td>9 (17.6)</td>
<td>25 (12.4)</td>
</tr>
<tr>
<td>Very good</td>
<td>48 (31.8)</td>
<td>21 (41.2)</td>
<td>69 (34.2)</td>
</tr>
<tr>
<td>Good</td>
<td>65 (43.0)</td>
<td>17 (33.3)</td>
<td>82 (40.6)</td>
</tr>
<tr>
<td>Fair</td>
<td>19 (12.6)</td>
<td>2 (3.9)</td>
<td>21 (10.4)</td>
</tr>
<tr>
<td>Poor</td>
<td>3 (2)</td>
<td>2 (3.9)</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>CAM insurance, yes</td>
<td>150 (64.2)</td>
<td>51 (22.4)</td>
<td>85 (42.3)</td>
</tr>
<tr>
<td>Child/youth has ever used CAM†, yes</td>
<td>102 (67.5)</td>
<td>51 (23.4)</td>
<td>125 (61.9)</td>
</tr>
<tr>
<td>Parent/caregiver information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent/caregiver age‡, years, mean ± SD</td>
<td>36.2 (7.1)</td>
<td>39.9 (9.0)</td>
<td>37.2 (7.8)</td>
</tr>
<tr>
<td>Female sex</td>
<td>130 (86.1)</td>
<td>41 (82.0)</td>
<td>171 (85.1)</td>
</tr>
<tr>
<td>Highest completed level of education</td>
<td>3 (2.0)</td>
<td>0 (0)</td>
<td>3 (1.5)</td>
</tr>
<tr>
<td>Registered apprenticeship or other trade</td>
<td>12 (8.1)</td>
<td>4 (2.0)</td>
<td>16 (8.1)</td>
</tr>
<tr>
<td>College, CEGEP or other nonuniversity</td>
<td>53 (35.8)</td>
<td>17 (34.7)</td>
<td>70 (35.5)</td>
</tr>
<tr>
<td>University, without university degree</td>
<td>11 (7.8)</td>
<td>4 (2.0)</td>
<td>15 (7.5)</td>
</tr>
<tr>
<td>University, with university degree§</td>
<td>26 (17.6)</td>
<td>17 (34.7)</td>
<td>43 (21.8)</td>
</tr>
<tr>
<td>Other</td>
<td>5 (3.4)</td>
<td>0 (0)</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>Annual household income, $</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10,000</td>
<td>2 (1.4)</td>
<td>2 (4.1)</td>
<td>4 (2.1)</td>
</tr>
<tr>
<td>10,000 to 19,000</td>
<td>11 (7.8)</td>
<td>3 (6.1)</td>
<td>14 (7.4)</td>
</tr>
<tr>
<td>20,000 to 39,000</td>
<td>20 (14.2)</td>
<td>8 (16.3)</td>
<td>28 (14.7)</td>
</tr>
<tr>
<td>40,000 to 79,999</td>
<td>44 (31.2)</td>
<td>19 (38.8)</td>
<td>63 (33.2)</td>
</tr>
<tr>
<td>≥80,000</td>
<td>64 (45.4)</td>
<td>17 (34.7)</td>
<td>81 (42.6)</td>
</tr>
<tr>
<td>Respondent had ever used CAM, yes</td>
<td>105 (70.0)</td>
<td>29 (58.0)</td>
<td>134 (67.0)</td>
</tr>
</tbody>
</table>

n Number with valid responses; *Child/youth mean age was significantly higher in Ottawa, Ontario (P=0.0492); †Child use of complementary and alternative medicine was significantly higher in Edmonton, Alberta (P=0.043); ‡Parent age was significantly higher in Ottawa (P=0.024); §A significantly higher percentage of parent/caregivers in Ottawa had university, with a university degree (P=0.012). CEGEP Collège d’enseignement général et professionnel
TABLE 2
Commonly used products/practices and their perceived helpfulness

<table>
<thead>
<tr>
<th>Product</th>
<th>Ever used (n=118)</th>
<th>Current use (n=79)</th>
<th>Perceived helpfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C</td>
<td>32 (27.1)</td>
<td>16 (20.3)</td>
<td>30 17 (56.7) 1 (3.3) 12 (40.0)</td>
</tr>
<tr>
<td>Multivitamin/mineral</td>
<td>90 (76.3)*</td>
<td>51 (64.6)</td>
<td>78 42 (53.8) 3 (3.8) 33 (42.3)</td>
</tr>
<tr>
<td>Calcium</td>
<td>16 (13.6)</td>
<td>8 (10.1)</td>
<td>14 10 (71.4) 0 (0) 4 (28.6)</td>
</tr>
<tr>
<td>Folic acid</td>
<td>4 (3.4)</td>
<td>2 (2.5)</td>
<td>2 2 (100.0) 0 (0) 0 (0)</td>
</tr>
<tr>
<td>Vitamin B</td>
<td>6 (5.1)</td>
<td>3 (3.8)</td>
<td>6 5 (83.3) 0 (0) 1 (16.7)</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>32 (27.1)</td>
<td>16 (20.3)</td>
<td>30 17 (56.7) 1 (3.3) 12 (40.0)</td>
</tr>
<tr>
<td>Flax oil</td>
<td>13 (11.4)†</td>
<td>9 (11.4)†</td>
<td>10 6 (60.0) 0 (0) 4 (40.0)</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>2 (2.5)</td>
<td>2 (2.5)</td>
<td>2 2 (100.0) 0 (0) 0 (0)</td>
</tr>
<tr>
<td>Calcium</td>
<td>16 (13.6)</td>
<td>8 (10.1)</td>
<td>14 10 (71.4) 0 (0) 4 (28.6)</td>
</tr>
<tr>
<td>Folic acid</td>
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<td>2 (2.5)</td>
<td>2 2 (100.0) 0 (0) 0 (0)</td>
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<tr>
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</tr>
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</tr>
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</tr>
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<tr>
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<td>2 2 (100.0) 0 (0) 0 (0)</td>
</tr>
<tr>
<td>Vitamin B</td>
<td>6 (5.1)</td>
<td>3 (3.8)</td>
<td>6 5 (83.3) 0 (0) 1 (16.7)</td>
</tr>
<tr>
<td>Vitamin C</td>
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</tr>
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</tr>
<tr>
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<td>4 (3.4)</td>
<td>2 (2.5)</td>
<td>2 2 (100.0) 0 (0) 0 (0)</td>
</tr>
<tr>
<td>Vitamin B</td>
<td>6 (5.1)</td>
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<tr>
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<td>51 (64.6)</td>
<td>78 42 (53.8) 3 (3.8) 33 (42.3)</td>
</tr>
</tbody>
</table>

Data presented as n (%) unless otherwise indicated. *Edmonton (Alberta) use greater than Ottawa (Ontario) use (P<0.05); †Ottawa use greater than Edmonton use (P<0.01); ‡Ottawa use greater than Edmonton use (P<0.001).

Sources of information
The most commonly used sources of information (in descending order of frequency) regarding CAM were: family/friends (65.1%), books (39.6%), health food stores (36.8%), pharmacy (34.9%), Internet (29.2%), CAM health providers (28.3%), the hospital clinic (27.4%) and conventional health providers (26.4%). The most trusted sources of information on CAM (rated on a 10-point scale) were conventional health providers (mean ± SD 8.4±1.6), the hospital clinic (8.2±2.1), the pharmacy (8.0±1.7) and CAM health providers (7.6±2.5).

The majority of caregivers reported ‘strongly agreed’ (33.2%) or ‘agreed’ (42.7%) in response to “I feel comfortable discussing CAM use in this clinic”. Most also ‘strongly agreed’ (21.1%) or ‘agreed’ (40.7%) with “I would like more information on CAM from this clinic.”

DISCUSSION
The present survey sheds light on the use of CAM by pediatric respiratory disease patients and the characteristics of its users and their parents/caregivers. As the first multicentre survey of this population in Canada, it may inform both caregivers and researchers in improving care and focusing further research.

While child lifetime CAM use differed significantly between patients in Edmonton and Ottawa (67.5% versus 45.1%, respectively; P<0.004), these values are consistent with other studies investigating pediatric chronic illness (5,9). These values also suggest regional/geographical differences within similar patient populations; however, our survey did not identify reasons for these regional differences.

As expected, child CAM use was strongly correlated with caregiver CAM use, which suggests that its use is tied to caregiver health-related beliefs, values and preferences. As in similar studies, poorer health status was related to CAM use (13). Parents, especially of children with chronic illness, may seek CAM after becoming dissatisfied with conventional therapy and its effects. It may be regarded as a ‘second chance’ at effective treatment and may be a way for parents to gain control over difficult-to-manage situations (15).

Two-thirds of patients in the present study used prescription medicine at the same time as CAM products and many did not discuss this with their physician or pharmacist. Concurrent use is not necessarily hazardous and, while most respondents did not report experiencing harm, given the frequency of concurrent use, more data demonstrating the safety of this practice are urgently needed. It has been suggested that several of the CAM products most popular with the study group can interact adversely with other CAM and conventional practices. Vitamin C with acetaminophen, vitamins D, B6, B9 and B12, with corticosteroids, and vitamins B9 and folic acid with ibuprofen have potential to interact, among countless combinations (11). Such combinations are not rare; a large Toronto emergency department survey of CAM and conventional medication use identified potential interaction in 16% of surveyed children (11). As such, physicians and other health care providers should inquire about and record history of CAM use routinely during patient visits. Some drug-natural health product combinations may, in fact, be helpful; for example, studies have suggested that probiotics may be effective in preventing antibiotic-associated diarrhea (16,17). Patient safety depends on disclosure and discussion of all health practice and our concern is not that patients use natural health products to improve their health, but that they do so without disclosure.
TABLE 3
Therapeutics and concurrent complementary and alternative medicine (CAM) use

<table>
<thead>
<tr>
<th>Therapeutic agent(s)*</th>
<th>Users, n (%) (n=69)</th>
<th>CAM products used concurrently</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesic agents: acetaminophen, codeine, diclofenac, ibuprofen</td>
<td>6 (8.7)</td>
<td>Vitamins and minerals</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>1</td>
</tr>
<tr>
<td>Antiasthmatic agents: beclomethasone, budesonide, fluticasone, montelukast salbutamol, terbutaline; budesonide/formoterol, fluticasone/salmeterol</td>
<td>36 (52.2)</td>
<td>Vitamins and minerals</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>6</td>
</tr>
<tr>
<td>Antibiotics: amikacin, amoxicillin, azithromycin, cephalexin, ciprofloxacin clarithromycin, tobramycin, trimethoprim/sulfamethoxazole</td>
<td>24 (34.8)</td>
<td>Vitamins and minerals</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>1</td>
</tr>
<tr>
<td>Anti-ulcer agents: lansoprazole, omeprazole, ranitidine, sucralfate</td>
<td>11 (15.9)</td>
<td>Vitamins and minerals</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>2</td>
</tr>
<tr>
<td>Nasal corticosteroids: budesonide, furoate, mometasone, triamcinolone</td>
<td>15 (21.7)</td>
<td>Vitamins and minerals</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>1</td>
</tr>
<tr>
<td>Pancreatic enzymes: pancrelipase</td>
<td>8 (11.6)</td>
<td>Vitamins and minerals</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>0</td>
</tr>
<tr>
<td>Psychostimulants: atomoxetine, caffeine, dextroamphetamine, modafinil, amphetamine/dextroamphetamine</td>
<td>6 (8.7)</td>
<td>Vitamins and minerals</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miscellaneous</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>0</td>
</tr>
<tr>
<td>Other: deflazacort, desmopressin, domase alfa, insulin, peglyte, phenobarbital, prednisone, tamsulosine, valproic acid; brompheniramine/phenylephrine/dextromethorphan (Dimetapp™)</td>
<td>14 (20.3)</td>
<td>Vitamins and minerals</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbals</td>
<td>2</td>
</tr>
<tr>
<td></td>
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<td>Miscellaneous</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homeopathy</td>
<td>1</td>
</tr>
</tbody>
</table>

*Listed alphabetically [single products; combinations]; †Pfizer, USA

Aside from being able to advise about positive and negative interactions, understanding CAM use can improve the ability of health professionals to deliver patient- and family-oriented care. While most patients in the present study reported that CAM was helpful and that they felt comfortable discussing their CAM use in the clinic, physicians have been shown, in many cases, to be dismissive of CAM and negligent in recording its use by their patients (12). Patient-centred care demands that health care practitioners learn about their patient’s health care beliefs and preferences (18). Beliefs about CAM and its effectiveness, especially compared with biomedical approaches, can impact adherence to prescribed therapy. For example, when respiratory disease therapy is perceived by patients to be ineffective or inappropriate, adherence can diminish (19).

Generalizability of the present study is limited by the selection of patients speaking either English or French, and attending one of two urban hospital-based clinics. The ability to recall the use of CAM may be limited, especially via a proxy (caregiver on behalf of a child), and responses may have been biased by expectations of desired responses. Finally, the present survey was not conducted over a full calendar year; there may be seasonal factors affecting the patients attending clinics and/or the use of CAM.

However, the present study does lay important groundwork. The CAM used by these patients may direct research on the motivation for their use and the dynamic between CAM and conventional therapy. The specific products and practices identified to be popular may be targets for more focused research on effectiveness and/or interaction with medications typical for pediatric respiratory patients. Ultimately, a better understanding of why patients seek CAM and the effects of its use may improve our ability to effectively work with patients and better support their health decisions.

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LAAC: long-acting anticholinergic; COPD: chronic obstructive pulmonary disease; LS: least square; SGRQ: St. George’s Respiratory Questionnaire; measures health-related quality of life in symptoms, activities and impact on daily life; 5 FEV₁: forced expiratory volume in 1 second.

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7. RAMQ, June 1, 2013.

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(LS mean change in SGRQ total score vs. placebo, -3.32; p<0.001)⁵